NIS briefing note

August 2010

Project Hydrus – AWE Aldermaston's proposed new hydrodynamics research facility

A briefing from Nuclear Information Service

Background

On 16th July 2010 the Ministry of Defence submitted a planning application to West Berkshire Council for construction of a new hydrodynamics research facility at the Atomic Weapons Establishment (AWE) Aldermaston (planning reference 10/01695/COMIND)[1].

The new facility, known as Project Hydrus by AWE's planners, is the latest development in AWE's site development strategy for modernising and rebuilding the facilities needed to manufacture Britain's nuclear weapons. Design and preparation work on the project has been underway for the last ten years and, after a series of delays, has now reached the planning application stage. The new facility will increase AWE's hydrodynamics research capabilities and will complement and eventually replace the work of a number of smaller existing facilities.

West Berkshire Council intends to come to a decision on the Project Hydrus planning application within three months of its submission date. This means the application is likely to be determined at a meeting of the Council's Eastern Area Planning Committee in September[2]. As has been the case for previous planning applications at AWE, the application has been submitted so that consultation will take place over a holiday period when it is likely to attract less attention than otherwise. AWE has made no effort to seek opinions on the proposed development from local residents and the wider public before submitting the planning application.

Key information about the proposed new facility, its impacts, and the risks it poses will be withheld from the public because the Secretary of State for Communities and Local Government has granted the Ministry of Defence exemption from preparing an environmental impact assessment for the development.

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1 West Berkshire Planning Applications web portal: planning application 10/01695/COMIND for "Replacement hydrodynamics research facility including an operations building with lightning protection system, a support building, an electrical substation, and associated landscaped areas including a Sustainable Drainage System together with construction related infrastructure including access roads, construction compound, fencing, gates and ancillary facilities." http://bit.ly/cl3Usq

2 Meetings of the Eastern Area Planning Committee are scheduled to take place on 8th September and 29th September 2010.

Phermex hydrotest at Los Alamos National Laboratory, USA. A test of a modified atomic bomb throws out super-hot depleted uranium.

Hydrodynamics and nuclear warhead science at AWE

Hydrodynamics is the study of how fluids respond to or exert forces. It is an important field of investigation for AWE because during the first microseconds of the explosion of a nuclear weapon, the solid components of the weapon experience extremely high pressures and shocks, causing them to behave and flow like liquids. The ability to understand and predict how materials behave under these conditions is essential in the design of thermonuclear weapons[3], and so hydrodynamics research plays a central role in AWE's studies into nuclear weapon physics, accounting for around 50% of the Establishment's physics research programme[4].

Hydrodynamic experiments allow the behaviour of materials at high strain rates and the development of compression and shock waves in warhead components to be studied. The experiments, which last only a few tens of millionths of a second, use high explosives to subject test materials to extremely high pressures and supersonic velocities, and use very short high-energy x-ray pulses to obtain photographs of how the test materials behave. Images from a number of giant flash x-ray machines can be combined to produce a three dimensional representation of the experiment using high performance computers. The most powerful of AWE's x-ray machines, known as Mogul E, is 25 metres long and weighs 280 tonnes. A number of other types of experimental facilities and diagnostic

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3 Keith O'Nions, Robin Pitman, and Clive Marsh: 'Science of nuclear warheads'. Nature, Volume 415 pp 853-857. 21 February 2002.

4 Andrew Randewich: 'Balance of Investment for Nuclear Physics Package Certification' in 'A collection of papers from the 2008 PONI conference series'. Project On Nuclear Issues, Centre for Strategic and International Studies. http://csis.org/images/stories/poni/090421_collection_of_conference_papers_2008.pdf

equipment are also available in AWE's research facilities, including shock tubes, gas and powder guns, a diamond anvil cell and high speed cameras.

Most experiments use non-fissile materials such as tantalum, lead or depleted uranium – often in assemblies similar to aspects of a warhead configuration - to simulate the plutonium from which the warhead core is manufactured, but a small number of experiments use plutonium itself.

During the development of the UK's nuclear weapons underground nuclear tests were essential to ensure that warhead designs worked as they were intended to. However, underground testing is now banned under the Comprehensive Test Ban Treaty (CTBT) and AWE considers that information obtained from previous tests is not reliable enough to allow changes in the properties of warhead materials to be predicted as the weapons age. Computer modelling work based on physics experiments conducted at high temperatures and pressures is needed to confirm that a nuclear weapon will function as designed in the absence of an underground testing programme. AWE considers hydrodynamics research to be an essential element of its 'assurance programme', which aims to ensure that Trident nuclear warheads remain secure and will operate reliably [5]. Data generated through the hydrodynamics research programme can be used for a range of uses, and information from hydrodynamic testing plays an essential role in warhead upgrade programmes and would be invaluable in the design of any new warhead to replace the current Trident design.

AWE considers itself a world leader in hydrodynamics research and already has a number of test facilities to conduct its explosive hydrodynamics experiments. These consist of large chambers with armour-plated walls and ceilings constructed of reinforced concrete more than half a metre thick which can accommodate repeated firings of high explosive without incurring structural damage. Three of the chambers are specially constructed to allow the conduct of experiments involving toxic materials. On the occasions when fissile material is used, the experiments are further contained within leak-tight spherical vessels, about 1 m in diameter, made of thick submarine steel, which are able to contain the radioactive products of the test explosion.

AWE has been active since the early 1960s in developing scientific methods and tools to investigate material compression and the transmission of shock waves during hydrodynamic experiments, using short pulses from high-energy X-ray machines. Simultaneous x-ray images of an experiment taken from two or more different directions allows a three dimensional model to be built up, while a series of radiographs taken at different times enables the development of shock waves or compression fields to be followed.

Although the current hydrodynamics test facilities at Aldermaston are very powerful, AWE's scientists do not consider them capable of providing data which is accurate enough to meet its future warhead programme needs. Project Hydrus, the proposed new hydrodynamics research facility, will be able to conduct powerful experiments with both non-fissile and fissile material and will have highly advanced radiographic capabilities giving improved image resolution and multiple x-ray views, allowing more accurate three dimensional modelling work.

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[5] Parliamentary Question from Nick Harvey MP to Des Browne MP, 'Official Report', 7 November 2006, Column 1448W
http://www.publications.parliament.uk/pa/cm200506/cmhansrd/vo061107/text/61107w0104.htm

Current hydrodynamics test facilities at AWE Aldermaston, showing two giant 'Mogul' flash x-ray machines on the outside of the test building.

AWE acknowledges that its hydrodynamics and physics research programme provides the basis for a broad range of collaborative work and experiments with scientists in the United States[6]. In February 2009 the 'Guardian' reported that Aldermaston had undertaken hydrodynamics research work in support of the US nuclear weapons programme, quoting John Harvey, policy and planning director at the US National Nuclear Security Administration, as stating: "There are some capabilities that the UK has that we don't have and that we borrow... that I believe we have been able to exploit that's been very valuable to us."[7] The US has recently developed a new high-powered hydrodynamics facility at Los Alamos National Laboratory in New Mexico - the Dual Axis Radiographic Hydro-Test facility (DARHT)[8] - and it is expected that information from hydrodynamics research programmes will be routinely shared between scientists from the two countries under the terms of the US-UK Mutual Defence Agreement[9].

AWE currently has what it describes as “a unique and unrivalled suite of flash x-ray sources coupled to firing chambers”[10] to allow it to conduct a wide range of different types of hydrodynamics experiments under different conditions. At the top end of this range is equipment which can be used for the most challenging ‘core punch experiments’, which are able to look deep inside simulant warheads as they are tested. Until recently AWE operated one of the world's leading hydrodynamics research facilities, but its capability has now been overtaken by the American DAHRT facility[11]. According to AWE's website the proposed new facility at Aldermaston “will ensure AWE’s world-leader status is maintained in this important field of science”[12], raising questions as to whether Project Hydrus is strictly necessary for AWE's research programme or whether the development has been driven by pride and competitiveness within AWE's scientific community.

Project Hydrus will represent a big step upwards in AWE's capability to undertake hydrodynamics research. It will be equipped with more powerful x-ray machines which have a greater resolution, three sets of x-ray machine views instead of the two available in current facilities, and the ability to handle higher explosive charges to generate greater experimental pressures and shocks. “When fully realised this capability will surpass equivalent facilities elsewhere”, say members of AWE's hydrodynamics research team[13].

Clearly Project Hydrus is far more than a replacement for AWE's current hydrodynamics facilities. AWE scientists have said that “To continue to meet the goals of the AWE experimental trials programme we need to maintain and improve our existing facilities and

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6 'A New Beginning'. AWE Annual Report 2000. Page 19.

7 'US using British atomic weapons factory for its nuclear programme'. Matthew Taylor and Richard Norton-Taylor, 'Guardian', 9th February 2009. http://www.guardian.co.uk/world/2009/feb/09/us-uk-atomic-weapons-nuclear-power

8 'A JASON study on Los Alamos DARHT'. Federation of American Scientists Secrecy News blog, 4 April 2007. http://www.fas.org/blog/secrecy/2007/04/a_jason_study_on_los_alamos_da.html

9 'US using British atomic weapons factory for its nuclear programme'. Matthew Taylor and Richard Norton-Taylor, 'Guardian', 9th February 2009. http://www.guardian.co.uk/world/2009/feb/09/us-uk-atomic-weapons-nuclear-power

10 'Project Hydrus and Pulsed Power at AWE'. AWE Presentation. Page 7. Available at http://www.secret-bases.co.uk/project-hydrus.pdf

11 'Project Hydrus and Pulsed Power at AWE'. AWE Presentation. Page 10. Available at http://www.secret-bases.co.uk/project-hydrus.pdf

12 'Hydrodynamics.' AWE company website. http://www.awe.co.uk/set/Hydrodynamics_87671.html

13 'Project Hydrus and Pulsed Power at AWE'. AWE Presentation. Page 12. Available at http://www.secret-bases.co.uk/project-hydrus.pdf

also to build new more capable facilities"[14]. Alongside the Orion high powered laser and new supercomputing facilities, Project Hydrus will play a core role in AWE's warhead research programme and would be vital in the design of any new warhead.

Cost issues

The Government will spend around £1 billion per year over the next three years at the Atomic Weapons Establishment to invest in new infrastructure and skills[15]. Similar US projects have typically ended up being many times their predicted costs. For instance, the costs of the DAHRT facility at Los Alamos National Laboratory went well over budget because the design relied upon new, unproven technology, eventually costing more than $US 1 billion to construct and commission[16]. The new hydrodynamics facility at AWE will have to be constructed to nuclear safety standards and will be equipped with hugely expensive state of the art radiographic equipment. According to AWE, "The entry-level cost for a hydrodynamics facility meeting modern standards is high"[17] and although the costs of Project Hydrus have not been disclosed by the Ministry of Defence, they are certain to amount to hundreds of millions of pounds.

Quentin Davies, Minister of State for Defence Equipment and Support in the former Labour government, stated that work undertaken at AWE's hydrodynamics facilities "exclusively supports defence activities" and this is expected to remain the case for the new facility[18]. Project Hydrus will be used to undertake research for the UK and US nuclear weapons programmes but will not be available for civilian research work, yet will cost hundreds of millions of pounds at a time when university science departments are facing deep cuts in their budgets.

Project Hydrus and the Comprehensive Test Ban Treaty

The UK's nuclear weapon designs were validated to check that they worked in a series of nuclear tests, firstly above ground in the atmosphere during the 1950s, and later through underground testing at the Nevada Test Site in the USA. Since 1992 AWE's scientists have been unable to use the Nevada Test Site because of an American moratorium on nuclear weapons testing announced by President George HW Bush and extended by subsequent presidents. In 1998 the UK government ratified the Comprehensive Test Ban Treaty (CTBT), which bans all critical nuclear tests, with then Foreign Secretary Robin Cook stating that ratification signaled the UK's "commitment to the goal of a nuclear

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14 'Project Hydrus and Pulsed Power at AWE'. AWE Presentation. Page 12. Available at http://www.secret-bases.co.uk/project-hydrus.pdf

15 Written Ministerial Statement by Quentin Davies MP, 9th September 2009. http://www.publications.parliament.uk/pa/cm/cmtoday/cmwms/archive/090909.htm#hddr_7

16 Tom Tierney and Greg Archbold: 'The UK-US Mutual Defense Agreement Role in a Responsive Nuclear Infrastructure' in 'A collection of papers from the 2006 PONI conference series'. Project On Nuclear Issues, Centre for Strategic and International Studies. http://csis.org/images/stories/poni/090108_2006_conference_series_text.pdf

17 Andrew Randewich: 'Balance of Investment for Nuclear Physics Package Certification' in 'A collection of papers from the 2008 PONI conference series'. Project On Nuclear Issues, Centre for Strategic and International Studies. http://csis.org/images/stories/poni/090421_collection_of_conference_papers_2008.pdf

18 Parliamentary Question from Norman Baker MP to Quentin Davies MP, 'Official Report', 5 March 2010, Column 1490W. http://www.publications.parliament.uk/pa/cm200910/cmhansrd/cm100305/text/100305w0027.htm#10030529009236

weapons free world".

Although the CTBT has not yet entered into force globally, the UK, having ratified it, is legally bound to follow its requirements. The treaty bans all nuclear tests above a certain minimum size, thus stopping new countries acquiring nuclear weapons and stopping existing nuclear-weapons states from developing new nuclear weapons. The preamble of the treaty recognises that a test ban, "by constraining the development and qualitative improvement of nuclear weapons and ending the development of advanced new types of nuclear weapons, constitutes an effective measure of nuclear disarmament and non-proliferation in all its aspects … An end to all such nuclear explosions will thus constitute a meaningful step in the realization of a systematic process to achieve nuclear disarmament"[19]. The UK government, in ratifying the CTBT, clearly understood that the treaty had the aim of ending the development of new nuclear weapons.

AWE's scientists evidently see hydrodynamics research as a way of side-stepping the test ban. According to an AWE web page about the new hydrodynamics research facility, no longer online, "The purpose of this facility is to provide the capability to conduct experiments to assess the performance and safety of warheads in the absence of nuclear testing due to the advent of the Comprehensive Nuclear Test Ban Treaty (CTBT)"[20]. Project Hydrus will help the government cheat the terms of the CTBT at the same time as it is insisting that other states must take steps to prevent the proliferation of nuclear weapons.

The planning application for Project Hydrus

Documents submitted to West Berkshire Council, the local planning authority, with the planning application for Project Hydrus show that the new facility will be constructed in the north-east part of the AWE Aldermaston site, close to existing hydrodynamics facilities and the explosives area site[21]. It will consist of an eight-sided operations building with all the sophisticated equipment necessary to conduct hydrodynamic experiments, surrounded by a set of towers which will act as a lightening protection system, plus a support building with staff facilities, equipment maintenance facilities, and an electrical sub station.

The Hydrus Facility will typically be used to conduct 10 test firing experiments per year. Two types of firings will be undertaken:

- Open Firings: Experiments conducted within a hardened structure which provides safety and waste management control of materials, and
- Contained / Closed Firings: Experiments conducted within a containment vessel located within the hardened structure which provides additional safety and waste management control for hazardous and radioactive materials.

AWE estimates that Project Hydrus will generate just 75 new jobs during the construction phase. It will employ approximately 50 people during operation, all of whom are current AWE employees.

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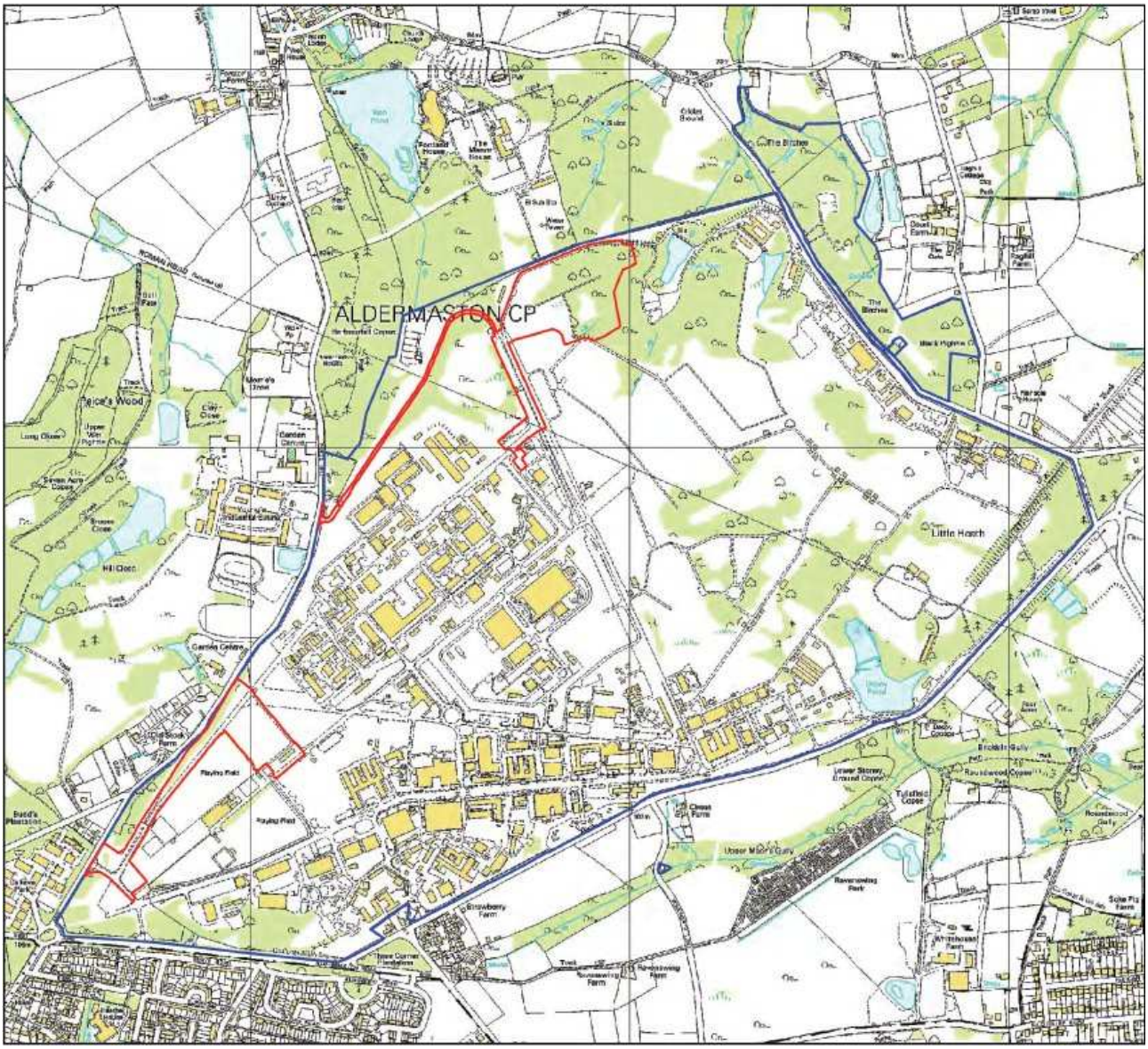
19 Comprehensive Test Ban Treaty: Preamble. http://www.ctbto.org/the-treaty/treaty-text/

20 'Hydrodynamics: Hydrodynamics Research Facility'. AWE web page http://www.awe.co.uk/main_site/scientific_and_technical/featured_areas/hydrodynamics_contents/hrf/index.html (no longer online)

21 Executive Summary, Hydrus Defence Exempt Environmental Appraisal. AWE Major Projects Directorate reference MER- 110-021924, June 2010. Available at: http://planning.westberks.gov.uk/rpp/showimage.asp?j=10/01695/COMIND&index=344474



Map of AWE Aldermaston site showing the Project Hydrus construction area (northern edge of the site) and the construction marshalling area (south west corner).

Much of the information that would usually be submitted in support of a normal planning application has been withheld from the planning authority and the public for the Project Hydrus planning application. A 'Defence Exempt Environmental Appraisal' report has been prepared for the development, rather than a full environmental impact assessment study[22]. The Defence Exempt Environmental Appraisal report does not include key information about processes, risks, and wastes associated with a proposed facility, and thus it is not possible to independently assess the scale of these impacts. This lack of information means that the planning committee and the public must rely entirely on the judgement of AWE and government regulatory agencies to decide whether risks posed by the new facility are acceptable and safeguards for protecting the public are adequate.

Limited information about the potential impacts of Project Hydrus is available from other sources. NIS considers that the areas with the greatest potential impact on safety and the environment are as follows:

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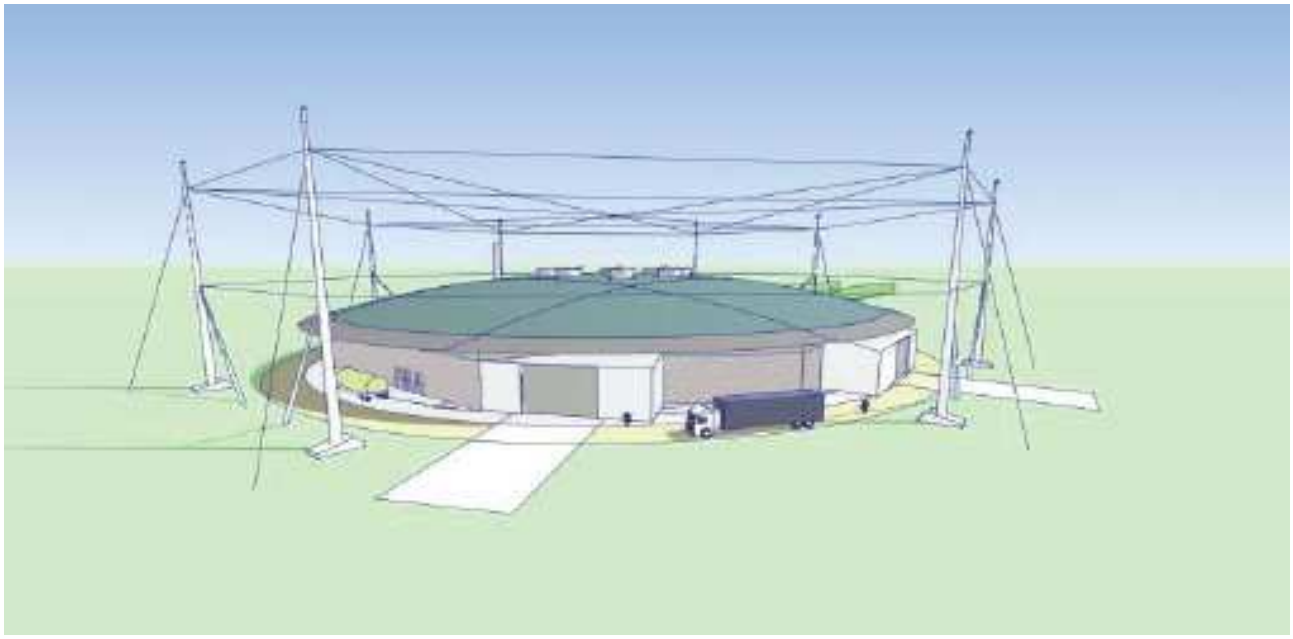
22 Hydrus Defence Exempt Environmental Appraisal. AWE Major Projects Directorate reference MER- 110-021924, June 2010. http://planning.westberks.gov.uk/rpp/index.asp?caseref=10/01695/COMIND



Impression of how the main Project Hydrus building will look.

- Radioactive plutonium will be used in some of the tests conducted in the facility, and so radioactively contaminated wastes will be generated, which will be stored on site pending development of a National Repository for the UK's radioactive waste.
- Explosives will also be handled and detonated as an integral part of the experimental programme.
- X-ray radiation from the high powered x-ray machines used to record images during experiments poses a potential hazard to human health.
- Hydrodynamic experiments generate noise and vibration. AWE is concerned that disclosure of specific information on noise and vibration signatures could be used to help enemies gain an understanding about warhead configurations.
- Construction traffic will have an impact in the local area, particularly upon Aldermaston village.

NIS's view

NIS considers that the multi-million pound costs of building a new hydrodynamics research facility at Aldermaston cannot be justified at the current time, when deep cuts in public spending planned over the next few years will correspond with the construction period for Project Hydrus.

Perhaps more importantly, a window of opportunity for nuclear arms control currently exists on the international stage. The Review Conference on the Nuclear Non-Proliferation Treaty which took place in May in New York was generally considered to represent a modest step forward towards disarmament, and with the 'New START' agreement between the USA and Russia and President Obama's arms control agenda continuing, prospects for multilateral nuclear disarmament look promising. Now is not the time for the USA's closest nuclear ally to push ahead with an investment programme aimed at ensuring that it can remain a nuclear weapons power for the next forty years.

In our view, the warhead physics research programme at AWE should be scaled back and

Project Hydrus should be cancelled. This would help in reducing public spending at a time when the economic priority is to reduce the UK's debt. Time allocated to the design of new nuclear weapons facilities at AWE's existing research facilities, such as the Orion high powered laser, should be handed over to universities for civil sector research.

Leading US nuclear weapons scientists have stated that investment in lasers, hydrodynamic testing, sub-critical testing and supercomputers in US laboratories is driven principally by a concern to maintain the USA's nuclear weapons programme and is not needed if the aim is simply to keep existing nuclear warheads safe and reliable, rather than to develop new nuclear weapons[23]. Instead of undertaking a science-based programme, the reliability of nuclear weapons can be achieved using engineering-based inspection and remanufacturing techniques.

This requires detaching and checking each of the thousands of individual components that make up a nuclear weapon and its subsystems. If there are any problems or signs of deterioration the part is simply replaced by an identical part. Stocks of identical parts are created through remanufacturing parts according to their original specifications. As long as the basic weapon design is not changed this method will continue to work. This engineering approach (sometimes referred to as curatorship) is a tried-and tested technique, being the method used to maintain the USA's stockpile of nuclear weapons during the Cold War.

NIS considers that a programme to develop a new nuclear warhead design at Aldermaston is not needed and should not be given the go-ahead by the government. Rather than increasing the capability of nuclear weapons, the current arsenal of warheads should be 'frozen in time' - maintained and serviced but without any upgrade in performance - until the time comes to take them out of service.

Have your say on Project Hydrus

West Berkshire Council is currently consulting on the planning application for the proposed new hydrodynamics research facility at AWE Aldermaston. You can give your comments on the application by writing to:

Mr Clive Inwards
Planning Department
West Berkshire Council
Council Offices
Market Street
Newbury
Berkshire
RG14 5LD

Email: planapps@westberks.gov.uk

Remember to quote the planning application reference in your letter: 10/01695/COMIND: Hydrodynamics Research Facility, AWE Aldermaston.

More information on the planning application for Project Hydrus can be found on the NIS website at http://nuclearinfo.org.

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23 'Britain's New Bomb Programme Exposed'. Greenpeace UK, October 2006. www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/8030.pdf