

Report from Rebecca E. Johnson B.Sc. (Hons), MA, Ph.D. FRSA

September 2016

INTRODUCTION

1. I have been requested to provide my expert opinion on:
 - The UK's current nuclear capability and the potential effect of those weapons;
 - The UK government's deterrence policy, particularly policies on the threat or use of nuclear weapons, and how those policies have changed since 1998; and
 - AWE Burghfield's role in light of those policies and what activities are conducted on the site.

Qualifications

2. I am the founder-director of the Acronym Institute for Disarmament Diplomacy, based in London. The Acronym Institute has consultative status with the United Nations. From 1994 to the present my work has mainly focused on nuclear policy, treaty negotiations, disarmament, non-proliferation and arms control.
3. During that time I edited the international policy journal *Disarmament Diplomacy* (until it closed in 2009), becoming known especially for my reporting and publications on UN and treaty meetings relating to nuclear and other inhumane weapons. I have attended and reported on every multilateral meeting of Non-Proliferation Treaty (NPT) states parties at the UN in Geneva, Vienna and New York from 1994 to the present, as well as many other UN and international meetings relating to a range of security, humanitarian and proliferation issues.
4. I was trained initially as a scientist, and then focused on international relations and diplomacy. I obtained my B.Sc from the University of Bristol (1977); after teaching in Japan I returned to the UK and obtained my MA from the University of London School of Oriental and African Studies (SOAS) in 1982. I received my PhD from the University of London School of Economic and Political Science (LSE) in 2004 (International Relations) with my thesis on Multilateral Nuclear Arms Control.
5. In addition to my work on disarmament, security and diplomatic negotiations over the

years, published by the United Nations and in a range of academic journals around the world, I have acted as a consultant to various governments and organisations, the European Union and the UN. I also served as director of the University of British Columbia's Simon's Centre for Disarmament and Non-Proliferation Research (2003-04), and senior advisor to the International WMD Commission, chaired by Dr Hans Blix (2004-06), as well as on the Board of the Bulletin of the Atomic Scientists (2001-06, as Vice Chair from 2003). I continue to serve on the International Panel on Fissile Materials (IPFM), based at Princeton University, USA, and the International Steering group of the International Campaign to Abolish Nuclear Weapons (ICAN), where I was the founding president and co-chair until 2014.

6. Since April 2010 I've been a frequent author for the *openDemocracy* online news service, with dozens of articles on issues relevant to UNSC resolution 1325 on Women, Peace and Security, humanitarian and disarmament initiatives, nuclear diplomacy, the United Nations and civil society, listed on <https://www.opendemocracy.net/author/rebecca-johnson>. I am also a commentator for BBC, CNN and other media on nuclear developments and other relevant issues.

7. Principal Books and Reports include:

- 'Arms Control and Disarmament' chapter in *Oxford Handbook of Modern Diplomacy*, (OUP, 2013).
- 'The humanitarian impacts of nuclear weapons – an imperative for achieving nuclear disarmament', *Irish Studies in International Affairs*, Volume 25, 2014.
- *Embedding the CTBT in norms, law and practice*, (UNA-UK, London, 2013).
- *Decline or Transform: Nuclear disarmament and security beyond the NPT review process*, with John Borrie and Tim Caughley (London, 2012).
- *Trident and International Law: Scotland's Obligations* (ed. with A. Zelter, Luath Press, 2011).
- *Unfinished Business: The negotiation of the CTBT and the end of nuclear testing* (United Nations, 2009).
- *Worse than Irrelevant: British nuclear weapons in the 21st century* (with Nicola Butler and Stephen Pullinger, London 2006).
- *Europe's Space Policies and their relevance to ESDP* (European Parliament publication, Brussels, June 2006).
- 'The Necessity to Reduce and Eliminate Nuclear Threats and Weapons in the Middle East and Internationally', in Thomas S. Axworthy and Zafar Adeel, eds, *Global Agenda 2013: Water, Energy, and the Arab Awakening*, United Nations University, 2014.

- 'Politics and Protection: Why the 2005 NPT Review Conference failed', in *Disarmament Diplomacy* 80 (Autumn 2005).
- 'The 2000 NPT Review Conference: a Delicate, Hard-Won Compromise', *Disarmament Diplomacy* 46 (May 2000).
- Indefinite Extension of the Non-Proliferation Treaty: Risks and Reckonings: Report of the 1995 NPT Review and Extension Conference, New York, 17 April to 12 May 1995, Acronym Report No. 7, London 1995.

Other relevant articles and chapters include:

- 'Dangerous and Inhumane: UK nuclear policy and Humanitarian Nuclear Ban Strategies', in Andrew Futter (ed), *The United Kingdom and the Future of Nuclear Weapons*, Rowman & Littlefield, 2016.
- 'Using humanitarian principles to push for nuclear disarmament', *New World*, (UNA-UK, March, 2014).
- 'Linking Humanitarian Law and Nuclear Disarmament Action', in *Austrian Review of International and European Law*, vol 15 (2010).
- *Preventable Threats: the humanitarian impacts of nuclear weapons, UK risks and challenges*, Acronym Institute, 2014 (updated from 2013).
- 'The NPT toward 2015: NAM and Non-Nuclear Weapon States Perspectives', in Emily Landau, Azriel Bermand eds., *The Nuclear Nonproliferation Regime at a Crossroads*, Institute for National Security Studies, Tel Aviv, May 2014.
- 'Turning Back from Doomsday', Introduction, in Commander Robert Green's book *Security Without Nuclear Deterrence*, (Astron Media, NZ, 2010).
- 'Assessing the 2010 NPT Review Conference', *The Bulletin of the Atomic Scientists*, vol. 66 no. 4, July-August 2010.
- 'Strengthening the NPT regime and paving the way for nuclear abolition', in *Perspectives for Progress: The 2010 NPT Review Conference and Beyond*, (Pugwash, 2010).
- 'Beyond Existing Treaties' in *eJournalUSA*, published by the US Department of State for the 2010 NPT Review Conference.
- 'Rethinking the NPT's role in security: 2010 and beyond', *International Affairs* 86:2 (2010), Royal Institute of International Affairs/Chatham House.
- *Nuclear Weapons Abolition: an idea whose time has come*, The Blackaby Papers, London, 2010.
- 'The Missing Link: Political Decision and Will to Build and Manage Security without Nuclear Weapons', in Hannes Swoboda and Jan Marinus Wiersma (eds.), *Peace and Disarmament: A World without Nuclear Weapons?* European Parliament (PSE), Brussels, 2009.
- 'Arms Control, Universality, and International Norms', in Jeffrey A. Larsen and James J. Wirtz (eds.), *Arms Control and Cooperative Security*, Lynne Rienner, Boulder Co. and London, 2009.
- 'Enhanced Prospects for 2010: An Analysis of the Third PrepCom and the Outlook for the 2010 NPT Review Conference', *Arms Control Today*, June 2009.

- 'End of a Nuclear Weapons Era: Can Britain Make History?' *Arms Control Today*, April 2006.
- 'Is the NPT up to the challenge of proliferation?' (*Disarmament Forum*, UNIDIR, October 2004).
- 'Security without weapons in space: challenges and options', UN Institute for Disarmament Research (*Disarmament Forum*, UNIDIR, March 2003);
- "Missile Defence and the Weaponisation of Space", ISIS Policy Paper, No. 11 (January 2003).
- 'Implications of the outcome of the NPT Review Conference', ISIS Special Briefing on UK Nuclear Weapons Policy (2001).
- 'Advocates and Activists: Conflicting Approaches on Nonproliferation and the Test Ban Treaty' in Ann Florini (ed), *The Third Force: The Rise of Transnational Civil Society*, (2000).
- 'Post-Cold War Security: the Lost Opportunities', UNIDIR, (Disarmament Forum, January 1999).
- 'Nuclear Arms Control through Multilateral Negotiations' in Nancy Gallagher (ed), *Arms Control: New Approaches to Theory and Policy*, (1998).
- *British Perspectives on the Future of Nuclear Weapons*, The Henry L. Stimson Center (1998).
- 'Ending Nuclear Weapon Testing: Getting and Keeping the CTBT', *Verification 1997* (VERTIC, London 1998).

Note: this list of publications is not comprehensive

The Trident nuclear weapons system, changing capabilities, doctrines and policies for deployment and use, from 1995 to the present.

8. What is commonly called "Trident" is the UK's nuclear weapons system deployed since 1994. It comprises 4 nuclear powered "Vanguard class" SSBN submarines, which were each designed to carry 16 US-made Trident II D5 missiles armed with up to 128 UK-made thermonuclear warheads.
9. The submarines were built at the Vickers (now BAE) shipyard in Barrow, with nuclear power reactors built by Rolls Royce.
10. The missiles are manufactured in the United States and leased to the MoD with contracts and agreements under the UK-US Mutual Defence Agreement (official title 'Agreement between the Government of the United States of America and the Government of the United Kingdom of Great Britain and Northern Ireland for

Cooperation on the uses of Atomic Energy for Mutual Defense Purposes'), originally signed in 1958¹ and renewed on subsequent occasions.²

11. The warheads for Trident (Mk 4A) were closely modelled on the US W76 warhead deployed by the US version of Trident, and now being upgraded to W76-1. These are boosted thermonuclear (hydrogen/H-bomb) designs, with an average yield of 100 kilotonnes, but the potential to be deployed with different yields (sometimes referred to as 'dial-a-yield').
12. The warheads for Trident and any successor nuclear weapons system are designed and manufactured at the Atomic Weapons Establishment (AWE) facilities at Aldermaston and Burghfield in Berkshire. While AWE Aldermaston is primarily responsible for research, development, plutonium processing and the design and testing of the nuclear and other warhead components, AWE Burghfield assembles the pit with high explosives and other components and packs them together as a finished nuclear warhead, ready to be fitted to the missiles and fired.
13. It would not be possible for Trident to be fired without the warhead manufacturing and production activities carried out by AWE Burghfield, in addition to the plutonium processing and related design and production work of AWE Aldermaston.
14. Nuclear explosions are traditionally measured in terms of a thousand tonnes of TNT equivalent, so 1 kt has an explosive power equivalent to 1,000 tonnes of the conventional explosive TNT. To provide context, the bomb used on Hiroshima is estimated to have been around 12-13 kt. This is often used as a unit of comparative explosive power. Therefore the average Trident warhead would deliver an explosive power of around 8 Hiroshimas - that is around 8 times greater than the bomb that incinerated Hiroshima.
15. Instead of 16 Trident missiles, each submarine nowadays carries no more than 8 missiles, with each missile now armed with up to 5 warheads that are on multiple independently targeted re-entry vehicles (MIRV).

16. Trident was designed to carry nuclear weapons deemed to be a Cold War deterrent, but the first was not ready for sea until 1994, after the Cold War had ended. Nonetheless, Trident has been deployed and justified by successive government leaders as a 'deterrent' and 'an insurance policy'.³
17. In UK political discourse, Trident is very frequently referred to as "our independent nuclear deterrent", equating it with the function of deterrence, rather than in terms of its designed capabilities as an indiscriminate explosive weapon of mass destruction.⁴
18. The concept of nuclear deterrence takes various forms, depending on the perceptions of those involved. The main versions include: deterrence by denial, meant to demonstrate that an aggressor's objectives will not be obtained; deterrence by threat of overwhelming punishment, requiring a large second strike retaliation capability; deterrence through the threat of mutual assured destruction (MAD), equivalent to collective suicide; extended deterrence, where the threat that nuclear weapons might be used by one or more parties is presented as a way to prevent aggression against homeland, allies, military forces or 'vital assets'; and core deterrence, where nuclear weapons are held solely to prevent any attack or use of nuclear weapons.⁵
19. The UK has evoked all these concepts of deterrence at different times and in different places. On grounds of security, sensitivity and the perception that secrecy is essential for deterrence, more detailed specifics relating to UK operations and targetting are highly classified. Nonetheless, as discussed in more detail below, UK operations associated with deterrence doctrines include sub-strategic and war-fighting roles that could lead to nuclear war. These include 'counter-value' targeting of cities, transport links and communications, counter-force targeting of military forces, warning shots or 'shots across the bow', and operations and capabilities for retaliation, punishing aggressors, and pre-emptive first use (discussed in more detail below).
20. UK policy on the use of nuclear weapons was formally updated in the 6 April 1995 statement to the Conference on Disarmament, which stated: "The United Kingdom will not use nuclear weapons against non-nuclear-weapon States parties to

the Treaty on the Non-Proliferation of Nuclear Weapons except in the case of an invasion or any other attack on the United Kingdom, its dependent territories, its armed forces or other troops, its allies or on a State towards which it has a security commitment, carried out or sustained by such non-nuclear-weapon State in association or alliance with a nuclear-weapon State. In giving this assurance the United Kingdom emphasizes the need not only for universal adherence to, but also for compliance with, the Treaty on the Non-Proliferation of Nuclear Weapons."⁶

21. The 1995 UK statement made "clear that Her Majesty's Government does not regard its assurance as applicable if any beneficiary is in material breach of its own non-proliferation obligations under the Treaty on the Non-Proliferation of Nuclear Weapons."⁷
22. This UK declaration was then referred to in UN Security Council resolution 984 (1995), which gave legal force to the declarations by all five NPT-defined nuclear weapon states (China, France, Russia, UK and USA) on negative security assurances and their policies on the use of nuclear weapons. UNSCR 984 and the five unilateral declarations were adopted in conjunction with the indefinite extension of the NPT in 1995. They updated UN Security Council resolution 225 (1968), which had been formulated by the UK, US and Soviet Union in conjunction with the conclusion and adoption of the NPT in 1968.
23. It was a condition of NPT indefinite extension in 1995 that the NPT-defined nuclear weapon states as well as other state parties to the NPT adopted decisions on 'principles and objectives for nuclear non-proliferation and disarmament' and a strengthened review process, and that these decisions should be fulfilled.⁸ This was the political package and condition for the NPT continuing in legal force beyond 1995, according to the President of the 1995 NPT Review and Extension Conference, Ambassador Jayantha Dhanapala.⁹
24. As described below, there has been no subsequent UN Security Council resolution on nuclear use and security assurances, and the UK has not formally adopted a different policy from the one that was publicly stated in April 1995 and recognised by the UN Security Council. Nonetheless, statements made by government ministers in

the House of Commons have indicated several changes in nuclear use policies, not necessarily in ways deemed consistent with UN Security Council Resolutions and NPT Conferences.

25. From 1995-2010 the UK dismantled all of Britain's residual tactical nuclear weapons. The number of warheads built for deployment on Trident was classified, but in 1998 the maximum number per submarine was discussed in Parliament as being 60-65.¹⁰
26. After taking the reins of government in 1997, Labour undertook a Strategic Defence Review (SDR), which was published on 8 July 1998. This confirmed that the overall UK stockpile would be reduced from a ceiling of 300 to "less than 200 operationally available" warheads.¹¹
27. The 1998 SDR also confirmed that normally just one submarine would patrol at any one time, and would carry out "secondary tasks" such as exercises, equipment trials and hydrographic testing while on patrol, "without compromising their security".¹²
28. The SDR further stated that each submarine would deploy a maximum of 48 warheads, rather than the ceiling of up to 96 envisaged when Trident was commissioned. The SDR announced cancellation of an additional 7 Trident missile bodies, leaving a new total of 58 to be leased from the United States' stockpile. This was described as "the minimum necessary to provide for our security for the foreseeable future and smaller than those of the major nuclear powers".¹³
29. The 1998 SDR also announced: "The submarine's missiles will not be targeted and it will normally be at several days 'notice to fire'. This reduced state of alert will enable greater use of ballistic missile submarines for secondary tasks such as exercises with other vessels, equipment trials and hydrographic work. Similarly, current threat levels do not require large numbers of conventional forces permanently allocated to the protection of the deterrent. We will, however, ensure that we can restore a higher state of alert should this become necessary at any time."¹⁴

30. In addition to announcing that Trident would be on a “reduced notice to fire” measured in days rather than the “15 minutes’ readiness to fire” associated with Cold War anxieties and postures of hair-trigger alert, the 1998 SDR confirmed that the UK would also not target its nuclear weapons at any specific country. This followed US and Russian announcements in 1995 that they had agreed not to target their nuclear weapons at each other.
31. It must be noted, however, that these declarations were understood and recognised as essentially operational gestures that could be quickly reversed.¹⁵ Sir Michael Quinlan, who was Under-Secretary of State for the Ministry of Defence 1988-92, noted that “if we got into a serious crisis”, the readiness to fire could be changed and the nuclear weapons retargeted by computer operation within minutes.¹⁶
32. Moreover, the 1998 SDR did not actually reconfirm the 1995 political declarations on negative security assurances, understood to be the principal statement of policy on the use of nuclear weapons. By contrast, it referred to a "sub-strategic" role for Trident, thereby upholding a policy shift made by Malcolm Rifkind, the Conservative Party’s Secretary of State for Defence in 1993, who first assigned a ‘sub-strategic’ role to Trident, arguing that smaller nuclear weapons could be used to send 'warning shots' or a 'shot across the bows' of an adversary.¹⁷
33. The 1998 SDR endorsed Rifkind's argument, stating: “The credibility of deterrence also depends on retaining an option for a limited strike that would not automatically lead to a full scale nuclear exchange. Unlike Polaris and Chevaline, Trident must also be capable of performing this ‘sub-strategic role’.”¹⁸
34. In 1998, Members of Parliament questioned how the use of a nuclear weapon against another country could ever be “seen as anything other than a strategic assault or a strategic threat”.¹⁹
35. The 1998 SDR also explained that the reduction in missiles and warheads was possible "taking into account Trident's greater accuracy than Polaris".²⁰
36. In conjunction with these new roles assigned to Trident, AWE Aldermaston and Burghfield have reportedly developed warheads that have differential yields and

explosive power, sometimes referred to as 'dial-a-yield' capabilities. There have been off the record confirmations that the majority of Trident Mk4 warheads are still 100 kt. [This information is classified so no more detail than this is available at present.]

37. Sir Michael Quinlan later argued that the “declared intention since the mid 1990s has been to exploit the versatility and accuracy of the Trident system to provide ‘sub-strategic’ deterrent or war-termination options short of extensive multiple strike.”²¹
38. Sir Michael Quinlan further noted that operational details are not disclosed, and suggested that substrategic roles probably entail that “some missiles may carry only one live warhead, and that that one warhead may have an explosive yield – perhaps through the use of only the ‘primary’ detonation – well below that of the normal warhead.”²²
39. While successive governments have published strategic reviews that summarise the political underpinning of nuclear policies, it is difficult to gain access to more specific detail on operations and targeting arising from decisions on doctrines and policies, or on accidents, dangers, risks or other issues relevant to ongoing safety and security of nuclear weapons, facilities, transports and deployments.
40. On grounds that are generally presented as "national security," but which often pertain more to issues that are politically sensitive or events that might embarrass government or military departments or personnel, the MoD maintains secrecy about most if not all aspects of the UK's nuclear operations and targeting, which are coordinated with nuclear planning by the United States, France and NATO. Democratic oversight and accountability are made more difficult as the 'national security' justification for secrecy is at times inappropriately extended to conceal incompetence, safety problems, and even dangerous incidents or accidents involving nuclear weapons, materials or delivery vehicles.
41. Notwithstanding the UK culture of secrecy regarding matters that might affect nuclear weapons, facilities and safety, it is possible to develop a general picture through UK government documents, parliamentary sources and open source documents from countries such as the United States, which may have a more open

culture regarding citizens' rights to information about military and governmental activities that may affect them.²³

42. Available information indicates that the UK subscribes to the 'counter-value' targeting of cities, transport links and communications, 'counter-force' targeting of military forces, facilities and weapons capabilities. In addition to targeting any facilities that might enable an adversary to retaliate, such as command and control headquarters (parliamentary, governmental or military), and retention of policies that include pre-emptive first use, it can be inferred from available sources that nuclear targeting and current policies permit nuclear retaliation and punishment (of aggressors) as well as purposes defined as "deterrent", including warning shots "across the bows" of a potential aggressor.²⁴
43. Unlike de-alerting, with which they were sometimes confused, the de-targeting and "reduced notice to fire" decisions involved only computer and operational changes that did not affect the physical deployment of Trident. It is generally accepted that genuine de-alerting would require some form of physical separation of warheads from delivery systems. The de-targeting and reduced notice to fire declarations are understood to have left the physical warhead and delivery systems physically intact, making it possible to reprogramme electronically the targets and quickly and easily. Similarly, an order from the Prime Minister could be quickly transmitted that would restore on-alert operations and accelerate command and control procedures so that firing could be conducted in minutes.²⁵
44. This was made clear in the 1998 SDR, which confirmed that a higher state of alert could be restored if necessary "at any time", and stated that the UK "Trident force will continue to be allocated to NATO in both the strategic and sub-strategic roles. It will however remain operationally independent and available for use by the United Kingdom alone in a case of supreme national need."²⁶
45. What this means in practice is that apart from the operational decision-making and communications procedures, Trident's physical targeting capabilities have remained in situ. Possible targets have been selected and their geographic coordinates

programmed into the guidance systems in accordance with UK and NATO's doctrines and policies.

46. It is therefore important to distinguish between nuclear policy statements and the operations and strategies that govern UK nuclear use and targeting in practice. Joint doctrines and operations relevant to the UK's assignment of Trident nuclear weapons to NATO indicate that the actual, on-the-ground targeting options and strategies were not affected by declarations in 1998 on de-targeting the missiles and putting Trident on reduced alert status and notice to fire.
47. The deployment and use policies for Trident outlined in strategic defence reviews from 1998 to 2015 have increased reliance on sub-strategic and war-fighting roles that could lead to nuclear war. Policy changes are signaled through apparently small but significant changes in wording on nuclear use and security assurances between the 1998, 2010 and 2015 defence reviews and the 2006 White Paper. The problem is that these policies are not necessarily reflected in operations and deployments on the ground and at sea.
48. As discussed later, the so-called "Moscow criterion", regarded in the Cold War as the essence of UK nuclear deterrence was considered still relevant in 2013.
49. At the UN First Committee in New York in October 2016, UK Ambassador Matthew Rowland delivered an official statement which is the most up-to-date presentation of UK policy following the parliamentary debate on 18 July 2016. This stated, "The UK maintains a minimum credible level of deterrence, with a single Trident submarine on patrol, normally on several days 'notice to fire' and for almost twenty years now, UK nuclear weapons have been de-targeted..."
50. The UK 2016 statement continued, "The 2015 National Security Strategy and Strategic Defence and Security Review that the UK's independent minimum credible nuclear deterrent, based on a Continuous at Sea Deterrence posture, will remain essential to the UK's security today as it has for over 60 years, and for as long as the global security situation demands, to deter the most extreme threats to the UK's national security and way of life and that of the UK's allies..." This was the rationale

for "the decision to take the necessary steps required to maintain the current posture by replacing the current Vanguard Class submarines with four Successor submarines", that are now to be named 'Dreadnought'.

51. The statement continued, "We would employ our nuclear weapons only in extreme circumstances of self-defence, including the defence of our NATO Allies. And we continue to offer the assurance that the UK will not use, or threaten to use, nuclear weapons against any Non-Nuclear Weapons State party to the Treaty on the Non-Proliferation of Nuclear Weapons. This assurance does not apply to any state in material breach of those non-proliferation obligations. While there is currently no direct threat to the UK or its vital interests from states developing weapons of mass destruction, such as chemical and biological capabilities, we reserve the right to review this assurance if the future threat, development or proliferation of these weapons make it necessary."

Relevance of nuclear diplomacy to UK policies, 1995 to the present

52. Between the disastrous NPT preparatory meeting in 1998 and the successful 2000 NPT Review Conference, there were a shift to a markedly more constructive British approach on nuclear disarmament issues. High level discussions within the Labour government, combined with civil society pressure and more attention in Parliament, resulted in Britain playing a constructive role in bridging differences between nuclear and non-nuclear positions.²⁷

53. In 2000, States Parties to the NPT held the first Review Conference after the Treaty was indefinitely extended in 1995. Many NPT Parties raised serious concerns at the lack of disarmament progress by the five nuclear weapon states in the Treaty, and also serious concerns about nuclear proliferation risks and threats, including the nuclear weapons programmes and policies of three nuclear-armed states outside the NPT (India, Israel and Pakistan). It was made clear to the UK and other nuclear weapon states that they needed to do more to comply with their nuclear disarmament obligations (Article VI of the NPT and the 1995 decisions). In view of the vague "good faith" wording of Article VI, the 2000 NPT Review Conference adopted a consensus Final Document that contained an explicit 13-paragraph "programme of

action for nuclear disarmament", often referred to as the "13 Steps".²⁸ Three paragraphs are of particular relevance here:

* Para 5. The principle of irreversibility to apply to nuclear disarmament, nuclear and other related arms control and reduction measures.');

* Para 6. An unequivocal undertaking by the nuclear weapon States to accomplish the total elimination of their nuclear arsenals leading to nuclear disarmament, to which all States parties are committed under article VI.' and

* Para 9. Steps by all the nuclear-weapon States leading to nuclear disarmament in a way that promotes international stability, and based on the principle of undiminished security for all:

- Further efforts by the nuclear-weapon States to reduce their nuclear arsenals unilaterally;
- Increased transparency by the nuclear weapon States with regard to the nuclear weapons capabilities and the implementation of agreements pursuant to article VI and as a voluntary confidence building measure to support further progress on nuclear disarmament;
- The further reduction of non-strategic nuclear weapons, based on unilateral initiatives and as an integral part of the nuclear arms reduction and disarmament process;
- Concrete agreed measures to further reduce the operational status of nuclear weapons systems;
- A diminishing role for nuclear weapons in security policies to minimize the risk that these weapons will ever be used and to facilitate the process of their total elimination...'
- The engagement as soon as appropriate of all the nuclear-weapon States in the process leading to the total elimination of their nuclear weapons.²⁹

54. The UK and other four NPT-defined nuclear weapon states to the 2000 NPT Review Conference made a joint statement on 1 May 2000, which confirmed policy shifts that the UK, US and Russia had announced previously, notably that none of their nuclear weapons were targeted at any state.³⁰

55. During the 2000 NPT Review Conference, the UK confirmed that its formal position on the use and threat of use of nuclear weapons was contained in its 1995 statement to the Conference on Disarmament and in UN Security Council resolution 984 (1995). These documents, linked to the indefinite extension of the NPT in 1995, updated UN Security Council resolution 225 (1968), which had been formulated by the UK, US and Soviet Union in conjunction with the conclusion and adoption of the NPT in 1968.³¹

56. In 2002, two years after adopting the Final Report of the 2000 NPT Review Conference, four years after the 1998 SDR, Geoff Hoon, then Labour Defence Secretary, argued that Saddam Hussein or other putative aggressors "can be absolutely confident that in the right conditions we would be willing to use our nuclear weapons."³²
57. Mr Hoon then clarified in a television interview that UK nuclear use might encompass both retaliation and pre-emption: "Let me make... clear the long standing British government policy that if our forces - if our people - were threatened by weapons of mass destruction we would reserve the right to use appropriate proportionate responses which might... in extreme circumstances include the use of nuclear weapons."³³
58. Three months later Mr Hoon clarified in response to a Defence Question on July 15, 2002, "that British Government policy has not changed since John Major, during the Gulf War, explicitly ruled out the use of British nuclear weapons against Iraq, even in reply to a chemical or biological attack on our forces, on the grounds that a proportionate response could be made using conventional weapons and that Britain would never breach the Nuclear Non-Proliferation Treaty."³⁴
59. The first statement was interpreted as changing and expanding UK nuclear use policy from what had been declared in the UK's negative security assurances in April 1995, which had been officially confirmed through UN Security Council Resolution 984. There was also consternation what appeared to be a policy shift made by Mr Hoon as Defence Secretary also went against the 8 July 1996 advisory opinion of the International Court of Justice³⁵ on the use and threat of use of nuclear weapons.³⁶
60. This exchange illustrates the difficulty of mapping changes in UK nuclear use policy, especially since nuclear operations, strategies and targeting are classified and so defence ministers do not answer specific parliamentary questions on the record. UK operations and targeting decisions continue to be coordinated with the United States and NATO, and what little information is available (mostly from US sources) suggests that these are not necessarily adjusted in military and practical terms in

conjunction with publicly announced policy shifts, such as defence reviews or the statements made in 1995 and 2000.

61. The 2005 and 2015 NPT Review Conferences failed to adopt any consensus decisions, amid recriminations about lack of progress on nuclear disarmament and the Middle East. The United Kingdom was one of only 3 NPT States Parties to refuse to join consensus on the 2015 NPT Final Document after four weeks of intensive negotiations.³⁷
62. The 2010 NPT Review Conference gave consensus to a statement of "deep concern at the catastrophic humanitarian consequences of any use of nuclear weapons and reaffirms the need for all States at all times to comply with applicable international law, including international humanitarian law."³⁸
63. This NPT-related understanding formed the basis for new initiatives by governments and civil society, with a series of international 'Humanitarian Impacts of Nuclear Weapons' (HINW) conferences in Oslo, Mexico and Vienna, and two UN working groups (in 2013 and 2016) on multilateral nuclear disarmament mandated by the UN General Assembly.
64. The UN General Assembly in December 2015 adopted UNGA Resolution 70/33, entitled "Taking forward multilateral nuclear disarmament negotiations", which established an Open-Ended Working Group that met for several weeks at the UN in Geneva during 2016.
65. Facts and evidence debated at these humanitarian conferences and UN meetings made clear that any accidental or intentional detonation of a nuclear warhead, such as the Trident warheads manufactured and assembled at AWE Aldermaston and Burghfield, would have catastrophic humanitarian and environmental impacts, that these impacts would not be confined to a single nation, but would be trans-boundary and trans-regional, with global health, environmental, development and humanitarian consequences. The governments and civil society experts also concluded that modernisation and renewal of nuclear weapons programmes since 2000 undermined

the NPT, and that the only effective way to ensure that nuclear weapons will not be used is to prohibit and eliminate them.³⁹

66. Notwithstanding that the UK boycotted the UN Open-Ended Working Group meetings in 2016, as they had boycotted a similar UN working group in 2013, on 19 August 2016 a large majority of UN Member States voted in favour of a recommendation from the Open-Ended Working Group to commence negotiations in 2017 on an international legal instrument to "prohibit all nuclear weapons under International Humanitarian Law, leading to their total elimination".
67. On 27 October 2016, 123 UN Member States voted.

Decisions on renewing Trident

68. Trident renewal, begun in 2006 and endorsed on 18 July 2016 with a majority parliamentary decision to sign contracts for 4 new SSBN submarines, is projected to deploy a similar sized and more sophisticated military nuclear explosive capability. It is not clear from the 2015 SDSR whether a parliamentary decision is needed on a replacement warhead, but the government highlighted nuclear cooperation with the United States and France and specified that AWE would sustain the ability to develop a replacement warhead if decided. In practice, over £5 billion has already been invested in refurbishments of AWE facilities that do not make sense unless a decision has already been taken to design and manufacture an upgraded warhead for Trident.
69. In December 2006, the Labour Government issued its White Paper on *The Future of the United Kingdom's Nuclear Deterrent*.⁴⁰ This presented the government's case to procure new nuclear submarines to carry UK nuclear weapons well beyond 2050.
70. Though the White Paper's emphasis is on replacing the submarine "platforms", it held open the option of developing new warheads.⁴¹ Expenditure on contracts of more than £5 billion on new facilities and equipment at AWE Aldermaston and Burghfield since 2006, as tracked through Parliamentary questions and research by various organisations and covered in detail on the websites of the Nuclear Information Service, Acronym Institute, CND and Scottish CND, among others.⁴²

71. The 2006 White Paper promised "a 20 percent reduction" in "our stockpile of operationally available warheads", noting also that "our current holding [of Trident D5 missiles] has reduced to 50" from 58, "as a result of a number of test firings".⁴³
72. As planned, the renewal of Trident combined with "the UK posture of deterrence [which] requires the maintenance of continuous at-sea patrols" would in practice mean little or no actual reductions in the UK nuclear force.⁴⁴
73. In May 2010, William Hague, as Foreign Secretary for the incoming Coalition government, announced that the UK actually possessed 225 warheads, and that, notwithstanding announced reductions, "additional warheads are needed to ensure the number of those ready to be deployed at any one time never falls below 160, taking into account routine maintenance and logistical management of the stockpile."⁴⁵
74. In his Prime Minister's statement on the Coalition Government's 2010 Strategic Defence and Security Review (SDSR), David Cameron said that the Government had reviewed the UK's deterrence requirements and concluded that the requirement could be met for an effective and credible deterrent with a smaller nuclear weapons capability.⁴⁶
75. The 2010 SDSR announced that by 2020 "the number of warheads on board each submarine would be reduced from a maximum of 48 to a maximum of 40, the number of operational missiles on the Vanguard Class submarines would be reduced to no more than eight, and the number of operational warheads reduced from fewer than 160 to no more than 120."⁴⁷
76. The 2010 SDSR stated: "the UK will not use or threaten to use nuclear weapons against non-nuclear weapon states parties to the NPT."⁴⁸
77. The Conservative government elected in 2015 undertook a hurried National Security Strategy and Strategic Defence and Security Review, subtitled "A secure and prosperous United Kingdom". This paved the way for signing contracts on four new nuclear-armed and nuclear-powered submarines.⁴⁹
78. The 2015 SDSR referred to Trident's destructive power, estimated at around 4 million tonnes per deployed nuclear submarine⁵⁰, as "the minimum amount of

destructive power needed to deter any aggressor". It stated that submarines on patrol would each "continue to carry 40 nuclear warheads and no more than eight operational missiles. We will retain no more than 120 operationally available warheads and, by the mid-2020s we will reduce the overall nuclear weapons stockpile to no more than 180 warheads, meeting the commitments set out in the 2010 SDSR."⁵¹

79. Therefore, the 2015 SDSR set the stockpile at 20 warheads more than the Coalition government had stated in 2010. This was confirmed by Defence Secretary Michael Fallon in March 2016, in which he presented UK policy as "to reduce further our stockpile of nuclear weapons to no more than [180 warheads by the mid-2020s](#)".⁵²
80. The 2015 SDSR noted its close collaboration with the US and France "on nuclear matters, including nuclear policy". UK and US defence cooperation is "underpinned by the recently renewed 1958 Mutual Defence Agreement..." Collaboration with France is conducted "under the 2010 Teutates Treaty" and is presented as "to develop the technologies associated with the safe and effective maintenance of our respective nuclear stockpiles".⁵³
81. However, the 2015 SDSR also referred to research on options for a replacement warhead. Although this may not be required until the 2030s, the MoD stated: "We continue to invest significantly in the Atomic Weapons Establishment to maintain the facilities and skills necessary to assure the safety and security of the current stockpile, and to sustain the ability to develop a replacement warhead when we need to do so."⁵⁴
82. With regard to nuclear use, the 2015 SDSR explicitly stated "Only the Prime Minister can authorise the launch of nuclear weapons, which ensures that political control is maintained at all times. We would use our nuclear weapons only in extreme circumstances of self defence, including the defence of our NATO Allies. While our resolve and capability to do so if necessary is beyond doubt we will remain deliberately ambiguous about precisely when, how and at what scale we would contemplate their use, in order not to simplify the calculations of any potential aggressor."⁵⁵

83. The 2015 SDSR updated the UK negative security assurance policy from 1995 with this statement: "The UK will not use, or threaten to use, nuclear weapons against any Non-Nuclear-Weapons State party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). This assurance does not apply to any state in material breach of those non-proliferation obligations."⁵⁶
84. The government reserved the right to review and change this assurance in the future, but did not discuss the impact of this modified security assurance on UN Security Council resolution 984 and the validity of the NPT's extension in 1995.
85. During the 18 July 2016 debate, Prime Minister Theresa May MP was asked whether "she personally [is] prepared to authorise a nuclear strike that could kill 100,000 innocent men, women and children". She replied "Yes. The whole point of a deterrent is that our enemies need to know that we would be prepared to use it, unlike the suggestion that we could have a nuclear deterrent but not actually be willing to use it."⁵⁷
86. Since 1998, UK nuclear policies have been changed. Nuclear use criteria, doctrines and policies have been moving away from the UK's statement on security assurances in April 1995, as enshrined in UN Security Council resolution 984 (1995), as well as other commitments on nuclear weapons and disarmament that are recognised as a condition for the NPT's extension beyond 1995.
87. Notwithstanding government expressions of compliance with the NPT and International Court of Justice (ICJ) Advisory Opinion of 8 July 1996 on the use and threat of use of nuclear weapons⁵⁸, UK nuclear policies do not meet the requirements set out by NPT States, the UN Security Council and the International Court in 1995-96.
88. Judge Mohammed Bedjaoui, who was President of the ICJ in 1994-97, referred to the UK when he described arguments from nuclear-armed States that international humanitarian law (IHL) would not necessarily be breached by the use of imagined future types of nuclear weapons posited as "low-yield nuclear weapons", "clean weapons", "reduced-effect weapons", and "tactical weapons" that may be "capable of

discrimination and, in particular, able to strike combatants while sparing non-combatants".⁵⁹ In a keynote address at an NPT event in 2008, Judge Bedjaoui noted that these speculations were mistakenly treated as elements of fact, and stated that "the Court should not have credited such reports, in particular because it had not received any evidence to prove the existence of nuclear weapons that emit no radiation and have no prolonged effects in space and time."⁶⁰

89. Judge Bedjaoui concluded that the Court had been mistakenly swayed by the argument about imaginary nuclear-type weapons or uses that – even if they had existed – would not have met the Court's definition of a nuclear weapon, being "rather some new and wholly other type of classical or conventional weapon, lying beyond the "nuclear threshold".⁶¹
90. Judge Bedjaoui subsequently argued: "In accordance with evidence heard by the Court, it is clear that an explosion caused by the detonation of just one 100 kt warhead would release powerful and prolonged ionising radiation, which could not be contained in space or time, and which would harmfully affect civilians as well as combatants, neutral as well as belligerent states, and future generations as well as people targeted in the present time. In view of these extraordinarily powerful characteristics and effects, any use of such a warhead would contravene international and humanitarian laws and precepts. In other words, even in an extreme circumstance of self-defence, in which the very survival of a State would be at stake, the use of a 100 kt nuclear warhead—regardless of whether it was targeted to land accurately on or above a military target—would always fail the tests of controllability, discrimination, civilian immunity, and neutral rights and would thus be unlawful."⁶²
91. Applying this revised understanding to the ICJ's deliberations, Judge Bedjaoui wrote: "the use of even a single [Trident] warhead in *any* circumstance, whether a first or second use and whether intended to be targeted against civilian populations or military objectives, would inevitably violate the prohibitions on the infliction of unnecessary suffering and indiscriminate harm as well as the rule of proportionality including with respect to the environment. In my opinion, such a system deployed and ready for action would be unlawful."⁶³

General Effects of Nuclear Weapon Detonations

Immediate effects

92. Assessments of the health and environmental effects and impacts of nuclear bomb detonations are drawn from extensive data collected from the two uses of nuclear weapons on Hiroshima and Nagasaki in August 1945 and over 2,000 fission and thermonuclear (H-bomb) tests conducted over the past 71 years by eight of the nine nuclear-armed states.⁶⁴
93. The uranium atomic bomb used on Hiroshima was around 12.5 kt and the plutonium bomb dropped on Nagasaki was around 20 kt. These bombs were large and crude, and their explosive power was relatively small. UK warheads are thermonuclear (also known as hydrogen or H bombs), which means they use a primary [nuclear fission](#) reaction involving both highly-enriched uranium (HEU) and plutonium to compress and ignite a secondary [nuclear fusion](#) reaction, using plutonium and hydrogen [isotopes](#), with radioactive tritium gas used to boost the explosion even more. This design ensures that much smaller bombs than the ones used on Hiroshima and Nagasaki – small enough to fit on the nose of the Trident missiles – will detonate with far greater explosive power.
94. When a thermonuclear bomb is detonated the initial immediate effects are a white-hot flash, fireball with intense heat and a percussive blast from the explosion.
95. The nuclear explosion also emits a massive electro-magnetic pulse (EMP). Not of significance in 1945, the EMP would be devastating in 2016, as it would disrupt and disable electronic equipment across a wide area of hundreds of miles, paralysing the emergency services, hospitals, transport and medical services, communications and financial services. This would cause chaos and severely hamper efforts to provide humanitarian assistance and relief for survivors.
96. The intense flash causes retinal burns over several kilometres. Depending on the specific circumstances, these can result in permanent or temporary blindness.

97. According to the [International Committee of the Red Cross \(ICRC\)](#), the heat generated by the Hiroshima bomb reached over 7,000 degrees Celsius at the hypocentre. It incinerated everything in a 3km radius, and ignited fires which combined into a massive wind-driven firestorm that consumed everything in its path. Firestorms also suck up oxygen, so that even people who manage to get to underground shelters die of asphyxiation.⁶⁵
98. The blast pressure waves travel at supersonic speeds. They cause buildings to collapse, and people and debris to fly through the air at high speed. Injuries include torn limbs and compound fractures, ruptured organs and penetrating wounds. Permanent or temporary deafness may be caused by ruptured eardrums. In Hiroshima and Nagasaki many deaths were caused by people who were crushed and trapped inside collapsed buildings being burned alive as they were unable to escape the ensuing fires. The ICRC reported that 13 sq km were utterly destroyed by the heat, blast and fires created by the 12.5 kt uranium bomb, and 6.7 sq km were completely destroyed by the 20 kt plutonium bomb used on Nagasaki. Around 140,000 people in Hiroshima died immediately or due to direct injuries by the end of 1945. In the same period, 70,000 people were killed in Nagasaki by the immediate and short-term impacts of the atomic bomb. Relative population densities and the shielding of Nagasaki's city centre by mountains accounts for the disparity in immediate fatalities.⁶⁶
99. According to the ICRC and Japanese sources, a further 170,000 people died over the next five years (by 1950), due primarily to radiation sickness or other bomb-related injuries. Several thousand committed suicide.⁶⁷

Second order effects – radioactive contamination

100. The second order of effects arising from radiation contamination create health and environmental damage over a period of a few days to tens of thousands of years.
101. People close to the explosion who manage to survive the blast, heat and fires are likely to suffer severe exposure to the radioactive isotopes generated by the nuclear detonation and may fall sick and die within days. People who are far enough away to

avoid serious harm from the blast, heat and fires may nonetheless be contaminated by radiation from the bomb. Carried into the atmosphere in the characteristic mushroom cloud, heavier particles of radioactive material from the bombed area will fall to the ground in a plume depending on wind direction and strength, and may also be deposited as "black rain".⁶⁸

102. There are different types of ionising radiation that work in different ways on the human body. Gamma rays are emitted by the explosion and can penetrate walls and the human body causing deep burns and organ damage. Alpha particles are most dangerous if they are breathed in or ingested, as they lodge in bodily organs and cause cancer in later years. Radioactive particles can adhere to surfaces and debris from the explosion that is lofted into the air. As plutonium has a half-life of 24,000 years, plutonium dust from a nuclear explosion can continue to contaminate a wide area and for longer than human history. Anyone eating or breathing in even microscopic particles of alpha-emitting plutonium faces heightened risks of cancer.
103. Radiation effects vary with exposure and conditions, including an individual's health, gender, age, distance from the bomb, and type of exposure.
104. People who receive high doses of radiation (principally gamma) are likely to die within days from radiation burns, organ failure and the collapse of their nervous systems.
105. Lower dose levels may cause vomiting, severe nausea and diarrhoea, leading to death or organ failure from dehydration.
106. Some people may not be aware they have been contaminated until they begin losing their hair. Radiation's destruction to the body's capacity to form new blood cells manifests itself in internal bleeding from organs that may not be obvious at first, though an early symptom can be bleeding gums.⁶⁹
107. Based on health studies of Hibakusha from Hiroshima and Nagasaki and people exposed to radiation during the decades of nuclear testing, many people show no overt symptoms of exposure until they fall sick with cancers such as leukaemia, myeloma and thyroid cancer, which are particularly indicative of radiation exposure.⁷⁰

108. Studies show that the impacts of radiation exposure are age-related – the younger someone is at the time of exposure, the more likely they are to suffer a heightened risk of cancers of all kinds.⁷¹
109. The impacts of radiation exposure are also gender-related. Women who are exposed to ionising radiation – whether as adults or girls of any age – suffer heightened risks of fertility and birth problems, including stillbirths and foetal deformity. [Pacific Women](#) exposed to fallout from US, British and French nuclear testing have spoken of giving birth to "[jelly-fish babies](#)" that died after a few minutes or hours.⁷²
110. Studies also indicate that radiation exposure increases the risk of illness not only across a range of cancers, but by lowering immune system defences.⁷³
111. Even in the event of a single nuclear detonation, which could be by accident, terrorist attack or militarily targeted weapon, the [ICRC](#) and a series of intergovernmental conferences in [Oslo, Mexico \(Nayarit\) and Vienna \(2013-14\)](#) heard evidence leading to the conclusion that it would be impossible for any national or international service to provide adequate humanitarian response and assistance, due not only to the massive destruction and large number of casualties, but also the effects of EMP on communications, medical and transport services, as well as the need to protect incoming emergency responders from becoming radioactively contaminated, to avoid putting their health in danger.⁷⁴
112. Longer term impacts on economic, social and political development must also be taken into account.

Third order impacts - Consequences for Development, Security and Human Rights

113. While there is growing research on the developmental impacts, the most authoritative is this speech from UN Secretary-General [Kofi Annan's speech](#) about nuclear dangers and the responsibility of governments and citizens, given on 2 May 2005, at the Opening of the 2005 NPT Review Conference:

114. "I firmly believe that our generation can build a world of ever-expanding development, security and human rights - a world 'in larger freedom'. But I am equally aware that such a world could be put irrevocably beyond our reach by a nuclear catastrophe in one of our great cities. In the chaos and confusion of the immediate aftermath, there might be many questions. Was this an act of terrorism? Was it an act of aggression by a state? Was it an accident? These may not be equally probable, but all are possible. Imagine, just for a minute, what the consequences would be. Tens, if not hundreds, of thousands of people would perish in an instant, and many more would die from exposure to radiation.
115. The global impact would also be grave. The attention of world leaders would be riveted on this existential threat. Carefully nurtured collective security mechanisms could be discredited. Hard-won freedoms and human rights could be compromised.
116. The sharing of nuclear technology for peaceful uses could halt. Resources for development would likely dwindle. And world financial markets, trade and transportation could be hard hit, with major economic consequences. This could drive millions of people in poor countries into deeper deprivation and suffering.
117. As shock gave way to anger and despair, the leaders of every nation represented here at this conference - as well as those who are not here - would have to ask: How did it come to this? Is my conscience clear? Could I have done more to reduce the risk by strengthening the regime designed to do so?
118. In our interconnected world, a threat to one is a threat to all, and we all share responsibility for each other's security. If this is true of all threats, it is particularly true of the nuclear threat."⁷⁵

Longer term effects – climate disruption, 'nuclear winter' and global famine

119. In 2006, a year after UN Secretary-General Kofi Annan raised the UN's concerns about nuclear detonations in the post cold war era, scientists began to update the studies that had been undertaken in the 1970s and 1980s by US, Russian and European scientists into the climate freezing phenomenon arising from the use of multiple nuclear weapons, to which they had given the name "nuclear winter". These studies influenced both President Reagan and President Gorbachev to meet and negotiate nuclear arms reductions in the period 1985-90.⁷⁶
120. The [updated studies](#) demonstrated that a relatively small number of Hiroshima-sized nuclear bombs could cause abrupt lowering of planetary temperatures, extreme weather and disruption and 'nuclear winter' lasting a decade, with the consequence of worldwide agricultural collapse and a global famine that could kill up to 2 billion people, more than a quarter of today's world population. This effect has been given the name "[nuclear famine](#)".⁷⁷
121. The baseline for the study is the scenario of 100 Hiroshima-sized nuclear weapons used on cities in South Asia (chosen because of the growing arms race between India and Pakistan).⁷⁸
122. In fact, few nuclear weapons in today's arsenals are as small and crude as the Hiroshima bomb, and the population density of many cities in today's world is far higher than the population density of Hiroshima or Nagasaki.
123. The UK warheads assembled at Aldermaston have an explosive power that is 8 times greater than the Hiroshima bomb. If used on today's cities a single Trident nuclear weapon would have a much more devastating impact than the Hiroshima bomb.
124. According to the climate studies, nuclear winter would be created by a much smaller number of nuclear explosions than assumed in the 1980s. This devastating climate impact would be triggered because of the pulverised remains of nuclear bomb targets being lofted into the upper atmosphere as sooty clouds that would then circulate much of the Earth.⁷⁹

125. The heavier particles would deposit out over the first year or so due to wind and rain, and these would contaminate wherever they fall with radioactive poisons, blighting everything they touch. The lighter, microscopic particles would continue to circulate for many years, creating a dark mantle that reduces and blocks sunlight reaching people and lands across the planet. This would cause days to appear much darker, with abrupt temperature decreases across the Earth's surface averaging over 1-3 degrees Celsius. That may not sound like a lot, but taken as a whole, the abrupt temperature drop, freezing temperatures and loss of sunlight would cause extreme weather conditions and disrupt rainfall and agriculture.⁸⁰
126. The studies concluded that millions of people – [up to two billion](#) – would be put at risk of starvation if nuclear weapons amounting 100 Hiroshimas were to be detonated on urban areas. The impacts would spread far beyond the directly affected country or region. People who already experience food insecurity, for example in Africa, would be most at risk, but the impacts are likely to be global.⁸¹
127. To put this into perspective, one UK nuclear-submarine armed with the normal complement of eight Trident missiles and forty 100 kt warheads carries the equivalent of 320 Hiroshimas.

AWE Burghfield's role in manufacturing and maintaining UK nuclear weapons

128. The Atomic Weapons Establishment (AWE) Burghfield occupies a low-lying 225 acre site between the village of Burghfield and less than three miles from the town of Reading, close to the M4 motorway which runs between. Burghfield Brook flows through the site, which is prone to flooding. It is seven miles from AWE Aldermaston, but run under the same management.
129. Still formally owned by the British people through the Ministry of Defence, AWE Aldermaston and Burghfield are managed by a privately owned profit-making consortium, AWE plc and its subsidiary, AWE Management Ltd, (AWEML) comprising two US arms manufacturers – Lockheed Martin, which produces the Trident II missiles, and Jacobs Engineering – plus UK service company SERCO.

130. AWE Aldermaston is responsible for the major research, design, and manufacture of the nuclear component of the UK's Trident warheads, as well as monitoring and verification projects in conjunction with nuclear disarmament obligations. In addition, AWE Aldermaston conducted a small research project on verifying nuclear disarmament, in partnership with the Norwegian government.
131. AWE Burghfield is responsible for the assembly, disassembly and refurbishment of the warheads. Assembly involves putting together the various nuclear warhead components, including packing the plutonium pit with deuterium tritium gas, beryllium and chemical high explosives.
132. Some of these warhead components are subject to deterioration over a few years, including the chemical explosives and radioactive tritium gas, which decays due to its short half-life of 12.3 years. A certain number of warheads are therefore transported several times a year by public roads and motorways between Burghfield and the Royal Navy's Storage Depot in Coulport, Scotland, so that their components can be checked and, if necessary, replaced.
133. Nuclear materials, explosives, and special components are also regularly transported between Aldermaston and Burghfield.
134. This work currently takes place in assembly/disassembly facilities comprising circular cells buried under several metres of gravel, which rise above ground level in humps known as "Gravel Gerties".
135. In the event of an explosion, the roofs of the Gravel Gerties are intended to collapse, allowing the gravel to pour in, contain the worst effects of the explosion and prevent radioactive contamination from escaping. The technicians inside would be trapped and suffocated even if they had survived the explosion. [Nuclear safety and security experts](#) doubt whether the Gravel Gerties would successfully contain a large explosion or release of radioactivity.
136. Inside the Gravel Gerties, technicians take apart nuclear warheads, check and replace their components, and then put them back together again. This is a complex

and sensitive process that has to be conducted with great care to avoid accidentally detonating high explosives which are packed around the warhead's plutonium core.

137. According to the Reading-based [Nuclear Information Service](#), an assessment by the Health and Safety Executive's Nuclear Installations Inspectorate (NII) in 2006 concluded that the fifty year old warhead assembly/disassembly facilities at Burghfield “fail to meet modern standards”, and that “only the design, construction and operation of new facilities will ensure that modern safety standards are met”.
138. 'Project Mensa' was undertaken to build a new warhead handling facility, ostensibly costed at £734 million. Mensa's construction is behind schedule and over budget. One reason reported by the [Nuclear Information Service](#) is disagreements between AWE and the Office for Nuclear Regulation on the construction methods necessary to ensure that nuclear safety standards will be met. The MoD has refused to say how far behind schedule the project is or how much has been overspent. As a result the Gravel Gerties are still in operation, patched up and kept going, posing increasing risks that the myriad small mistakes and accidents could result in an overwhelming environmental disaster.
139. The Mensa construction site has a separate entrance that allows contractors with a lower level of security clearance and non-UK staff to work on the project.
140. According to [Nuclear Information Service](#), £7 billion has been earmarked for construction work at Burghfield and Aldermaston over a 25-year programme.
141. In 2015 the Office for Nuclear Regulation gave AWE permission to “implement the enabling works associated with the existing warhead service life modifications at the AWE Burghfield Assembly Facility”. This is believed to be the first stage in production of the modified UK Trident Mark 4A warhead, a programme intended to extend and upgrade the destructive capability of Trident. This work will be undertaken in the Gravel Gerties until 'Project Mensa' is complete.
142. In addition to Project Mensa, AWE is undergoing major construction work to ensure its ability to manufacture and maintain nuclear weapons for the long-term future.

143. Burghfield's role and construction are essential for developing and manufacturing a new UK warhead if the decision to renew Trident goes ahead.
144. Though the decision on renewal taken on 18 July was directly connected to signing contracts to build 4 new nuclear submarines, in practice public money has been spent and agreements and contracts signed with the purpose of equipping the UK also to design and manufacture new warheads in conjunction with the Trident renewal decision. Though some MPs have called for debates on whether to upgrade UK warheads, no further undertaking has been made for parliamentary scrutiny or debate on these further steps in renewing Trident.
145. On the contrary, the new generation of US Trident missiles is currently under development in the United States, and UK governments since at least 2004 have already spent billions of pounds on refurbishing facilities at AWE Aldermaston and Burghfield with the purpose of designing, manufacturing and assembling new warheads for an upgraded Trident nuclear weapon system.
146. Two new buildings have recently opened at Burghfield – the 'Leo' small components manufacturing facility, and the 'Phoenix' conventional manufacturing facility.
147. AWE Burghfield is also one of five candidate sites for the storage of radioactive waste from decommissioned nuclear submarines. If a decision is made to store the waste at Burghfield it will be necessary to construct appropriate facilities for secure storage. Such a decision would greatly increase the road transports of radioactive waste from the Rosyth and/or Devonport naval dockyards to Burghfield, increasing risks of accident and contamination to civilians using the roads and in the areas surrounding AWE Burghfield.

Flooding and other recent safety problems at AWE Burghfield

148. Following a periodic review of safety conducted for the NII in 2002, over 1000 safety shortfalls were identified at AWE Burghfield.⁸²

149. These included concerns about the structural safety of processing buildings, the condition of cranes used for nuclear lifts, and problems relating to glove boxes, fire dampers, and cabling. AWE's progress in fixing these problems was regarded as "unacceptably slow" by NII inspectors. The shortfalls were originally due to be dealt with by April 2006, but the deadline was postponed to April 2007, and then postponed again to September 2007.
150. Following AWE's failure to meet the September deadline NII required AWE to halt nuclear work at Burghfield until the necessary fixes had been completed, only allowing the site to recommence normal operation at the end of April 2008. The ban on operations at Burghfield is believed to be the first time that the MoD had ever been compelled to stop working on its nuclear weapons programme.
151. In December 2013 the Mirror newspaper reported that a large number of MoD police officers stationed at Burghfield were being investigated for neglect of duty. The newspaper reported that officers had not conducted security patrols, had been sleeping on the job, and had failed to complete other key duties. At least seven officers resigned during the course of the investigation and in total 44 officers have been investigated for misconduct.
152. In December 2009 the alkalinity level in a discharge from a construction area at AWE Burghfield into the Burghfield Brook exceeded the level permitted by the Environment Agency.
153. In February 2010 another sample from the discharge exceeded permitted limits. AWE was issued with a formal warning letter by the Environment Agency following the incidents.
154. In November 2013 a discharge from an outfall at Burghfield was found to be contaminated with sand, and breached permit limits.
155. In 2014, the Environment Agency formally notified AWE that it had breached a condition of its environmental permit, and that this is an offence under UK law. The Agency provided the company with advice on how to comply with their legal obligations in this regard. In the same year, the Office for Nuclear Regulation (ONR)

also announced that it was considering enforcement action against AWE for failing to comply with instructions for managing its growing backlog of radioactive waste.

156. In its 2015-16 report the ONR announced that both AWE Aldermaston and Burghfield had failed to improve nuclear safety performance and would require special measures and 'enhanced regulatory attention'. This was the fourth year running for Aldermaston and represented a decline in Safety standards at Aldermaston, which had only been removed from the ONR's regime of special measures the previous year. AWE Burghfield has a record of flood problems, creating significant risks for the warhead disassembly and waste storage activities, which for other safety reasons need to be underground.

157. In October 2000 several buildings within the nuclear licensed site area were flooded. As noted in the [Nuclear Information Service](#) reporting of these events, flooding in some buildings was described as “serious” and waters reached a foot deep.

158. In July 2007 serious flooding came close to overwhelming buildings where nuclear warheads are assembled. Eighty-four buildings were flooded, some to a depth of two feet. Radioactive materials had to be recovered from two flooded buildings, posing substantial challenges in recovering the material and decontaminating the buildings. After the incident all live nuclear work at Burghfield was halted by NII for nine months because emergency systems had been so seriously compromised by the flooding and because essential safety improvement work had been delayed.

159. The cost of damage caused by the flooding reached £5 million. This was paid for by the MoD using taxpayers' money, rather than from AWE plc's profits, as confirmed by Peter Luff, Defence Minister 2010-12, in reply to a Parliamentary Question by Caroline Lucas MP in 2010: "The cost incurred by the Ministry of Defence as a result of the flood at the Atomic Weapons Establishment (AWE) in 2007 was some £5 million. The Ministry of Defence Police based at Burghfield also incurred flood-related costs totalling £110,000 which did not form part of the AWE Management Ltd claim. A small claim from an AWE sub-contractor has still to be resolved. The £5 million flood-related costs described above were incurred by AWE Management Ltd

and their operating company, AWE plc, and were the costs claimed from the Department under non-nuclear indemnity. No costs were incurred by commercial insurers as a result of the flood, as the non-nuclear indemnity is in place to cover such events."⁸³

160. Following the 2007 flooding AWE installed pumps, portable flood defences, and other equipment to tackle any future incidents. These were deployed 13 times over the period July 2007 – January 2015 following weather warnings, and also when the site was closed over holiday periods. Construction work has now started on developing a flood alleviation scheme, which will include increasing the capacity of the Burghfield Brook channel in AWE Burghfield and construction of a flood retention pond to the south of the site. The Office for Nuclear Regulation (ONR) Annual Report and Accounts for 2015/16 (HC 112) referred to AWE's continued use of ageing facilities and a number of safety significant legacy issues that were not being resolved.

161. Nuclear engineer and consultant [John Large analysed the off-site emergency planning arrangements](#) in place for AWE Aldermaston and Burghfield for NIS, with particular focus on the risks of radiation release arising from explosions or fires. Documenting the inadequate plans and emergency response capabilities at AWE and in the local area, Large critiques the ONR's assessments and castigates the "pervading sense of 'muddling through'". Noting that when a serious fire broke out in August 2010 in the Aldermaston explosives area, local fire-fighters were held back from tackling the emergency because the AWE "did not have a sufficient number of personal dosimeters on the Aldermaston site to equip each fire-fighter", Large's report exposes the poor level of preparedness and capabilities to respond even to relatively small scale accidents at these nuclear sites.⁸⁴

162. Safety problems and incidents are often not reported at the time, but may be revealed through Parliamentary Questions or Freedom of Information requests in accordance with FOI law, though as noted above, "national security" justifications are often evoked to prevent public or parliamentary scrutiny or even cover up mistakes or

embarrassing and dangerous incidents even when local and public security would be enhanced by greater transparency.

Effects and impacts if Trident is fired or a warhead is accidentally detonated

163. In 2013 a [study into the detonation of a single 100 kt warhead on Manchester](#) was conducted by Article 36, with support from Scientists for Global Responsibility and others. Such a detonation could occur from a nuclear attack or the accidental detonation of a warhead, for example a serious accident and fire affecting the nuclear warhead convoys that use public roads between Burghfield and the Scottish nuclear depot at Coulport.⁸⁵
164. The study found that such a single detonation would cause around 81,000 immediate deaths, leaving 212,000 injured. It would destroy vital infrastructure, hospitals, housing and commercial buildings. The capacity of medical and local emergency services would be severely degraded. In the case of a weapon exploding at ground level, radioactive fallout would inflict further serious health impacts and hamper efforts to help the survivors, which would likely include large numbers of injured, homeless and displaced people. Even outside the zones of direct damage, systems of communication and transport would be left inoperable, while survivors and others fleeing the disaster zone would overwhelm services in the rest of the country.⁸⁶
165. Even with the limited case study of a single 100 kt nuclear detonation on Manchester, medical and blood transfusion services would be quickly overwhelmed, with the added complexity of radiation-induced problems for survivors and responders, ranging from acute sickness to immune suppression and impaired healing. As a consequence, many “short-term survivors” would succumb, unable to receive the help that could save their lives. In the event of multiple detonations, such as a regional nuclear war, there would be massive disruptions to transport, trade, computing and communications services that would severely restrict the ability of outside providers to assist in delivering blood and other vital medical services to afflicted areas.⁸⁷

166. Two other recent studies analysed the environmental impact of firing the nuclear weapons normally carried by one of the UK's nuclear submarines in accordance with the policy of 'continuous at-sea deterrence' (CASD). The firepower is assumed to be 8 Trident missiles equipped with forty 100kt MIRVed warheads.
167. Despite the end of the Cold War, UK nuclear forces continue to be configured in accordance with doctrines that include the "Moscow criterion" developed during the Cold War, even though the formal UK position since 2000 is that the weapons are not kept in an operationally targetted mode. John Ainslie's detailed report *'If Britain fired Trident'* therefore based its calculations on the hypothetical scenario of all 40 warheads being launched against targets in and around Moscow. This would cause 5.4 million direct deaths during the first few months, principally from blast, fire and acute radiation poisoning. Residential tower blocks would be shattered, and extensive fires and firestorms would incinerate schools, hospitals and homes across a wide area. Radioactive fallout would affect populations at greater distances, depending on weather and wind conditions. Moscow would be effectively destroyed, its communications, transport and infrastructure crippled, and its hospitals wrecked or incapacitated.⁸⁸
168. Taking the Moscow criterion in the UK's deterrence doctrine one step further with a hypothetical scenario in which Trident was fired at Moscow and five other major Russian cities, Scientists for Global Responsibility (SGR) concluded that this would cause the direct deaths of 10 million people and put many more at risk from injuries and radiation poisoning. Citing recent research on the environmental and agricultural impacts of a hundred Hiroshima-sized bombs (estimated at 1.2-1.5 million tons (MT) aggregate) this 2013 SGR study premised that one Trident-armed submarine could deliver an explosive power of around 4 MT.⁸⁹
169. SGR's 2013 publication was an update of its earlier analysis of the wider climatic impacts and humanitarian problems if the nuclear weapons on one UK submarine were launched. The report analyses how detonating nuclear weapons on major cities – whether in Russia, China, the Indian sub-continent or anywhere else – would

pulverise buildings, create huge fires and loft massive quantities of sooty smoke into the atmosphere, which would circulate globally, reducing heat and light from the sun for several years.⁹⁰

170. As well as killing millions instantly, firing Trident could cause devastating climate disruption that would adversely affect agriculture, natural ecosystems and the food resources of billions of people around the world. The human suffering would be compounded by severely impaired medical and emergency services. Building on the Nuclear Famine study by US physician Ira Helfand and looking at the blowback and associated impacts on the British Isles, SGR concluded that “deploying a weapon capable of devastating the world’s climate system is a grossly disproportionate, and perhaps even suicidal, response to uncertain future security concerns”.⁹¹

171. As long as the UK manufactures, maintains and deploys nuclear weapons, the MoD has found it necessary to undertake the road transport of thermonuclear warheads on public roads and motorways between AWE Burghfield and the nuclear warhead storage depot at Coulport, north-west of Glasgow. These convoys are directly related to AWE Burghfield's role in assembling and disassembling the warheads to check for defects and replace ageing or decaying components.

172. The MoD says the convoys are safe, but there are good reasons to be concerned about the dangers. According to a [recent report](#), "emergency exercises run by the MoD imagine disaster scenarios in which horrific multiple crashes lead to fires, explosions and the spread of radioactive contamination over cities. Post-mortems of seven exercises reveal that the MoD and the emergency services would have serious difficulties dealing with such disasters". In response to requests under freedom of information law, the MoD provided information on 8 significant accidents between 1960 and 1991, and over 180 safety incidents between 2000 and 2016. In summary, Edwards' report notes that the nuclear warhead convoy has "crashed, broken down and got lost. Its brakes have failed, it has leaked fuel and suffered a range of other mechanical failures. Bad luck, poor weather, human error and computer software glitches have all been to blame". The MoD is quoted in the report as saying that the

risks are “tolerable when balanced against the strategic imperative to move nuclear weapons”.⁹²

SUMMARY and CONCLUSIONS

173. In 2016 the UK government boycotted a UN Open-Ended Working Group convened by the UN General Assembly to consider multilateral nuclear disarmament, and instead took forward the decision to renew the submarines to carry a new-generation Trident nuclear weapons system beyond 2060. The UN talks were open to all UN Member States and relevant international organisations and civil society experts.

174. Trident renewal, begun in 2006 and endorsed on 18 July 2016 with a majority parliamentary decision to sign contracts for 4 new SSBN submarines, is projected to deploy a similar sized and more sophisticated military nuclear explosive capability. It is not clear from the 2015 SDSR whether a parliamentary decision is needed on a replacement warhead, but the government highlighted nuclear cooperation with the United States and France and specified that AWE would sustain the ability to develop a replacement warhead if decided.

175. After considering the OEWG findings that made clear that any accidental or intentional detonation of a nuclear warhead, such as the Trident warheads manufactured and assembled at AWE Aldermaston and Burghfield, would have catastrophic humanitarian and environmental impacts, that these impacts would not be confined to a single nation, but would be transboundary and transregional, with global health, environmental, development and humanitarian consequences. The OEWG also discussed concerns that modernisation and renewal of nuclear weapons programmes since 2000 undermined the NPT, and that the only effective way to ensure that nuclear weapons will not be used is to prohibit and eliminate them.

176. In October 2016, 123 UN Member States voted to convene a multilateral UN conference in 2017 "to negotiate a legally binding treaty to prohibit nuclear weapons, leading towards their total

elimination". The UK was among 38 States who voted against this resolution.⁹³

177. While boycotting the multilateral disarmament process being convened under UN auspices, the UK Government signed further contracts in 2016 to build a new generation of four nuclear-powered 'Dreadnought' submarines to carry an updated version of Trident missiles with the intention that these will be armed with an updated version of UK warheads to be manufactured and assembled at AWE Burghfield.
178. Without the role played by AWE Burghfield, it would not be possible to manufacture, deploy, modernise or use British nuclear weapons.
179. The manufacturing and assembly work required at AWE Burghfield involves highly dangerous procedures, which are still carried out in ageing facilities that are prone to flooding. Notwithstanding investments of billions of pounds already spent on refurbishing nuclear warhead manufacture and assembly facilities at AWE Aldermaston and Burghfield, with billions of pounds more earmarked, safety problems are still causing concern.
180. The warheads for Trident are transported several times a year on public roads and motorways from Burghfield to Scotland, where they are either stored in bunkers at RNAD Coulport or attached to Trident missiles on board nuclear submarines, from where they are deployed on "continuous at-sea deterrent" patrols.
181. There have been small but significant changes in wording on nuclear use and security assurances between the 1998, 2010 and 2015 defence reviews and statements delivered at UN and NPT Conferences. Notwithstanding publicly available documents, the MoD maintains secrecy about most if not all aspects of the UK's nuclear operations and targeting, which are coordinated with the United States, France and NATO. The 'national security' justification for avoiding democratic transparency and scrutiny has too often been extended to conceal dangerous incidents or accidents involving nuclear weapons, materials, delivery vehicles and facilities such as AWE Burghfield.

182. As well as authorised and intentional uses, the risks of accidental or unauthorised detonations of nuclear warheads are reported to have increased rather than diminished since 1998. The MoD has admitted that the nuclear warhead convoys to and from AWE Burghfield have been involved in 8 serious accidents and 180 safety incidents. According to the MoD, the risks are “tolerable when balanced against the strategic imperative to move nuclear weapons”. The recent *'Nukes of Hazard'* report notes that the nuclear warhead convoy has "crashed, broken down and got lost. Its brakes have failed, it has leaked fuel and suffered a range of other mechanical failures. Bad luck, poor weather, human error and computer software glitches have all been to blame".⁹⁴ Regulatory bodies have repeatedly raised safety concerns about AWE management and safety at Burghfield.

183. While the UK has made or associated itself with a variety of positive statements and declarations on the humanitarian consequences of nuclear weapons use, the need to comply with international humanitarian law, and the objective of a world free of nuclear weapons, available information indicates that the UK subscribes to the 'counter-value' targeting of cities, transport links and communications, counter-force targeting of military forces, facilities and weapons capabilities. In addition to targeting any facilities that might enable an adversary to retaliate, such as command and control headquarters (parliamentary, governmental or military), and retention of policies that include pre-emptive first use, it can be inferred from available sources that nuclear targeting and current policies permit nuclear retaliation and punishment (of aggressors) as well as purposes defined as "deterrent", including warning shots "across the bows" of a potential aggressor.⁹⁵

184. When combined with available information from the United States relevant to UK nuclear targeting and operations, it can be concluded that from 1998 to the present, the UK has put growing emphasis on sub-strategic and war-fighting roles for Trident, increasing the risks of nuclear war.

185. Notwithstanding government expressions of compliance with the NPT and International Court of Justice (ICJ) Advisory Opinion of 8 July 1996 on the use and threat of use of nuclear weapons, UK nuclear policies do not meet the requirements set

out by NPT States, the UN Security Council and the ICJ in 1995-96, or the statement adopted by the UK and other NPT States Parties at the 2010 NPT Review Conference, which reaffirmed the need for all States at all times to comply with applicable international law, including international humanitarian law."

186. UK nuclear weapons and policies are such that it would be impossible for Trident missiles armed with the warheads manufactured by AWE Burghfield to be used in any way that would be capable of discriminating between combatants and non-combatants.
187. Recent studies have demonstrated that the detonation of just one 100 kt warhead would cause a humanitarian catastrophe, regardless of whether its cause was accidental or intentional.
188. UK-based studies show that if the nuclear weapons carried on just one Trident-armed submarine were fired at six cities in Russia, they could cause up to 10 million direct deaths, widespread radioactive contamination and, if their targets are five or more urban areas, they could create dust clouds that would encircle the earth for several years, creating climate chaos, agricultural collapse and 'nuclear winter'. These climate effects are likely to be prolonged for several years. If so, global famine could put up to 2 billion people at risk of dying from starvation.

Dr Rebecca Johnson, 28 November 2016

For all criminal cases in England & Wales under CrPR this Declaration should be inserted into the Expert's Report between the end of the report and the Expert's signature.

EXPERT'S DECLARATION (Criminal Cases)

This Declaration should be inserted between the end of The Report and the Expert's signature.

DR. REBECCA JOHNSON

I (Insert Full Name) DECLARE THAT:

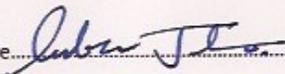
- 1 I understand that my duty is to help the court to achieve the overriding objective by giving independent assistance by way of objective, unbiased opinion on matters within my expertise, both in preparing reports and giving oral evidence. I understand that this duty overrides any obligation to the party by whom I am engaged or the person who has paid or is liable to pay me. I confirm that I have complied with and will continue to comply with that duty.
- 2 I confirm that I have not entered into any arrangement where the amount or payment of my fees is in any way dependent on the outcome of the case.
- 3 I know of no conflict of interest of any kind, other than any which I have disclosed in my report.
- 4 I do not consider that any interest which I have disclosed affects my suitability as an expert witness on any issues on which I have given evidence.
- 5 I will advise the party by whom I am instructed if, between the date of my report and the trial, there is any change in circumstances which affect my answers to points 3 and 4 above.
- 6 I have shown the sources of all information I have used.
- 7 I have exercised reasonable care and skill in order to be accurate and complete in preparing this report.
- 8 I have endeavoured to include in my report those matters, of which I have knowledge or of which I have been made aware, that might adversely affect the validity of my opinion. I have clearly stated any qualifications to my opinion.
- 9 I have not, without forming an independent view, included or excluded anything which has been suggested to me by others including my instructing lawyers.

This version applies from 1st October 2015

- 10 I will notify those instructing me immediately and confirm in writing if for any reason my existing report requires any correction or qualification.
- 11 I understand that:
- 11.1 my report will form the evidence to be given under oath or affirmation;
 - 11.2 the court may at any stage direct a discussion to take place between experts;
 - 11.3 the court may direct that, following a discussion between the experts, a statement should be prepared showing those issues which are agreed and those issues which are not agreed, together with the reasons;
 - 11.4 I may be required to attend court to be cross-examined on my report by a cross-examiner assisted by an expert.
 - 11.5 I am likely to be the subject of public adverse criticism by the judge if the Court concludes that I have not taken reasonable care in trying to meet the standards set out above.
- 12 I have read Part 33 of the Criminal Procedure rules and I have complied with its requirements.
- 13 I confirm that I have acted in accordance with the Code of Practice for Experts.
- 14 [For Experts instructed by the Prosecution only] I confirm that I have read guidance contained in a booklet known as Disclosure: Experts' Evidence and Unused Material which details my role and documents my responsibilities, in relation to revelation as an expert witness. I have followed the guidance and recognise the continuing nature of my responsibilities of revelation. In accordance with my duties of revelation, as documented in the guidance booklet, I confirm that:
- 14.1 I have complied with my duties to record, retain and reveal material in accordance with the Criminal Procedure and Investigations Act 1996, as amended;
 - 14.2 I have compiled an Index of all material. I will ensure that the Index is updated in the event I am provided with or generate additional material;
 - 14.3 in the event my opinion changes on any material issue, I will inform the investigating officer, as soon as reasonably practicable and give reasons.

STATEMENT OF TRUTH

I confirm that the contents of this report are true to the best of my knowledge and belief and that I make this report knowing that, if it is tendered in evidence, I would be liable to prosecution if I have wilfully stated anything which I know to be false or that I do not believe to be true.

Signature  Date 28th September 2016

The Academy of Experts
3 Gray's Inn Square
London WC1R 5AH
DX283 London, Chancery Lane
Tel: 020 7430 0933 Facsimile: 020 7430 0666
e-mail: admin@academy-experts.org

- 1 Agreement between the Government of the United States of America and the Government of the United Kingdom of Great Britain and Northern Ireland for Cooperation on the uses of Atomic Energy for Mutual Defense Purposes, signed 3 July, 1958, US Legal Library files, accessed from the website of the Nuclear Threat Initiative (NTI), 22 September 2016, http://www.nti.org/media/pdfs/56_4.pdf?_=1316627913
- 2 Foreign and Commonwealth Office, 16 October 2014, Amendment to the Agreement Cooperation on the uses of Atomic Energy for Mutual Defense Purposes, accessed from UK Government website on 22 September 2016, <https://www.gov.uk/government/publications/cs-ukus-amendment-to-the-agreement-for-cooperation-on-the-uses-of-atomic-energy-for-mutual-defense-purposes>
- 3 'David Cameron: Trident 'the best insurance policy you can have'', Daily Telegraph, April 4, 2013.
- 4 See for example, the title of the 2006 Government White Paper 'The Future of the United Kingdom's Nuclear Deterrent', the subsequent report of the House of Commons Defence Committee 'The Future of the UK's Strategic Nuclear Deterrent', which critiqued the White Paper, references to Trident in the 2010 and 2015 Strategic Defence and Security Reviews. A more recent example is the Conservative government motion based on its 2015 Strategic Security and Defence Review (SDSR), for renewing "the UK's independent minimum credible nuclear deterrent, based on a Continuous at Sea Deterrence posture", as debated in the House of Commons on 18 July 2016, see Debate on motion that 'This House supports the Government's assessment in the 2015 National Security Strategy and Strategic Defence and Security Review...' opened by Prime Minister Theresa May MP, Hansard vol 613, 18 July 2016.
- 5 See Acronym Institute for Disarmament Diplomacy working paper on 'Security and humanitarian implications of relying on nuclear weapons for deterrence, and effective legal alternatives', published by the UN Open-ended Working Group on Multilateral Nuclear Disarmament, A/AC.286/NGO/22/Rev.1.
- 6 UK Declaration on Security Assurances, Made on 6 April 1995 by the Permanent Representative of the United Kingdom to the Conference on Disarmament, Sir Michael Weston. ; and UK Statement to the NPT Review and Extension Conference, 21 April, 1995. Summarised and referenced in Rebecca Johnson, Indefinite Extension of the Non-Proliferation Treaty: Risks and Reckonings: Report of the 1995 NPT Review and Extension Conference, New York, 17 April to 12 May 1995, Acronym Report No. 7, London 1995.
- 7 UK Declaration on Security Assurances, Made on 6 April 1995 by the Permanent Representative of the United Kingdom to the Conference on Disarmament, Sir Michael Weston. ; and UK Statement to the NPT Review and Extension Conference, 21 April, 1995. Summarised and referenced in Rebecca Johnson, Indefinite Extension of the Non-Proliferation Treaty: Risks and Reckonings: Report of the 1995 NPT Review and Extension Conference, New York, 17 April to 12 May 1995, Acronym Report No. 7, London 1995.
- 8 Rebecca Johnson, Indefinite Extension of the Non-Proliferation Treaty: Risks and Reckonings: Report of the 1995 NPT Review and Extension Conference, New York, 17 April to 12 May 1995, Acronym Report No. 7, London 1995.
- 9 Jayantha Dhanapala, with Randy Rydell, Multilateral Diplomacy and the NPT: an Insider's View, UNIDIR, United Nations, 2005. See also Rebecca Johnson, John Borrie and Tim Caughley, Decline or Transform: Nuclear disarmament and security beyond the NPT review process, Acronym Institute for Disarmament Diplomacy, London, April 2012
- 10 The 1992-97 Conservative Government had reduced the maximum ceiling for the number of warheads carried by each Trident submarine from 128 to 96. In practice, the Labour Government subsequently revealed, Trident submarines were usually deployed with around 60 warheads. According to information elicited by Julian Lewis, MP, from a series of Parliamentary Questions he asked of the Government "...the typical number of warheads deployed on Trident submarines from the moment of their inception in service was 60. Sometimes it was slightly fewer, sometimes it may have been a little more, but it was never more than 65." Debate on Royal Navy, House of Commons, *Hansard*, November 1998, Col.551.
- 11 1998 Strategic Defence Review, HMG Cm3999, 8 July 1998.

- 12 1998 Strategic Defence Review, HMG Cm3999, 8 July 1998.
- 13 1998 Strategic Defence Review, HMG Cm3999, 8 July 1998.
- 14 Sir Michael Quinlan, oral evidence to the House of Commons Defence Committee, HC 986 Ev 2, quoted in Rebecca Johnson, Nicola Butler and Stephen Pullinger, *Worse than Irrelevant: British nuclear weapons in the 21st century*, Acronym Institute, London 2006.
- 15 *Worse than Irrelevant: British nuclear weapons in the 21st century*, *op. cit.* pp 32-33.
- 16 Sir Michael Quinlan, oral evidence to the House of Commons Defence Committee, HC 986 Ev 2, quoted in Rebecca Johnson, Nicola Butler and Stephen Pullinger, *Worse than Irrelevant: British nuclear weapons in the 21st century*, Acronym Institute, London 2006.
- 17 Malcolm Rifkind, *UK Defence Strategy: A Continuing Role for Nuclear Weapons?* Speech to the Centre for Defence Studies, London, November 16, 1993. See also Rebecca Johnson, *British Perspectives on the Future of Nuclear Weapons*, Henry L Stimson Center, Washington DC, January 1998.
- 18 1998 Strategic Defence Review, HMG Cm3999, 8 July 1998.
- 19 House of Commons Defence Committee, "The Strategic Defence Review", Volume III – Minutes of Evidence and Memoranda, September 10, 1998, referenced in Rebecca Johnson, Nicola Butler and Stephen Pullinger, *Worse than Irrelevant: British nuclear weapons in the 21st century*, Acronym Institute, London 2006, p 15.
- 20 1998 Strategic Defence Review, HMG Cm3999, 8 July 1998.
- 21 Michael Quinlan, 'The Future of United Kingdom Nuclear Weapons: Shaping the Debate', *International Affairs*, 82:4 July 2006.
- 22 Michael Quinlan, 'The Future of United Kingdom Nuclear Weapons: Shaping the Debate', *International Affairs*, 82:4 July 2006.
- 23 See for example, US Joint Chiefs of Staff, Doctrine for Joint Nuclear Operations, Joint Publication (JP) 3-12, 15 March 2005, and previous versions or drafts, especially 1995, 1998, 2003. Available from http://www.nukestrat.com/us/jcs/jp3-12_05.htm accessed 13 October, 2016.
- 24 See for example, US Joint Chiefs of Staff, Doctrine for Joint Nuclear Operations, Joint Publication (JP) 3-12, 15 March 2005; and Malcolm Rifkind, *UK Defence Strategy: A Continuing Role for Nuclear Weapons?* Speech to the Centre for Defence Studies, London, November 16, 1993.
- 25 *Worse than Irrelevant: British nuclear weapons in the 21st century*, *op. cit.* pp 32-33.
- 26 In this section the quotes are taken from the 1998 Strategic Defence Review, Cm3999, 8 July 1998.
- 27 Rebecca Johnson, 'The 2005 NPT Review Conference: A delicate, hard-won compromise', *Disarmament Diplomacy* 46 (May 2000).
- 28 2000 Review Conference of the Parties to the Treaty on Non-Proliferation of Nuclear Weapons, Final Document, Volume 1 (NPT/CONF.2000/28 (Parts I and II)), p.14. See also Rebecca Johnson, 'The 2005 NPT Review Conference: A delicate, hard-won compromise', *Disarmament Diplomacy* 46 (May 2000).
- 29 Quoted from 2000 Review Conference of the Parties to the Treaty on Non-Proliferation of Nuclear Weapons, Final Document, Volume 1 (NPT/CONF.2000/28 (Parts I and II) in Rabinder Singh QC and Dr Christine Chinkin, 'The Maintenance and Possible Replacement of the Trident Nuclear Missile System'. In Rebecca Johnson and Angie Zelter (eds.) *Trident and International Law: Scotland's Obligations*, Luath Press, 2011.
- 30 Rebecca Johnson, 'The 2005 NPT Review Conference: A delicate, hard-won compromise', *Disarmament Diplomacy* 46 (May 2000).
- 31 UK Declaration on Security Assurances, Made on 6 April 1995 by the Permanent Representative of the United Kingdom to the Conference on Disarmament; and UK Statement to the NPT Review and Extension Conference, 21 April, 1995. Summarised and referenced in Rebecca Johnson, *Indefinite Extension of the Non-Proliferation Treaty: Risks and Reckonings: Report of the 1995 NPT Review and Extension Conference*, New York, 17 April to 12 May 1995, Acronym Report No. 7, London 1995. See also Rebecca Johnson, 'The 2005 NPT Review Conference: A delicate, hard-won compromise', *Disarmament Diplomacy* 46 (May 2000).

- 32 Rt. Hon. Geoff Hoon MP, Minutes of Evidence taken on March 20, 2002, Q237, published in House of Commons Defence Committee, 'Missile Defence', First Report, HC 290-II, January 30, 2003
- 33 Rt. Hon. Geoff Hoon MP, Secretary of State for Defence, speaking on the *Jonathan Dimbleby* programme, ITV, 24 March, 2002.
- 34 Rt. Hon. Geoff Hoon MP, Secretary of State for Defence, in Defence Questions, 15 July 2002, Columns 10f, cf. Early Day Motion 1707 [Session 2001-2], (23.07.2002).
- 35 International Court of Justice, Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, I.C.J. Reports 1996. p 225. [Reported for July 8, 1996, General List No. 95]. The full decision, documentation and dissenting decisions also formed the Annex to 'Advisory Opinion of the International Court of Justice on the legality of the threat or use of nuclear weapons'. See also Note by the Secretary-General, United Nations General Assembly A/51/218, October 15, 1996.
- 36 See Rebecca Johnson, Nicola Butler and Stephen Pullinger, *Worse than Irrelevant: British nuclear weapons in the 21st century*, Acronym Institute, London 2006.
- 37 Rebecca Johnson, 'Politics and Protection: Why the 2005 NPT Review Conference failed', in *Disarmament Diplomacy* 80 (Autumn 2005); Wilfrid Wan, Why the 2015 NPT Review Conference Fell Apart, United Nations University, May 2015, <https://cpr.unu.edu/why-the-2015-npt-review-conference-fell-apart.html> accessed 22 September 2016; Cesar Jeramillo, 'NPT Review Conference: No outcome document better than a weak one', Bulletin of the Atomic Scientists, June 2015 <http://thebulletin.org/npt-review-conference-no-outcome-document-better-weak-one8366> accessed 22 September 2016
- 38 A (principles and objectives) v, Conclusions and recommendations for follow-on actions, 2010 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, Final Document, Part I. User Field sss1 =
- 39 Chair's summary, Oslo Conference on the Humanitarian Impacts of Nuclear Weapons, 5 March 2013; Second Conference on the Humanitarian Impact of Nuclear Weapons, Chair's Summary, 14 February 2014, available from Ministry of Foreign Affairs, Mexico; Third Conference on the Humanitarian Impact of Nuclear Weapons, Chair's Summary, 9 December 2014, available from the Foreign Ministries of Norway, Mexico and Austria respectively. See also this author's many articles on the humanitarian disarmament processes and the UN Open-ended Working Group in openDemocracy 2012-2016.
- 40 The Future of the United Kingdom's Nuclear Deterrent, Cm6994, December 2006.
- 41 Rebecca Johnson, 'The UK White Paper on Renewing Trident: the wrong decision at the wrong time', *Disarmament Diplomacy* 83, Winter 2006.
- 42 The number of sources on these websites are too numerous to itemise.
- 43 The Future of the United Kingdom's Nuclear Deterrent, Cm6994, December 2006.
- 44 Rebecca Johnson, 'The UK White Paper on Renewing Trident: the wrong decision at the wrong time', *Disarmament Diplomacy* 83, Winter 2006.
- 45 Foreign Secretary William Hague, speaking in debate on Queen's Speech, Parliament, 26 May 2010, quoted in 'UK to be "more open" about nuclear warhead levels, BBC news report, 26 May 2010, http://news.bbc.co.uk/1/hi/uk_politics/8706600.stm accessed on 22 September 2016.
- 46 David Cameron, Prime Minister's statement on 2010 Strategic Defence and Security Review and Trident, 19 October 2010.
- 47 MoD Factsheets and Philip Hammond MP, Defence Secretary, 29 June 2011, accessed from UK Government site on 22 September 2016, <https://www.gov.uk/government/news/reduction-in-uk-nuclear-warheads-begins>
- 48 MoD Factsheets and Philip Hammond MP, Defence Secretary, 29 June 2011, accessed from UK Government site on 22 September 2016, <https://www.gov.uk/government/news/reduction-in-uk-nuclear-warheads-begins>
- 49 UK Government, *National Security Strategy and Strategic Defence and Security Review 2015: A secure and prosperous United Kingdom*, Cm 9161, November 2015

- 50 Philip Webber, The climatic impacts and humanitarian problems from the use of the UK's nuclear weapons, Scientists for Global Responsibility, February 2013 (revised from SGR Winter 2008)
- 51 UK Government, National Security Strategy and Strategic Defence and Security Review 2015: A secure and prosperous United Kingdom, Cm 9161, November 2015
- 52 Michael Fallon MP, Defence Secretary, speaking at the Policy Exchange , London, on ' The case for the retention of the UK's independent nuclear deterrent', 23 March 2016, link <https://www.gov.uk/government/speeches/the-case-for-the-retention-of-the-uks-independent-nuclear-deterrent> accessed 22 September 2016.
- 53 Michael Fallon MP, Defence Secretary, speaking at the Policy Exchange , London, on ' The case for the retention of the UK's independent nuclear deterrent', 23 March 2016, link <https://www.gov.uk/government/speeches/the-case-for-the-retention-of-the-uks-independent-nuclear-deterrent> accessed 22 September 2016.
- 54 Michael Fallon MP, Defence Secretary, speaking at the Policy Exchange , London, on ' The case for the retention of the UK's independent nuclear deterrent', 23 March 2016, link <https://www.gov.uk/government/speeches/the-case-for-the-retention-of-the-uks-independent-nuclear-deterrent> accessed 22 September 2016.
- 55 UK Government, National Security Strategy and Strategic Defence and Security Review 2015: A secure and prosperous United Kingdom, Cm 9161, November 2015
- 56 UK Government, National Security Strategy and Strategic Defence and Security Review 2015: A secure and prosperous United Kingdom, Cm 9161, November 2015
- 57 Debate on motion that 'This House supports the Government's assessment in the 2015 National Security Strategy and Strategic Defence and Security Review...' opened by Prime Minister Theresa May MP, Hansard vol 613, 18 July 2016.
- 58 'Advisory Opinion of the International Court of Justice on the legality of the threat or use of nuclear weapons', International Court of Justice, Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, I.C.J. Reports 1996. [Reported for July 8, 1996, General List No. 95]
- 59 The quotes are from Judge Bedjaoui, but the UK was one of the nuclear weapon states to make these arguments. See United Kingdom, Written Statement, at 53, para. 3.70, quoted in *Legality of the Threat or Use of Nuclear Weapons*, *supra* note 7, at 261-262, para. 91.
- 60 Mohammed Bedjaoui, 'Good Faith, International Law, and Elimination of Nuclear Weapons', in Rebecca Johnson and Angie Zelter (eds.) *Trident and International Law: Scotland's Obligations*, Luath Press, 2011. This chapter was based on a keynote address from Judge Bedjaoui at a meeting held on 1 May 2008 during the NPT Preparatory Committee meeting at the Palais des Nations, Geneva.
- 61 Mohammed Bedjaoui, 'Good Faith, International Law, and Elimination of Nuclear Weapons', in Rebecca Johnson and Angie Zelter (eds.) *Trident and International Law: Scotland's Obligations*, Luath Press, 2011
- 62 Mohammed Bedjaoui, 'Good Faith, International Law, and Elimination of Nuclear Weapons', in Rebecca Johnson and Angie Zelter (eds.) *Trident and International Law: Scotland's Obligations*, Luath Press, 2011
- 63 Mohammed Bedjaoui, 'Good Faith, International Law, and Elimination of Nuclear Weapons', in Rebecca Johnson and Angie Zelter (eds.) *Trident and International Law: Scotland's Obligations*, Luath Press, 2011
- 64 This section relies heavily on reports dating back to 1945 by the International Committee of the Red Cross (ICRC), and to publications from the International Physicians for the Prevention of Nuclear War (IPPNW), Scientists for Global Responsibility, and the expert presentations and papers made to the Humanitarian Impacts of Nuclear Weapons (HINW) Conferences held in Oslo, March 4-5 2013, Nayarit Mexico, February 14-15, 2014, and Vienna, December 8-9 2014, as well as UN documents and statements, especially in the 2013 and 2016 Open-Ended Working Group (OEWG). Many of these can be accessed from www.reachingcriticalwill.org, www.acronym.org.uk, or www.icanw.org .

- 65 International Committee of the Red Cross, *The Effects of Nuclear Weapons on Human Health*, Information Note 1, ICRC, Geneva, 2013. Available <https://www.icrc.org/eng/assets/files/2013/4132-1-nuclear-weapons-human-health-2013.pdf> accessed 22 September 2016.
- 66 International Committee of the Red Cross, *The Effects of Nuclear Weapons on Human Health*, Information Note 1, ICRC, Geneva, 2013. Available <https://www.icrc.org/eng/assets/files/2013/4132-1-nuclear-weapons-human-health-2013.pdf> accessed 22 September 2016. Jakob Kellenberger, 'Bringing the era of nuclear weapons to an end', Statement by the President of the ICRC to the "Geneva Diplomatic Corps", April 20, 2010. Accessed at: <http://www.icrc.org/web/eng/siteeng0.nsf/html/nuclear-weapons-statement-200410>
- 67 Personal conversations with Hibakusha (Atomic bomb survivors) over the years, confirmed by ICRC publications. See also Beatrice Fihn (ed.), *Unspeakable Suffering, Reaching Critical Will*, WILPF, Geneva, March 2013.
- 68 Philip Webber, *The climatic impacts and humanitarian problems from the use of the UK's nuclear weapons*, Scientists for Global Responsibility, February 2013 (revised from SGR Winter 2008); Beatrice Fihn (ed.), *Unspeakable Suffering, Reaching Critical Will*, WILPF, Geneva, March 2013.
- 69 Beatrice Fihn (ed.), *Unspeakable Suffering, Reaching Critical Will*, WILPF, Geneva, March 2013.
- 70 Beatrice Fihn (ed.), *Unspeakable Suffering, Reaching Critical Will*, WILPF, Geneva, March 2013.
- 71 Beatrice Fihn (ed.), *Unspeakable Suffering, Reaching Critical Will*, WILPF, Geneva, March 2013.
- 72 Zohl de Ishtar, ed. *Pacific Women Speak Out for Independence and Demilitarisation*, Raven, Christchurch, 1998. See also testimony from Lijon Eknilang to the ICJ in 2005, reproduced in the Annex to 'Advisory Opinion of the International Court of Justice on the legality of the threat or use of nuclear weapons' International Court of Justice, *Legality of the Threat or Use of Nuclear Weapons*, Advisory Opinion, I.C.J. Reports 1996. [Reported for July 8, 1996, General List No. 95].
- 73 Beatrice Fihn (ed.), *Unspeakable Suffering, Reaching Critical Will*, WILPF, Geneva, March 2013.
- 74 Chair's summary, Oslo Conference on the Humanitarian Impacts of Nuclear Weapons, 5 March 2013; Second Conference on the Humanitarian Impact of Nuclear Weapons, Chair's Summary, 14 February 2014, available from Ministry of Foreign Affairs, Mexico; Third Conference on the Humanitarian Impact of Nuclear Weapons, Chair's Summary, 9 December 2014, available from the Foreign Ministries of Norway, Mexico and Austria respectively.
- 75 K. Annan, The Secretary-General Address to the Nuclear Non-Proliferation Treaty Review Conference, 2 May 2005, available at <http://www.un.org/en/conf/npt/2005/statements/npt02sg> accessed 22 September 2016.
- 76 [Crutzen, Paul J.](#); Birks, John W. (1982). "The Atmosphere After a Nuclear War: Twilight at Noon". *Ambio*. **11** (2–3): 114.; [Budyko, M. I.](#); [Golitsyn, G. S.](#); Izrael, Y. A. (September 1988). *Global Climatic Catastrophes*. Springer. [ISBN 0-387-18647-6](#); [Golitsyn, G.S.](#) and [Phillips, N.A.](#) [WCRP](#), Possible climatic consequences of a major nuclear war, WCP-113, WMO/TD #99, 1986; [Turco, R.P.](#); [Toon, O.B.](#); [Ackerman, T.P.](#); [Pollack, J.B.](#); [Sagan, C.](#) (December 23, 1983). "Nuclear Winter: Global Consequences of Multiple Nuclear Explosions". *Science*. **222** (4630): Harwell, Mark A. (November 1984). *Nuclear Winter: The Human and Environmental Consequences of Nuclear War*. Springer. [ISBN 0-387-96093-7](#).
- 77 A. Robock, I. Oman, G.I. Stenchikov, O.B. Toon, C. Bardeen, and R.P. Turco, "Climatic consequences of regional nuclear conflicts", *Atmospheric Chemistry and Physics*, 7, 2003-2012, 2007, www.atmos-chem-phys.net/7/2003/2007. C. Bardeen *et al.*, 'Climatic Consequences of Regional Nuclear Conflicts', *7 Atmospheric Chemistry and Physics* (2007), available at <http://www.atmos-chem-phys.net/7/2003/2007>; and Ira Helfand, *Nuclear Famine: Two Billion People at Risk*, IPPNW, December 2013

- 78 A. Robock, I. Oman, G.I. Stenchikov, O.B. Toon, C. Bardeen, and R.P. Turco, “Climatic consequences of regional nuclear conflicts”, *Atmospheric Chemistry and Physics*, 7, 2003-2012, 2007, www.atmos-chem-phys.net/7/2003/2007.
- 79 A. Robock, I. Oman, G.I. Stenchikov, O.B. Toon, C. Bardeen, and R.P. Turco, “Climatic consequences of regional nuclear conflicts”, *Atmospheric Chemistry and Physics*, 7, 2003-2012, 2007, www.atmos-chem-phys.net/7/2003/2007.
- 80 A. Robock, I. Oman, G.I. Stenchikov, O.B. Toon, C. Bardeen, and R.P. Turco, “Climatic consequences of regional nuclear conflicts”, *Atmospheric Chemistry and Physics*, 7, 2003-2012, 2007, www.atmos-chem-phys.net/7/2003/2007. C. Bardeen *et al.*, ‘Climatic Consequences of Regional Nuclear Conflicts’, 7 *Atmospheric Chemistry and Physics* (2007), available at <http://www.atmos-chem-phys.net/7/2003/2007>; and Ira Helfand, *Nuclear Famine: Two Billion People at Risk*, IPPNW, December 2013
- 81 Ira Helfand, *Nuclear Famine: Two Billion People at Risk*, IPPNW, December 2013
- 82 I am grateful to Peter Burt of Nuclear Information Service for sharing his research with me, which is reflected in much of the detail in this section, which is also available on the Nuclear Information Service website.
- 83 Response to Parliamentary Question from Caroline Lucas MP, Hansard 16 Jun 2010, Column 465W <http://www.publications.parliament.uk/pa/cm201011/cmhansrd/cm100616/text/100616w0009.htm#100616103000738> accessed 22 September 2016. See also Nuclear Information Service, ‘Swamped: The devastating impact of the July 2007 floods on Britain’s nuclear weapons factories, October 2008, available <http://nuclearinfo.org/article/awe-burghfield-accidents-safety-media/swamped> accessed 28 September 2016.
- 84 John Large, *The Lay-person's Alternative Guide to REPPiR Relating to the Atomic Weapons Establishment (AWE) Aldermaston and Burghfield*, Nuclear Information Service, April 2012
- 85 Richard Moyes, Philip Webber and Greg Crowther, *Humanitarian consequences: Short case study of the direct humanitarian impacts from a single nuclear weapon detonation on Manchester, UK*. Article 36, February 2013
- 86 Richard Moyes, Philip Webber and Greg Crowther, *Humanitarian consequences: Short case study of the direct humanitarian impacts from a single nuclear weapon detonation on Manchester, UK*. Article 36, February 2013
- 87 Frank Boulton, *Blood Transfusion Services in the wake of the humanitarian and health crisis following multiple detonations of nuclear weapons*, Medact, February 2013
- 88 John Ainslie, *If Britain Fired Trident: The humanitarian catastrophe that one Trident-armed UK nuclear submarine could cause if used against Moscow*, Scottish CND February 2013
- 89 Philip Webber, *The climatic impacts and humanitarian problems from the use of the UK's nuclear weapons*, Scientists for Global Responsibility, February 2013 (revised from SGR Winter 2008)
- 90 Philip Webber, *The climatic impacts and humanitarian problems from the use of the UK's nuclear weapons*, Scientists for Global Responsibility, February 2013 (revised from SGR Winter 2008).
- 91 Philip Webber, *The climatic impacts and humanitarian problems from the use of the UK's nuclear weapons*, Scientists for Global Responsibility, February 2013 (revised from SGR Winter 2008). See also Rebecca Johnson, *Preventable Threats: the humanitarian impacts of nuclear weapons, UK risks and challenges*, Acronym Institute and ICAN-UK 2014 (updated from 2013)
- 92 Rob Edwards, *Nukes of Hazard: the Nuclear Bomb Convoys on our Roads*, ICAN-UK and Acronym Institute, 2016
- 93 A/C/71/L.41 <http://reachingcriticalwill.org/images/documents/Disarmament-fora/1com/1com16/resolutions/L41.pdf> accessed 28 November 2016.
- 94 Rob Edwards, *Nukes of Hazard: the Nuclear Bomb Convoys on our Roads*, ICAN-UK and Acronym Institute, 2016
- 95 See for example, US Joint Chiefs of Staff, *Doctrine for Joint Nuclear Operations*, Joint Publication (JP) 3-12, 15 March 2005; and Malcolm Rifkind, *UK*

Defence Strategy: A Continuing Role for Nuclear Weapons? Speech to the Centre for Defence Studies, London, November 16, 1993.