Research Paper

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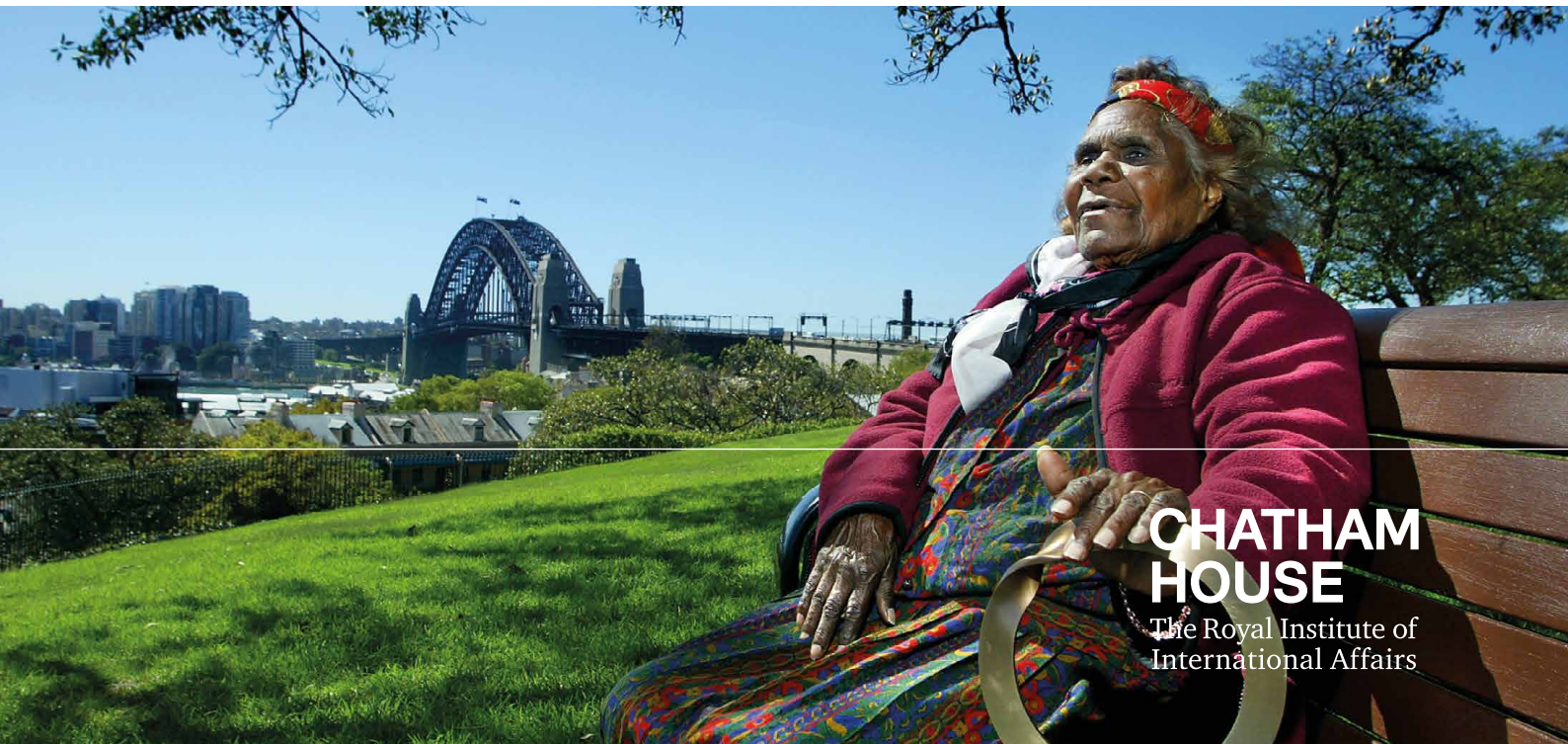
The Humanitarian Impacts of Nuclear Testing

Regional Responses and Mitigation Measures



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- Entry into force of the 1996 Comprehensive Nuclear-Test-Ban Treaty (CTBT) would be an important step for implementation of the commitments of all parties to the nuclear Non-Proliferation Treaty (NPT). The run-up to the 2020 NPT review conference over the next three years will be a critical time for the NPT and CTBT, and for other measures aimed at halting nuclear proliferation and bringing about global nuclear disarmament. 2020 will be the 50th anniversary of the NPT and the 25th anniversary of its indefinite extension. Frustration that progress on nuclear disarmament has been so slow despite states' commitments is threatening to destabilize the international nuclear order.

- Nuclear weapons tests have had severe impacts on public health and the environment, also affecting cultural heritage, food security, water security, indigenous peoples and local communities, and creating long-term problems such as land confiscation and population displacement.

- Scenario-based research covering different regions of the world (Africa, Europe, the Middle East, the Pacific region and South Asia) based on the experiences of nuclear testing reveals varying levels of preparedness for responding to a nuclear detonation, whether deliberate or accidental, due to a varying awareness of the challenges a detonation would create. The research also shows an uneven understanding of states' responsibilities for ensuring the safety and security of their populations in the event of a nuclear explosion.

- There are some similarities between Africa, Europe, the Middle East, the Pacific region and South Asia – and between countries within these regions – in terms of who is responsible for assisting populations following nuclear weapons explosions, nuclear tests or nuclear accidents.

- However, sharp differences also exist between states, and between regions, in terms of institutional awareness, roles and expectations in civil society. The humanitarian community and civil society organizations in developing countries, for instance, have greater confidence in the ability of military forces to respond to a nuclear catastrophe than do their counterparts in European countries.

- The long and continuing history of nuclear weapons testing has much to teach researchers, humanitarian organizations, international bodies and governments about how best to address the effects of nuclear weapons use and develop appropriate policies for prevention – whether through incremental steps or by complete prohibition.

1. Introduction

The next three years, in the run-up to the 2020 nuclear Non-Proliferation Treaty (NPT) review conference, represent a critical time for the Comprehensive Nuclear-Test-Ban Treaty (CTBT) and other measures aimed at halting nuclear proliferation and achieving global nuclear disarmament. 2020 will mark the 50th anniversary of the NPT and the 25th anniversary of its indefinite extension. The NPT was originally a fixed-term treaty of 25 years. Frustration that progress on nuclear disarmament has been so slow despite states' commitments is threatening to destabilize the international nuclear order.

Nuclear weapons tests – and equally policies relying on nuclear weapons use – would endanger the vision of the Sustainable Development Goals (SDGs). The impacts of nuclear weapons testing and nuclear weapons detonations, for instance, would have severe consequences for human health and well-being (SDG 3), the availability of clean water and sanitation (SDG 6), the alleviation of poverty and hunger (SDGs 1 and 2), and gender equality (SDG 5), among others. Learning from the continuing history of nuclear testing allows states and civil society to examine some of the missing links between development and security.[1]

The Chatham House research project on the humanitarian impacts of nuclear weapons testing explores the wide-ranging consequences of nuclear weapons testing throughout history. Nuclear weapons tests have caused damage to human health and the environment, and have had noted impacts on cultural heritage, food security, water security, indigenous peoples and local communities. They have led to problems such as land confiscation and population displacement. The effects on regions inhabited by indigenous groups, where so many of the nuclear tests have been conducted, have been especially severe.

Background

On 16 July 1945, a month before the bombings of Hiroshima and Nagasaki, the US conducted the world's first nuclear weapon test, codenamed 'Trinity', in New Mexico. In the following decades nuclear weapons were detonated in the atmosphere, underground and underwater as experimental tests were conducted by states possessing nuclear weapons.[2]

These tests had many purposes. They were primarily devised so that scientists could learn more about the engineering and physics principles of the weapons, and hone new designs and design skills.[3] But the tests also yielded information on the effects of nuclear weapons on living creatures and the environment.[4] In some cases the intention was also political – with tests designed as much

[1] Lewis, P., Unal, B. and Aghlani, S. (2016), *Nuclear Disarmament: The Missing Link in Multilateralism*, Research Paper, London: Royal Institute of International Affairs, https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/2016-10-12-nuclear-disarmament-lewis-unal-aghlani-final-version.pdf.
[2] The nuclear weapons states referred to here are the US, the Soviet Union, the UK, France, China, India and Pakistan.
[3] Kimball, D. (2016), 'The Nuclear Testing Tally', Arms Control Association, updated September 2016, https://www.armscontrol.org/factsheets/nucleartesttally.
[4] Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) (undated), 'General Overview of the Effects of Nuclear Testing', https://www.ctbto.org/nuclear-testing/the-effects-of-nuclear-testing/general-overview-of-theeffects-of-nuclear-testing.

to instil fear in other states, by demonstrating a country's nuclear superiority, as to further military and scientific research. In other cases military personnel were deliberately exposed to the tests[5] and then monitored throughout their lives, so that the effects on their bodies could be studied.[6] Civilians – mostly indigenous peoples – living in the vicinity of test sites were similarly monitored. Some such groups were permanently displaced from their lands, with devastating consequences.[7]

In total, there have been 500 recorded atmospheric tests and more than 2,000 tests in all environments, including underground.[8] Vast amounts of money have been spent on the tests themselves, on monitoring their effects, and on attempts to clean up after them.[9]

By the 1960s, a growing awareness of the destructive environmental and health impacts of nuclear weapons tests spurred a large number of governments – along with a civil society movement composed of doctors and other medical experts, environmentalists, humanitarian actors and peace activists – to call for a complete ban on nuclear weapons tests.[10]

However, despite the mounting evidence of the damage the tests caused, the nuclear weapons states were initially reluctant to ban them. They justified the tests as necessary for the development, safety and security of their nuclear arsenals – and as 'the last step' in an incremental process[11] intended to lead to the global elimination of nuclear weapons.[12] In addition, nuclear weapons, in the hands of a few states, were deemed essential for defence and deterrence in the context of the Cold War.

In large part it was the known health and environmental effects of nuclear weapons tests that prompted the US, UK and Soviet Union to agree to begin negotiations on a comprehensive ban on them. The shock of the Cuban missile crisis in 1962 also supported this process.

The 1958–63 negotiations[13] failed to achieve a total test ban. However, by focusing on the very worst humanitarian impacts of nuclear weapons testing, negotiators succeeded in agreeing the 1963 Partial Test Ban Treaty (PTBT), which provided for a global ban on nuclear explosions in the atmosphere, in outer space and underwater.[14] The CTBT, which was not signed until 1996, after the

[5] Green, J. (2001), 'UK Admits Military Personnel Deliberately Exposed to Nuclear Tests', Environment News Service-Newswire, 18 May 2001, http://www.ens-newswire.com/ens/may2001/2001-05-18-04.html; see also France 24 (2010), 'Soldiers deliberately exposed to nuclear tests says report', France 24, 16 February 2010, http://www.france24.com/en/20100216-soldiers-deliberately-exposed-nuclear-tests-says-report.
[6] Makhijani, A. (2005), 'A Readiness to Harm: The Health Effects of Nuclear Weapons Complexes', *Arms Control Today*, 1 July 2005, https://www.armscontrol.org/print/1852.
[7] Donnison, J. (2014), 'Lingering impact of British nuclear tests in the Australian outback', BBC, 31 December 2014, http://www.bbc.co.uk/news/world-australia-30640338.
[8] CTBTO (undated), 'Types of Nuclear Weapons Tests', https://www.ctbto.org/nuclear-testing/history-of-nuclear-testing/types-of-nuclear-weapons-tests/.
[9] The US's environmental management, clean-up and health costs (victim compensation and defence nuclear waste disposal) for the 2008 financial year were estimated to be $8.3 billion. See Schwartz, S. I. and Choubey, D. (2009), *Nuclear Security Spending: Assessing Costs Examining Priorities*, Washington, DC: Carnegie Endowment for International Peace, p. 24, http://carnegieendowment.org/files/nuclear_security_spending.pdf.
[10] UN Office for Disarmament Affairs (2017), 'Fact Sheet: Disarmament and Civil Society', https://unoda-web.s3-accelerate.amazonaws.com/wp-content/uploads/2017/01/Disarmament-and-Civil-Society-Fact-Sheet.pdf.
[11] For more information on current approaches to nuclear disarmament and non-proliferation, please see Annex II of this paper.
[12] Borrie, J., Caughley, T., Torbjørn, G. H., Løvold, M., Nystuen, G. and Waszink, C. (2016), *A Prohibition on Nuclear Weapons: A Guide to the Issues*, UN Institute for Disarmament Research (UNIDIR) and International Law and Policy Institute (ILPI), http://www.unidir.org/files/publications/pdfs/a-prohibition-on-nuclear-weapons-a-guide-to-the-issues-en-647.pdf.
[13] Burr, W. and Montford, H. L. (2003), 'The Making of the Limited Test Ban Treaty, 1958-1963', National Security Archive, 8 August 2003, http://nsarchive.gwu.edu/NSAEBB/NSAEBB94/.
[14] US Department of State (undated), 'Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water', entered into force on 10 October 1963, https://www.state.gov/t/isn/4797.htm.

end of the Cold War, extended the scope of the ban on nuclear weapons testing to include underground explosions.[15]

Current state of affairs

Twenty years on from the negotiation of the CTBT in Geneva, the treaty has yet to enter into force. Progress is being held up by eight key ('Annex 2') countries – China, Egypt, India, Iran, Israel, North Korea, Pakistan and the US – that are required to ratify the CTBT in order for it to enter into force, but that have still not done so.[16] Indeed, a quarter of a century after the end of the Cold War, interest in nuclear weapons has been revived rather than reduced. Established nuclear weapons states such as the US and Russia have increased investment in modernization.[17] The activities of new players such as North Korea have raised concerns that more states may step into the nuclear weapons possessor category if insecurities increase and alliance commitments become uncertain.[18]

Nuclear weapons tests have been halted in all states that have signed the CTBT, while India and Pakistan – despite having neither signed nor ratified the treaty yet – have not carried out any tests since 1998.[19] However, North Korea has conducted five tests in the past decade,[20] and is likely to continue doing so.[21] The US's position has also proved problematic. The US Senate's failure to ratify the CTBT in 1999[22] resulted in the stagnation of progress towards ensuring the treaty's entry into force. In addition, increased uncertainty about the long-standing commitments made by the five NPT nuclear weapons states[23] with regard to the CTBT and other nuclear disarmament, arms control and non-proliferation measures is leading some analysts to question whether the norms established against nuclear testing will hold.

Engagement in the debate over CTBT ratification can be divided into two perspectives. The first holds that ratification is unnecessary given that the norm against testing is universally accepted by all states, with the notable exception of North Korea. The strength of this norm is therefore believed to be sufficient for the pursuit of a world free from nuclear weapons tests.

[15] US Department of State (undated), 'Comprehensive Nuclear Test-Ban Treaty (CTBT)', https://www.state.gov/t/avc/c42328.htm.
[16] The CTBT requires a named set of 44 states (listed in Annex 2 of the treaty) to ratify the treaty in order for it to enter into force. See https://www.ctbto.org/the-treaty/status-of-signature-and-ratification/.
[17] Kristensen, H. M. (2014), 'Nuclear Weapons Modernization: A Threat to the NPT', Arms Control Association, 1 May 2014, https://www.armscontrol.org/act/2014_05/Nuclear-Weapons-Modernization-A-Threat-to-the-NPT; see also Kile, S. N. and Kristensen, H. M. (2016), 'Trends in World Nuclear Forces, 2016', SIPRI (Stockholm International Peace Research Institute), https://www.sipri.org/sites/default/files/FS%201606%20WNF_Embargo_Final%20A.pdf.
[18] Campbell, K. M., Einhorn, R. J. and Reiss, M. B. (2004), *The Nuclear Tipping Point: Why States Consider their Nuclear Choices*, Washington, DC: Brookings Institution Press.
[19] United Nations (undated), 'Ending Nuclear Testing, International Day against Against Nuclear Tests 29 August – Ending Nuclear Testing', http://www.un.org/en/events/againstnucleartestsday/history.shtml.
[20] Nuclear Threat Initiative (2017), 'North Korea – Overview', http://www.nti.org/learn/countries/north-korea/.
[21] Sanger, E. D. and Broad, W. (2017), 'As North Korea Speeds its Nuclear Program, U.S. Fears Time Will Run Out', *New York Times*, 24 April 2017, https://www.nytimes.com/2017/04/24/world/asia/north-korea-nuclear-missile-program.html?_r=0.
[22] US Senate Committee on Foreign Relation (1999), 'Hearing Before the Committee on Foreign Relations United States Senate One Hundred Sixth Congress', 7 October 1999, Federation of American Scientists, https://fas.org/nuke/control/ctbt/text/ctbtsenate.htm; see also Kimball, D. (2009), 'Learning From the 1999 Vote on the Nuclear Test Ban Treaty', *Arms Control Today*, 5 October 2009, https://www.armscontrol.org/act/2009_10/LookingBack.
[23] Weiss, L. (2003), 'Nuclear-Weapon States and the Grand Bargain', *Arms Control Today*, 1 December 2003, https://www.armscontrol.org/act/2003_12/Weiss.

The second perspective holds that while most states may be upholding a norm of opposition to nuclear testing, the eight non-ratifying Annex 2 states[24] are standing in the way of a complete and final prohibition. This perspective sees the current global norm against testing more as an expression of political will than as demonstrating ethical or moral concerns and legal commitment.

The debate over CTBT ratification also feeds into a much larger recent discussion concerning the fate of the NPT. This debate has considered at least four approaches for moving forward to achieve nuclear disarmament and ensuring the safe use of nuclear technology:

1. Following the long-term 'step-by step' process;
2. Following the 'progressive' approach;
3. Negotiating a global nuclear weapons convention; and
4. Establishing effective legal measures against nuclear weapons ('legal prohibition' approach) through negotiating a treaty to prohibit nuclear weapons.

These approaches are not necessarily distinct from one another. There are commonalities between the step-by-step process and the progressive approach, for example, and the 'humanitarian impacts of nuclear weapons initiative' initiated the legal prohibition approach. Humanitarian organizations, international bodies and governments can all learn a great deal from the long history of nuclear testing. In particular, they can gain insights into how the world can approach nuclear weapons and – whether through incremental steps or complete prohibition – seek to prevent their use.

About this paper

This research paper aims to open up a discussion on what we can learn from the experiences of nuclear weapons testing, and how those lessons might apply to nuclear weapons policies. The paper developed from discussions held by Chatham House and regional partners in five workshops, each of which focused on a different region: Africa, Europe, the Middle East, the Pacific region and South Asia. Each workshop studied the effects of nuclear weapons tests from 1945 onwards. These effects were built into a gamed simulation – or 'table-top exercise' – of a nuclear weapons detonation or multiple detonations.

The decision to use scenarios based on nuclear weapons explosions rather than scenarios based on nuclear testing served a specific purpose. Nuclear tests are conducted to discover what the effects of a nuclear weapons explosion will be. Nuclear testing is not a single event on its own. Several steps ahead of nuclear weapons testing lies the decision to be ready in principle to use nuclear weapons. In addition, despite the catastrophic long-term effects of nuclear weapons testing, tests are themselves shadows of the impacts forecast for a nuclear weapons detonation on a large city.

[24] The 44 'Annex 2' signatory states are Algeria, Argentina, Australia, Austria, Bangladesh, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, DPR Korea, DR Congo, Egypt, Finland, France, Germany, Hungary, India, Indonesia, Iran, Israel, Italy, Japan, Mexico, the Netherlands, Norway, Pakistan, Peru, Poland, the Republic of Korea, Romania, Russia, Slovakia, South Africa, Spain, Sweden, Switzerland, Turkey, Ukraine, the UK, the US, Vietnam.

The table-top exercises powerfully captured the possible impact of such a devastating act. The exercises were played by the workshop participants, comprising representatives from a range of humanitarian organizations, government departments and national points of contact at atomic energy agencies. The paper also draws on discussions in several meetings of the International Federation of Red Cross and Red Crescent Societies (IFRC).

2. Risks of Nuclear Weapons Testing

Understanding the physics, engineering and impacts of nuclear weapons has been a long process, dating back to Rutherford's discovery of the nucleus in 1911. Since at least the start of the Manhattan project in 1942, studies on the effects of nuclear testing on humans have been hampered by military secrecy, restrictions on access to documents, and the subsequent loss of documentation and memories. However, new information is coming to light in the form of declassified data. Our understanding of the consequences of nuclear detonations is also changing as new information about their circumstances and new calculations reveal further impacts that were previously not fully considered or factored into decision-making. In recent decades, for example, there has been empirical scientific analysis of the long-term impacts of ionizing radiation.[25] In order to fully understand the risks of nuclear testing, it is also necessary to consider the reasons why states have conducted nuclear weapons tests in the past and their rationales for potentially doing so again in the future. Younger generations can benefit from this accumulated experience of the humanitarian consequences of nuclear testing to inform decision-making on future policies and security doctrines.

Nuclear tests have health and environmental impacts that go beyond borders. As a consequence of nuclear testing over many decades, a substantial amount of radioactive material (e.g. iodine-131, strontium-90 and caesium-137) has been released into the atmosphere, soil and water. The impacts of such isotopes depend on their uptake in the environment and in the human body, the type of radiation emitted, the quantity of isotopes, and their half-life and degree of radioactivity. During the years of atmospheric nuclear testing, the reach of the fallout depended on the type of warhead, altitude and location of detonation, topography, weather conditions and wind direction. In a two-and-a-half-year period from 1959, over 61,000 deciduous teeth were collected and analysed in the US to assess the accumulation of strontium-90 in children. The research found that 'deciduous teeth can be usefully employed as a means of monitoring strontium-90 uptake in man'.[26] The contamination of the food chain (e.g. cow's milk) poses similar concerns.[27] For instance, French nuclear testing in Polynesia in the 1960s and 1970s led to increased cases of ciguatera marine food poisoning.[28] Another study, conducted on families living near the test site in the US state of Nevada, showed increases in lymphoma, 'excess cases of thyroid cancer', breast cancer, melanoma, bone cancer and brain tumours.[29]

The amount of radiation released above ground is dramatically reduced – even close to zero – in underground nuclear testing. However, depending on the yield and magnitude of the explosion, underground nuclear weapon tests have had geological and hydrological – and thus environmental

[25] Turco, R. P., Toon, O. B., Ackerman, T. P., Pollack, J. B. and Sagan, C. (1983), 'Nuclear Winter: Global Consequences of Multiple Nuclear Detonations', *Science*, December, Vol. 222, No. 23, pp. 1283–92.
[26] Reiss, L. Z. (1961), 'Strontium-90 Absorption by Deciduous Teeth', *Science*, November, Vol. 134, Issue 3491, pp. 1669–73.
[27] Gusev, B., Abylkassimova, Z. and Apsalikov, K. (1997), 'The Semipalatinsk nuclear test site: a first assessment of the radiological situation and the test-related radiation doses in the surrounding territories', *Radiation and Environmental Biophysics*, October, Vol. 36, Issue 3, doi:10.1007/s004110050072.
[28] Danielsson, B. and Masters, C. (1990), 'Poisoned Pacific: the legacy of French nuclear testing', *Bulletin of the Atomic Scientists*, Vol. 46, Issue 2, p. 22; see also Ruff, T. (1989), 'Ciguatera in the Pacific: A Link with Military Activities', *The Lancet*, No. 8631.
[29] The study analysed Mormon families living near the Nevada test site, comparing them with all Mormons in Utah. For instance, 'there were 19 diagnosed cases of leukaemia when 3.6 were expected, from 1958 to 1966'. See Johnson, C. J. (1984), 'Cancer Incidence in an Area of Radioactive Fallout Downwind From the Nevada Test Site', *Journal of the American Medical Association*, Vol. 251, Issue 2.

– impacts.[30] One of the features of underground nuclear testing is the 'venting' of varying amounts of radioactive gases into the atmosphere.[31] Such tests also create large underground cavities, which can lead to cratering at the earth's surface and affect topography. Underground tests can also cause radioactive isotopes to leach into underground water supplies and the surrounding soil.

During the Cold War, a few underwater tests were conducted in order to assess the damage that nuclear detonations could cause to naval forces, ships and submarines.[32] Depending on their depth, their location and the weather conditions, underwater tests can cause radioactive sea spray, which can contaminate water supplies on nearby land. Operation Crossroads, conducted by the US in 1946, is a well-known example of underwater testing. It was part of a series of 23 nuclear weapons tests conducted between 1946 and 1958 at Bikini Atoll in the Marshall Islands.

Nuclear weapons tests have had severe impacts on local communities in different parts of the world. The Royal Commission into British Nuclear Tests in Australia found that the Totem I test, conducted by the UK in 1953, took place under conditions that produced unacceptable levels of fallout.[33] The test planners did not take into account the presence of people living in Wallatinna and Melbourne Hill, downwind from the test site.[34] Reports on indigenous communities in the Pacific have also highlighted the detrimental long-term effects of nuclear weapons tests, showing that communities 'are living with the social, economic, and environmental after-effects of fifty years of nuclear testing'.[35]

The effects of nuclear tests go beyond the physical impacts of radiation. In most of the small islands in the Pacific where nuclear tests were conducted, land and property have been lost, and people have been displaced. The impacts on local heritage have been devastating. For instance, the sacred objects of the Yalata community had to be relocated,[36] and the enforced displacement of indigenous populations has prevented traditional ways of life and heritage from being passed on to future generations.[37]

There have also been adverse impacts on mental health, resulting from a climate of fear over radiological exposure in test locations and a culture of stigmatization. Testimonies from *hibakusha* – as survivors of the Hiroshima and Nagasaki bombings are known – reveal cases of social stigma and exclusion such as discrimination over marriage, stemming from popular beliefs about the effects of radiation on reproduction.[38] The British and Australian governments used to describe the

[30] The effects are subject to several conditions, such as the amount of energy released to the surface, risks of venting, and the type of material on the ground that would mix with the released radioactivity.
[31] Significant venting examples are Test Platte (1962), Test Eel (1962), Test Des Moines (1962), Test Baneberry (1970) and 26 other tests. Reported in *Radioactive heaven and earth: the health and environmental effects of nuclear weapons testing in, on, and above the earth: A report of the IPPNW International Commission to Investigate the Health and Environmental Effects of Nuclear Weapons Production and the Institute for Energy and Environmental Research*, Apex Press, 1991.
[32] CTBTO (undated), 'Types of Nuclear Weapons Tests'.
[33] Royal Commissioner, Mr Justice McClelland (1985), *The Report of the Royal Commission into British Nuclear Tests in Australia*, 2 vols, Australian Government Publishing Service.
[34] Ibid.
[35] Maclellan, N. (2008), 'France continues to avoid responsibility for nuclear compensation', Report to the Medical Association for the Prevention of War (MAPW), p. 4.
[36] Holdstock, D. and Barnaby, F. (2003), *The British nuclear weapons programme, 1952-2002*, Psychology Press.
[37] Personal correspondence and interview with Sue Coleman-Haseldine, Kokatha-Mula community first-generation nuclear testing survivor, April 2016. See also Brady, M. (1999), 'The Politics of Space and Mobility: Controlling the Ooldea/Yalata Aborigines, 1952–1982', *Aboriginal History*, Vol. 23, pp. 1–14.
[38] Todeschini, M. (1999), 'Illegitimate Sufferers: A-Bomb Victims, Medical Science, and the Government', *Daedalus*, Spring, Vol. 128, Issue 2, pp. 67–100.

test sites at Maralinga and Emu Fields as a 'wasteland' – land that was not 'valuable'.[39] In Japan, after the 2011 Fukushima Daiichi nuclear crisis, it was reported that evacuations had caused 'a new stigma—a class of people shuttled about, irradiated through no fault of their own—who are being shunned from clinics and even refugee camps for fear of "polluting" others'.[40] Interviews with the evacuees from Fukushima reported fear of 'marriage discrimination'[41] similar to the social stigma experienced by *hibakusha* women.[42] Similarly, the UN Institute for Disarmament Research (UNIDIR) and the International Law and Policy Institute (ILPI) have reported accounts that Marshallese women suffered 'humiliating examinations by US military medical and scientific personnel'.[43]

[39] Personal correspondence and interview with Sue Coleman-Haseldine.
[40] Cunningham, P. J. (2011), 'Reflection On Japan: Growing Stigma Against Victims of Fukushima', New America Media, 19 April 2011, http://newamericamedia.org/2011/04/mad-foreigners-and-fukushima-maidens.php.
[41] Heath, M. A. (2013), 'Radiation Stigma, Mental Health, and Marriage Discrimination: The Social Side-Effects of the Fukushima Daiichi Nuclear Disaster, A thesis', presented to the Department of International Studies, US.
[42] Becker, S. M. (2012), 'Psychological Issues in a Radiological or Nuclear Attack', in Mickelson, A. B. (2012), *Medical Consequences of Radiological and Nuclear Weapons*, Office of The Surgeon General, Department of the Army, United States of America, p. 179.
[43] Borrie, J., Dimmen, G. A., Hugo, G. T., Waszink, C. and Egeland, K. (2016), 'Gender Development and Nuclear Weapons', UNIDIR: ILPI.

3. Regional Responses to Nuclear Weapons Testing and Nuclear Weapons Explosions

A comparative study

In 2015–16, Chatham House conducted a series of workshops on the humanitarian impacts of nuclear weapons testing. The workshops covered Africa, Europe, the Middle East, the Pacific region and South Asia (with a lesser focus on Southeast Asia), respectively. The workshops were generally conducted with a partner organization from the relevant region, utilizing its local knowledge and expertise.[44] Each workshop was structured around a simulation based on the detonation of nuclear weapons, and focusing on the following themes:

- The distinct consequences of nuclear testing for human and public health;
- What nuclear testing programmes have taught us about the effects of nuclear weapons;
- The impacts that nuclear weapons use would have on human societies, drawing from the testing programmes;
- The knock-on effects that nuclear weapons use would have for humanitarian assistance in other areas, drawing from the testing programmes;
- The capacity of humanitarian organizations to respond and the limits of current response strategies, drawing from the testing programmes and other disasters;
- Likely difficulties in maintaining social cohesion and governance following an explosion or nuclear weapons test, drawing from the testing programmes and other disasters;
- Concerns related to cultural heritage and cultural property destruction;
- Environmental impacts of nuclear testing (including underground tests);
- Impacts on climate, agriculture and food security, following nuclear weapons explosions, drawing from the testing programmes;
- The status of communications, power and transport systems following nuclear explosions; and
- Similarities and differences between responses to a nuclear weapons test/explosion and responses to other types of emergency (e.g. natural disasters).

[44] Chatham House partnered with the Heinrich Böll Stiftung –Turkey branch, for the Middle East workshop; with La Trobe Law School at La Trobe University for the Pacific workshop; with the African Centre for Science and International Security for the Africa workshop; and with the Observer Research Foundation for the South Asia workshop. Chatham House conducted the Europe workshop on its own.

The simulation exercises focused on the impacts that nuclear explosions would have not only in specific countries but also in wider regions, and on the mechanisms for global preparedness and prevention. Parallels as well as contrasts were found between all five regions. The conclusions from the workshops indicated that nuclear weapons states have not taken comprehensive steps to protect communities from the dangers and continuing impacts of nuclear weapons tests and detonations.

In the workshops on Europe and the Middle East, the scenario exercises explored a 20-kiloton airburst nuclear detonation in Adana, Turkey (see Annex I, Scenario 1).[45] The workshop on South Asia did not feature a table-top exercise.[46] In the Pacific workshop, participants explored a situation in which multiple attacks using 10-kiloton and 20-kiloton warheads were launched from submarines, targeting the US communications and control base at Pine Gap and RAAF Base Darwin (see Annex I, Scenario 2). In the sub-Saharan Africa workshop, the group considered humanitarian responses to multiple 10-kiloton nuclear detonations at targets inside Ghana (see Annex I, Scenario 3).

Discussions centred on three key areas: preparedness, response and prevention. Lessons from historical nuclear testing programmes, and from the nuclear detonations in Hiroshima and Nagasaki, were used to inform participants about the consequences of nuclear weapons use, and about the importance of preventing both further tests and the use of such weapons in conflict.[47] This highlights how experience gained from a study of nuclear weapons testing programmes can cast light on the implications of a potential nuclear weapons conflict.

The rest of this chapter presents an analysis of the understanding of nuclear weapons testing among the workshop participants in each region and describes the outcome of their scenario discussions, which explored additional complexities and layers of response – including societal and cultural considerations such as compensation, minimizing discrimination, and protecting indigenous community rights. Humanitarian organizations, when establishing or reviewing response protocols for potential nuclear weapons explosions, need to possess knowledge related to plans, procedures and preparedness. In other words, interactive discussion on nuclear weapons detonations necessarily encompasses a large pool of expertise on risk mitigation measures.

The discussions in the five workshops raised the following questions for future consideration:

- What is the status of nuclear host countries under the NPT? Is it legal to host nuclear weapons without breaching NPT Article I – that states are not to transfer nuclear weapons or nuclear explosive devices?

- What are the implications of hosting nuclear weapons, for instance if a nuclear weapons state were to lend some of its nuclear weapons to a non-nuclear weapons country?

[45] Initially two scenarios were prepared for the Middle East focus group workshop. One took Adana city centre as the detonation point, and the other Incirlik airbase.
[46] Regional comparisons and similarities related to plans, procedures and prevention mechanisms are based on scenarios for the four regions stated. A general framework of understanding is provided for South Asia, but no scenario was developed for this region and it is not included in the regional comparisons.
[47] For an account of the devastating consequences of the nuclear bombings on Hiroshima and Nagasaki and their implications for nuclear weapons policies, see Borrie, J. and Caughley, T. (2014), *An Illusion of Safety: Challenges of Nuclear Weapon Detonations for United Nations Humanitarian Coordination and Response*, Geneva: UNIDIR, http://www.unidir.org/files/publications/pdfs/an-illusion-of-safety-en-611.pdf.

- What is NATO's nuclear disarmament policy?[48]
- What measures can reduce the risks of nuclear weapons testing?
- How can CTBT ratification be effectively promoted?
- How can effective measures (including the pursuit of legally binding measures towards nuclear disarmament) be developed to prevent nuclear weapons use?
- What would be the best set of risk mitigation measures?

By simulating nuclear catastrophes through interactive games and/or scenarios, the Chatham House workshops aimed to generate fruitful discussions on the risks posed by nuclear weapons. As a fringe activity, some participants were asked to play the BBC 'Taster' game 'How to Survive a Nuclear Bomb'.[49] More than 7,000 people around the world have played this pilot game, the scenario for which begins immediately after a nuclear bomb is dropped and ends with a military rescue on day 4. The scenario is based on the declassified British war game 'Exercise REGENERATE'.[50] Players are expected to respond to simulations of difficult situations, in which rapid decision-making is required 'to ensure survival in the wake of a nuclear attack'.[51] According to the BBC, in information shared with Chatham House, there is a one-third drop-off rate from the game at the end of day 2. This can be assumed to mean that 33 per cent of players fail to survive in the game beyond that point.[52]

European perspectives

The UK, France and the Soviet Union[53] all conducted nuclear tests over multiple decades. All have since signed and ratified the CTBT, the former Soviet states (including Russia) on an individual basis after the collapse of the Soviet Union. Most of the tests took place far away from the European mainland, with locations selected on the basis of colonial history, and in lands belonging to indigenous peoples.[54]

The UK conducted a total of 45 nuclear tests, at locations in the Asia-Pacific region (nine tests), southern Australia (12 tests), and at the Nevada test site (24 tests) as part of a joint venture with the US.[55] France conducted its 50 atmospheric and 160 underground tests either in what was then the

[48] The 2010 NATO Strategic Concept is cyclical, suggesting that NATO will continue to be a nuclear alliance as long as there are nuclear weapons in the world. Considering that eight of the 12 nuclear weapons states or nuclear host countries are NATO members, it is futile to expect a change in the nuclear realm without the efforts of the alliance.
[49] BBC Taster (2016), 'How to Survive a Nuclear Bomb', http://www.bbc.co.uk/taster/projects/how-to-survive-a-nuclear-bomb.
[50] 'Exercise REGENERATE: Training for staff designated for wartime regional government', The National Archives, 1 January 1982–31 December 1982, former reference to the document: SC 82 20/105/6.
[51] BBC Taster (2016), 'How to Survive a Nuclear Bomb'.
[52] Players may have left this game for other reasons. However, whenever a player's health and/or morale suffers, the game stops, automatically causing the player to drop out. This probably accounts for the sharp decline on day 2.
[53] Soviet nuclear testing is included in the European perspectives; however, this research paper does not include an in-depth analysis of the humanitarian impacts of nuclear testing in Kazakhstan, Turkmenistan, Ukraine and Uzbekistan.
[54] Jacobs, R. (2013), 'Nuclear Conquistadors: Military Colonialism in Nuclear Test Site Selection during the Cold War', *Asian Journal of Peacebuilding*, Vol. 1, No. 2, November, pp. 157–77.
[55] CTBTO (undated), '3 October 1952 – First British Nuclear Test', https://www.ctbto.org/specials/testing-times/3-october-1952-first-british-nuclear-test (accessed 22 Sep. 2016).

French Algerian Sahara desert, or in French Polynesia.[56] In the Soviet Union 715 tests were conducted between 1949 and 1990, including in Novaya Zemlya and what are now Kazakhstan, Uzbekistan, Turkmenistan and Ukraine.[57] Remote areas were chosen deliberately in order to avoid affecting large numbers of people, although the health effects of nuclear testing would be felt in the local population and environmental impacts were recorded across the Soviet Union. Test detonations were conducted as ground blasts; in the air, including at high altitudes; and underwater. In 1961, over Novaya Zemlya, the largest ever human-made detonation occurred. With a blast yield of 50 megatons, 'Tsar Bomba' was 3,000 times more powerful than the weapon used at Hiroshima[58] and produced a fireball 'two miles' in diameter.[59]

The European focus group in the workshop featured the perspectives of participants from a range of countries, including Sweden, Kosovo, Malta, Poland, Lithuania, Hungary and Serbia. The group considered a scenario involving a 20-kiloton airburst nuclear detonation in Adana, Turkey – the same scenario as that used in the Middle East workshop (see Annex I, Scenario 1). Participants developed responses to the scenario as it unfolded in the simulation, incorporating their own experiences working in the humanitarian sector (14 of the 25 members of the group worked or had worked for humanitarian organizations), and with specific reference to precedents in natural disaster management and human displacement. One participant, for instance, drew on personal experience in leading a humanitarian response to the 2014 Ebola outbreak.

It was noted that although governments across the world assume that Red Cross and Red Crescent organizations would be obliged, and able, to provide first-response assistance in the aftermath of a nuclear detonation, these organizations would only be able to work 'on the safe side of the cordon'.

In addition, a key dilemma today for humanitarian organizations in Europe is whether or not to deliver assistance without a mandate from governments. Delivering assistance without permission, or against the orders of the government of the country in which they are working, could jeopardize their relationship with that government. With this in mind, most humanitarian organizations in the scenario decided to wait for instructions from the government of the state concerned before responding. They saw their job as being to 'fill the gaps' where the government required assistance, rather than to lead the response themselves.

Participants were informed that the fallout from a nuclear explosion would be likely to prompt many people to misdiagnose themselves with radiation sickness, putting an additional strain on public health systems at a time of crisis. This kind of scenario would likely be exacerbated if governments' disaster response measures remained opaque.

Decontamination of those exposed to radiation would be a high priority in Europe. Military triage cannot be undertaken until decontamination has taken place. Establishing 'collection points' – safe

[56] Bergkvist, N. O. and Ferm, R. (2000), 'Nuclear Explosions 1945 -1998', FOA Defence Research Establishment and Stockholm International Peace Research Institute, p.11. See also CTBTO (undated), 'France's Nuclear Testing Programme', https://www.ctbto.org/nuclear-testing/the-effects-of-nuclear-testing/frances-nuclear-testing-programme/ (accessed 22 Sep. 2016).
[57] CTBTO (undated), '29 August 1949 – First Soviet Nuclear Test', https://www.ctbto.org/specials/testing-times/29-august-1949-first-soviet-nuclear-test.
[58] Huard, P. R. (2015), 'Revealed: The Most Powerful Nuclear Bomb Ever', *The National Interest*, 16 August 2015, http://nationalinterest.org/blog/the-buzz/revealed-the-most-powerful-nuclear-bomb-ever-13600.
[59] Ibid.

areas for people to be decontaminated and receive urgent medical treatment before they are allowed to be reunited with their families – was therefore discussed as a key objective.

Following a nuclear explosion, people's fears about radiation would likely be manifested in a reluctance to handle corpses. Participants discussed the role of humanitarian organizations in managing safe burial procedures.

The scenario exercise showed that while humanitarian organizations in Europe have the initial capacity and experience to plan for and respond to a range of humanitarian crises, in practice they give priority to immediate problems and lack a broader understanding of the humanitarian impacts of nuclear weapons testing and nuclear weapons use.

Middle Eastern perspectives

The consequences of a nuclear weapons detonation – requiring decisions on whether to protect staff, assist victims or maintain continuity in humanitarian operations such as with Syrian refugees – would be severe in the Middle East, the workshop found.[60] There is no existing international capability for managing the large numbers of displaced people from the region who would need to be assisted and relocated, especially given the lack of capacity to handle the 65.3 million people (to date) already forcibly displaced as the result of conventional conflict.[61]

The workshop also noted a general lack of planning in the Middle East for responding to incidents that involve a nuclear weapons exchange. Institutional processes are lacking. Instead, response capacity is largely built on personal and practical experiences of human displacement resulting from conventional conflicts, and on similar experiences of natural disaster relief efforts. Some of the workshop participants, for instance, had been involved in humanitarian and relief operations after the 1999 earthquake in Turkey; in response efforts in Gaza, Iraq and Lebanon; or in the humanitarian response to the recent use of chemical weapons in Syria.

Although there are some similarities between such incidents, the unconventional characteristics of nuclear weapons (i.e. the extent of the blast, heat, thermal radiation and prolonged radiation effects) present different challenges that need to be considered. Some participants, for instance, gave the example of local governing bodies in their country having set up special meeting points for use in the event of natural disasters. Yet in the case of a nuclear weapons detonation, people would be advised to stay indoors in order to minimize their immediate exposure to radiation. Existing meeting points could nevertheless be useful in efforts to direct and provide shelter for displaced people. Local humanitarian organizations with a clear planning structure could be an important asset at this stage of the response effort.

Organizational culture in the Middle East tends to be based on strict hierarchies, and activities often require permission or approval from the authorities. Governments and military forces are viewed as the primary response units, and would be expected to coordinate the activities of

[60] Borrie, J. (2015), 'Why pursue effective measures', ILPI, 19 June 2015, http://unidir.ilpi.org/?p=363.
[61] UNHCR (undated), 'Figures at a Glance', http://www.unhcr.org/uk/figures-at-a-glance.html.

humanitarian organizations within an overall response strategy. Noticeably, the humanitarian community based in the region trusts and respects government agencies in emergency situations. This type of trust also exists between military units and civil society organizations. The workshop participants agreed that, as humanitarian workers, they would not be able to initiate a response without receiving certain information from their governments; and that the role of volunteers and aid workers was complementary to that of government in responding to any emergency, including a nuclear weapons detonation. After learning that the window for delivering a humanitarian response to a nuclear explosion without exposing workers to danger is very narrow, participants considered the options for disseminating information to those in the affected zone.

The simulation exercise considered the displacement and cross-border effects of a nuclear weapons explosion. The scenario was designed to capture contemporary issues of displacement, including the current crisis around the assistance needs of Syrian refugees living in tent cities in Turkey. Once displacement resulting from a nuclear explosion was recognized as a significant additional problem, participants discussed potential methods for directing people into safer locations as and when possible. These discussions created a debate over whose responsibility it was to direct displaced people should the government be unable to function at full capacity. The displacement of people in the Syrian conflict was discussed as an example for understanding this type of situation.

Regional coordination among humanitarian groups in the Middle East is almost non-existent. Although some information about response options is held by government bodies (such as emergency and disaster management centres or disaster relief units), this information is not commonly known within civil society. The group discussed the types of information that would need to be shared with those inside the affected zone and in neighbouring areas. First, advice would be needed on how to administer triage and treatment to casualties. Workshop facilitators also reminded participants of the added complexity for risk assessment caused by changes in wind direction. It was noted that a more cohesive network of regional civil society organizations and actors (equipped with a list of regional volunteers, personnel and trained individuals) is vital for disaster preparedness – particularly in responding to a nuclear weapons explosion.

Given the cross-border effects of such an incident, humanitarian organizations need to conduct capacity assessments in order to identify points of weakness in advance. Yet these assessments may not be entirely accurate. Regional or international organizations (e.g. Syrian organizations in Turkey, or the UN staff stationed in a country) will probably lack comprehensive knowledge of local terrain – particularly if they are stationed in one area for a limited time – and will also face capacity constraints.

The workshop discussions concluded that a practical and effective response to a nuclear weapons detonation would be nearly impossible. None of the discussed areas of government and humanitarian response would be able to function properly in the crisis scenario presented. There were additional concerns that unexpected bureaucratic challenges could create further logistical problems for the delivery of vital equipment. In this regard, pressuring national authorities to focus on preventing – as opposed to simply responding to – a nuclear detonation could be a more realistic option for humanitarian organizations.

South Asian perspectives

Though both Pakistan and India are party to the PTBT, neither has signed the CTBT. Between 1974 and 1998, the two countries carried out a total of 12 tests inside their respective territories. India first conducted what it called a 'peaceful nuclear explosion' on 18 May 1974 at the Pokhran Test Range in Rajasthan, a mere 150 km from the Pakistan border; the explosion had a yield of 12–15 kilotons.[62] This and subsequent tests prompted Pakistan to accelerate the development of its own nuclear weapons capability, a process that had begun a year after the Indo-Pakistan war of 1971. In May 1998, India conducted five further tests at the same site, all of them underground. Pakistan responded later in that month by conducting its own tests in the province of Balochistan.[63] The country's prime minister, Muhammad Nawaz Sharif, pointed to India's nuclear weapons programme as the driving force behind Pakistan's tests, remarking that '[t]oday, we have evened the score with India'.[64] Both countries have conducted nuclear tests in order to demonstrate military superiority, and – in both 1974 and 1998 – in the midst of intense political and military tension.

Both India and Pakistan have experienced catastrophic accidents and natural disasters requiring considerable military-led humanitarian responses. A gas leak at a chemical plant in the Indian city of Bhopal in 1984 caused the deaths of approximately 25,000 people, and left over 150,000 others chronically ill.[65] Given the lack of central government planning for a chemical disaster on that scale, the military and medical communities were among the only Indian state organs to function with success in the response to the emergency.[66]

In the Kashmir region in 2005, an earthquake measuring 7.6 on the Richter scale killed an estimated 86,000 people and reduced over 32,000 buildings to rubble.[67] By affecting a politically (and militarily) contested location, the earthquake added an extra layer of complexity to existing political tensions, making a military-led response even more sensitive.[68]

Humanitarian responses to other crises in Asia have highlighted various gaps in capacity that are likely to be exacerbated in the event of nuclear weapons use or nuclear testing.[69] In 2004, an earthquake and tsunami in the Indian Ocean killed approximately 280,000 people, the worst-hit countries being Indonesia, Sri Lanka, India and Thailand.[70] The regional and global response to this catastrophe required cooperation across borders between different states and non-state actors, each

[62] Perkovich, G. (1999), *India's Nuclear Bomb: the Impact on Global Proliferation*, University of California Press, p. 181.
[63] Khan, F. H. (2012), *Eating Grass: The Making of the Pakistan Atomic Bomb*, Stanford University Press, pp. 281–82.
[64] Burns, J. F. (1998), 'Nuclear Anxiety: The Overview; Pakistan, Answering India, Carries out Nuclear Tests; Clinton's Appeal Rejected', *New York Times*, 29 May 1998, http://www.nytimes.com/1998/05/29/world/nuclear-anxiety-overview-pakistan-answering-india-carries-nuclear-tests-clinton.html?pagewanted=all.
[65] Edwards, T. (1994), 'What Happened: Union Carbide's Toxic Gas Release', The Bhopal Medical Appeal, http://bhopal.org/what-happened/.
[66] Laor, E. (2012), 'Lessons from the Bhopal Disaster: Part II', *HazMat Responder World*, Autumn 2012, http://www.cbrneworld.com/_uploads/download_magazines/Bhopal_Disaster_2.pdf.
[67] ShakeMaps, 'Shakemap usdyae_05', United States Geological Survey (USGS), https://earthquake.usgs.gov/data/shakemap/.
[68] Cosgrave, J. and Herson, M. (2008), 'Perceptions of crisis and response: A synthesis of evaluations of the response to the 2005 Pakistan earthquake', *ALNAP Review of Humanitarian Action*, www.alnap.org/pool/files/ch4-final-web.pdf.
[69] See, for instance, the recommendations in UNICEF (2008), '2004 Indian Ocean Earthquake and Tsunami: Lessons Learned', *Humanitarian Action Report*, http://www.unicef.org/har08/index_tsunami.html; Scheper, E., Parakrama, A. and Patel, S. (2006), 'Impact of the tsunami response on local and national capacities', Tsunami Evaluation Coalition, https://docs.unocha.org/sites/dms/documents/tec_capacities_report.pdf; Oxfam (2014), *The Indian Ocean Tsunami, 10 Years on*, Oxfam Research Reports, 18 December 2014, https://www.oxfam.org/sites/www.oxfam.org/files/file_attachments/the_indian_ocean_tsunami_10_years_on_-_lessons_from_the_response_and_ongoing_humanitarian_funding_challenges.pdf.
[70] BBC (2005), 'Indonesia quake toll jumps again', 25 January 2005, http://news.bbc.co.uk/1/hi/world/asia-pacific/4204385.stm.

with its own procedures and bureaucratic processes for delivering humanitarian assistance.[71] Political obstacles to humanitarian relief were also highlighted in the 2015 Rohingya refugee crisis, when efforts to relocate displaced people facing persecution in Myanmar and resettle them in a range of other states across Asia encountered considerable logistical and political difficulties.

Governments and civil societies in South and Southeast Asia assume that the International Committee of the Red Cross (ICRC) would be able or available to act as a first responder – effectively or otherwise – in the event of a nuclear weapons detonation. But, as noted above, the ICRC would be capable of responding only in so far as its networks and members could carry out their responsibilities safely. Lack of proper equipment and the difficulty of obtaining customs clearances for dual-use equipment in emergency situations also pose serious questions about the ICRC's capacity to respond quickly or effectively.

Pacific perspectives

From 1946 until the CTBT received signatures in 1996, nuclear weapons tests were carried out by the following countries: the US (1,032); the Soviet Union (715); France (210); the UK (45); and China (45). In terms of test locations, the Pacific region accounted for a substantial share of these detonations. France conducted 193 tests in the Pacific, the US over 100 tests and the UK 21 (if Australia is included).[72] The long-term legacy of these tests has been visible in environmental damage, earthquakes, tsunamis, and other geological and hydrological effects.

Nuclear test explosions in the Pacific region have caused widespread humanitarian harm: in addition to contamination and severe health problems, local communities have suffered displacement and loss of land and cultural heritage. They have struggled to receive compensation and have encountered problems relating to a lack of official accountability. Workers involved in clean-up operations have developed leukaemia. The clean-up of radioactive materials around the Australian test site at Maralinga, for instance, was hampered by organizational difficulties, and some areas remain polluted by plutonium.[73] Some studies have also shown increased levels of thyroid cancer in children owing to the release of strontium-90 during the tests.[74] According to an IAEA report in 1998, 'permanent rehabilitation' of the Bikini Atoll is not permissible in view of the radiological conditions. It also warned that 'remedial actions such as scrapping or removal of topsoil would cause serious environmental harm'.[75] A greater awareness of the legacy of testing in the Marshall Islands/Bikini Atoll is being achieved as a result of a large civil society campaign which has brought these issues to light and sought compensation.

[71] Williams, H. R. (2009), 'Response to the 2004 Tsunami: An International Perspective', in Steets, J. and Hamilton, D. S. (eds) (2009), *Humanitarian Assistance: Improving U.S.-European Cooperation*, Raising the Bar project, Center for Transatlantic Relations, The Johns Hopkins University/Global Public Policy Institute, http://www.disastergovernance.net/fileadmin/gppi/RTB_book_chp21.pdf.
[72] CTBTO (undated), 'History of Nuclear Testing: World Overview', https://www.ctbto.org/nuclear-testing/history-of-nuclear-testing/world-overview/.
[73] Parkinson, A. (2002), 'Maralinga: The Clean-Up of a Nuclear Test Site', *Medicine & Global Survival*, February 2002, Vol. 7, No. 2, pp. 77–81.
[74] For more information, see Makhijani, A., Smith, B. and Thorne, M. C. (2006), *Science for the Vulnerable: Setting Radiation and Multiple Exposure Environmental Health Standards to Protect Those Most at Risk*, Institute for Energy and Environmental Research, 19 October 2006, http://ieer.org/resource/depleted-uranium/science-vulnerable-setting-radiation.
[75] IAEA (1998), 'Radiological Conditions at Bikini Atoll and the Prospects of Resettlement', Radiological Assessment Report Series 2.

The Pacific workshop brought together 18 experts from academia and civil society. This group had extensive information and knowledge concerning the impacts of nuclear testing and nuclear weapons explosions. The discussion focused on the effects on Aboriginal and indigenous communities. Identity in many Australian Aboriginal cultures rests on a strong spiritual and physical bond with the land and sea, visible in distinctive practices, customs and artwork. It is believed that people have a responsibility to protect the environment.

Communities with a common experience of the history of colonialism shared similar experiences of the impacts of nuclear testing. Aboriginal peoples living in close proximity to nuclear test sites felt the effects of displacement, health complications, land confiscation and cultural devastation to a disproportionate degree. One of the more intangible legacies was a sense of humiliation. Tests in Maralinga, furthermore, have left local communities highly distrustful of the Australian government. Compensation has never been properly established. In most instances it has been sporadic, distributed only to a small number of families and individuals, and confined to citizens of the states conducting the tests.[76]

Nuclear tests in the Marshall Islands exposed populations to an additional risk: from radioactive waste stored in concrete cascades, which are beginning to erode as the result of a rise in sea level and the effects of climate change. According to a 2013 US Department of Energy report, the waste 'has started to reach to the crater' and has begun contaminating the soil.[77] The *Guardian* newspaper reported that despite an eight-year clean-up operation after testing ceased, the US Congress 'refused to fund a comprehensive decontamination programme to make the entire atoll fit for human settlement again'.[78] The case was fought in the US Ninth Circuit Court of Appeals.[79]

The Marshall Islands also brought court cases against all nuclear weapons states in 2014, calling on them to pursue nuclear disarmament obligations in good faith. In the case against the UK subject to the compulsory ruling of the International Court of Justice, the court concluded that the UK's conduct could not show an opposition of views and did not provide a basis for finding a dispute between the two states. The court therefore concluded that the UK's first preliminary objection must be upheld and that, lacking jurisdiction, it could not proceed to the merits of the case.[80] Similar judgments have been made with regard to jurisdiction based on the absence of a dispute between the parties in the cases against Pakistan[81] and India.[82]

The group discussions highlighted that international treaties related to nuclear testing contain no provisions for supporting victims. In addition, survivor networks have not existed until very

[76] Ruff, T. A. (2015), 'The humanitarian impact and implications of nuclear test explosions in the Pacific Region', *International Review of the Red Cross*, Vol. 97, Issue 899, pp. 775–813.
[77] Hamilton, T. (2013), *A Visual Description of the Concrete Exterior of the Cactus Crater Containment Structure*, Lawrence Livermore National Laboratory, October 2013, LLNL-TR-648143, https://marshallislands.llnl.gov/ccc/Hamilton_LLNL-TR-648143_final.pdf.
[78] Jose, C., Wall, K. and Hinze, J. H. (2015), 'This dome in the Pacific houses tons of radioactive waste – and it's leaking', *Guardian*, 3 July 2015, https://www.theguardian.com/world/2015/jul/03/runit-dome-pacific-radioactive-waste.
[79] In the United States Court of Appeals for the Ninth Court, The Republic of the Marshall Islands (plaintiff—appellant) v. The United States of America (defendants—appellees), Case: 15- 15636, 13 July 2015.
[80] International Court of Justice (2016), Judgment of 5 October 2016, 'Obligations Concerning Negotiations Relating to Cessation of the Nuclear Arms Race and to Nuclear Disarmament (Marshall Islands v. United Kingdom)', http://www.icj-cij.org/docket/files/160/19198.pdf.
[81] International Court of Justice (2016), Judgment of 5 October 2016, 'Obligations Concerning Negotiations Relating to Cessation of the Nuclear Arms Race and to Nuclear Disarmament (Marshall Islands v. Pakistan)', http://www.icj-cij.org/docket/files/159/19166.pdf.
[82] International Court of Justice (2016), Judgment of 5 October 2016, 'Obligations Concerning Negotiations Relating to Cessation of the Nuclear Arms Race and to Nuclear Disarmament (Marshall Islands v. India)', http://www.icj-cij.org/docket/files/158/19134.pdf.

recently. The 'Humanitarian Impacts of Nuclear Weapons' conference held in Oslo in 2013 was the first opportunity for many survivors to learn of the experiences of others.

The workshop and scenario discussion[83] concluded that there is no adequate preparedness for dealing with a nuclear weapons detonation in the Pacific region, and that any response to a nuclear weapons incident would simply be based on the prior experiences of humanitarian organizations in managing smaller-scale conventional crises. The IFRC has been actively pursuing a nuclear disarmament campaign, and has been increasing awareness and education within its different chapters. However, workshop discussants argued that the Australian Red Cross would be incapacitated in the event of a nuclear weapons explosion; and that no matter what plans were put in place before an explosion, the magnitude of such a disaster would make it impossible to adhere to them. The participants were not informed as to whether the Australian government has any formal response plans in respect of a nuclear weapons detonation.

African perspectives

France conducted 17 nuclear tests in Algeria between 1960 and 1966, four of them atmospheric.[84] The 1962 Evian Accords – in effect the peace treaty between the two countries – gave France the right to conduct nuclear tests in the Algerian desert for a further five years following Algeria's independence. After this period, France conducted all of its tests in the Pacific region. Recently declassified military documents have revealed that radiation fallout from the French nuclear tests in Algeria was not restricted to the Saharan desert, as claimed by France at the time, but had an impact on the entire continent and even extended to southern Spain and Italy.[85]

In addition, on 22 September 1979 a nuclear device was detonated in the atmosphere over the South Atlantic – this test has received much attention but has never been officially recognized or claimed.[86]

Forty years after the testing programme in Algeria, the IAEA's examination of the test sites in the country concluded that 'vegetation is scarce and only two plant samples could be collected'.[87] The IAEA observed different pathways of exposure in atmospheric and underground testing in Algeria that could be used as a rule of thumb for estimating all nuclear testing exposure. In the case of atmospheric tests, some of these pathways consisted of 'external exposure from radionuclides on the ground, inhalation of material, ingestion of food or touching soil adhering to hands and deposited on foodstuffs, particularly in windy conditions'.[88] In the case of underground tests, the study found that at In Ekker, Taourirt Tan Afella, exposure might result from 'external radiation in

[83] See Annex I of this paper for the scenario summary.
[84] CTBTO (undated), '13 February 1960 - The First French Nuclear Test', https://www.ctbto.org/specials/testing-times/13-february-1960-the-first-french-nuclear-test.
[85] Sewell, A. (2014), 'Fallout from France's 1960 atomic bomb tests hit southern Europe', *Science*, 16 February 2014, http://www.digitaljournal.com/tech/science/fallout-from-france-s-1960-atomic-bomb-tests-hit-southern-europe/article/371105.
[86] Burr, W. and Cohen, A. (eds) (2016), 'The Vela Incident: South Atlantic Mystery Flash in September 1979 Raised Questions about Nuclear Test', National Security Archive Electronic Briefing Book No. 570, 8 December 2016, http://nsarchive.gwu.edu/nukevault/ebb570-The-22-September-1979-Vela-Satellite-Incident/.
[87] IAEA (2005), *Radiological Conditions at the Former French Nuclear Test Sites in Algeria: Preliminary Assessment and Recommendations*, Radiological Assessment Report Series, http://www-pub.iaea.org/MTCD/publications/PDF/Pub1215_web_new.pdf.
[88] Ibid.

the vicinity of ejected lava, inhalation or ingestion of dust, ingestion of contaminated water, ingestion of contaminated food (e.g. meat, milk)'.[89]

The workshop discussions noted that nuclear disarmament is not generally viewed as an urgent security matter in many African states, and is consequently not prioritized. Historically, the continent's nuclear disarmament narrative has fed into independence efforts and into the socio-economic development of newly independent states.[90] Ghana's first prime minister and president, Kwame Nkrumah, once remarked that 'the poisonous fall-out did not, and never will, respect the arbitrary and artificial divisions forged by colonialism across our beloved continent', and declared that 'Africa is not interested in such "defence" which means no more than the ability to share in the honour of destroying mankind'.[91]

In the 1990s, the Organisation of African Unity (now the African Union) helped lead negotiations on the Treaty of Pelindaba.[92] The treaty has provided a regional platform for disarmament discussions, and established a nuclear-weapon-free zone in Africa in 1997. Although most African states have actively engaged in the NPT and other disarmament conferences – such as in the Oslo, Nayarit (Mexico) and Vienna conferences on the humanitarian impacts of nuclear weapons[93] – nine African countries have still either not signed or not ratified the CTBT.[94] This failure highlights the lack of prioritization of this issue at the regional level, and perhaps within the African Union.

South Africa is often considered the region's leader in multilateral debates concerning nuclear disarmament,[95] in particular because it completely dismantled its nuclear weapons programme between 1989 and 1994.[96] It is, to date, the only state to have done so. Yet as one participant noted, there remains a 'legacy of contested truth and political amnesia'. Participants in the workshop considered the humanitarian impact of the South African nuclear weapons programme to be unique, though similarities with other regions (such as the Pacific) were also noted: for instance, racial segregation and injustice were both drivers and consequences of South Africa's nuclear weapons programme, as they were elsewhere. Participants argued that it was important for South Africa 'to get to grips with its nuclear history' and to educate the public about the consequences of nuclear weapons. Education is also necessary, participants concluded, to improve legislation to address emerging security threats, such as the potential for drones to attack nuclear sites.[97]

[89] Ibid. p. 29.
[90] Saxena, S. C. (1998), 'Disarmament: The African Perspective', *Strategic Analysis*, Vol. 22, Issue 7, pp. 993–1017.
[91] Nkrumah, K. (1960), 'Positive Action Conference for Peace and Security in Africa', posted on GhanaCulturePolitics, originally published 7 April 1960, http://ghanaculturepolitics.com/positive-action-conference-for-peace-and-security-in-africa.
[92] ILPI (2016), *The Road to Pelindaba: An overview of the history and politics of nuclear non-proliferation and disarmament in Africa*, 29 July 2016, Background Paper No. 20/2016, p. 13, http://nwp.ilpi.org/wp-content/uploads/2016/08/BP20-16_AFRICA-REV-1.pdf.
[93] According to an updated ILPI publication, at the Oslo conference 35 African states were present, and nine of them had delivered statements. In Nayarit and Vienna, participation by African states increased to 45, with 16 and 20 statements respectively. See ILPI (2016), *The Road to Pelindaba*, p. 20.
[94] Mauritius, Somalia and South Sudan have not signed the treaty; Comoros, Egypt, Equatorial Guinea, São Tomé and Príncipe, The Gambia and Zimbabwe have signed but not ratified the treaty. See CTBTO (undated), 'Status of Signature and Ratification', https://www.ctbto.org/the-treaty/status-of-signature-and-ratification/.
[95] Since the third humanitarian impact of nuclear weapons conference in Vienna, the international community has expected South Africa to hold the fourth conference. The South African delegation was also a vocal participant at the 2015 NPT review conference.
[96] See, for instance, Swart, S. J. (2015), 'An African contribution to the nuclear weapons debate', *International Review of the Red Cross*, Vol. 97, Issue 899, pp. 753–73.
[97] In August 2016, a drone that crashed in a South African nuclear power plant was returned to its owner without any charges being laid. This is a legal gap in many countries. See ESI Africa (2016), 'Drone crash lands into SA nuclear facility', ESI Africa, 10 August 2016, https://www.esi-africa.com/news/drone-crash-lands-sa-nuclear-facility/.

Participants were of the opinion that response and coordination mechanisms in Africa are inadequate.[98] Moreover, military units and governments are viewed as the only institutions capable of leading any sort of response efforts in an emergency situation. The assessment of the group was that civil society would have a minimal capacity to deliver a humanitarian response; and that church groups (particularly Evangelical groups) and older leaders (wise elders), rather than formal civil society organizations, had vital networks that would enable them to feature more prominently in disseminating accurate information to local communities in the event of a nuclear incident.

Participants in the hypothetical nuclear weapons explosion scenario argued that a humanitarian response would be impossible given that the military would block all access points across the region. Moreover, a nuclear weapons explosion in a strategic location (such as a military base in Ghana – see Annex I, Scenario 3) would have immediate knock-on effects on the humanitarian response. Participants from Ghana stated that even ambulances would be located inside the explosion area, and would therefore be lost.

The scenario discussion revealed a lack of awareness in the wider region of the catastrophic impacts of a nuclear weapons explosion. Participants argued that even the best plans and procedures would not work in such an eventuality. Information would be hard to verify, and one of the participants noted that 'the first person who shares their views with the public would be viewed as the expert', regardless of that person's expertise or competency. It was therefore seen as important to empower a well-trained and educated civil society. In the African context, this would involve medical students, medical personnel, traditional doctors and local community services, given that trust in these actors is particularly high, in comparison with central government services and certified doctors. Nevertheless, it is not certain who would take on leadership in the event of a nuclear explosion.

Public health systems are already stretched, as demonstrated by the recent experience with the Ebola outbreak in West Africa. Temporary relief centres were discussed as alternative options for protecting victims. The Red Cross participants argued that psychological assistance for survivors, and care for children, would be their priority in the longer term.

[98] Even though the response capacity in different parts of Africa would vary, the workshop had a continental focus.

4. Conclusions

In the current world situation, the deliberate or accidental detonation of a nuclear weapon is assumed to be a low-probability, high-impact event. Whatever the actual probability – which varies according to political tensions and actors – such a detonation nevertheless represents high risk. Other than prevention, no adequate preparedness and response measures are currently in place – whether at the level of the state, through humanitarian organizations or in development-oriented civil society – for coping with a nuclear weapons catastrophe. Assessing response capacities, particularly the complex humanitarian responses required, is an important process. Where state capacity is lacking, the UN can provide resources; however, at the Nayarit conference in 2014 it was stated that 'the UN is unlikely be able to offer coordinated humanitarian assistance in the immediate aftermath' of a nuclear incident.[99] Before assisting victims, humanitarian organizations need to prioritize the protection of their own staff and volunteers.

Engaging in scenario exercises based around delivering emergency response in the aftermath of a nuclear weapons detonation can help local humanitarian organizations to identify vulnerable nodes, logistical and communication problems, and priority response areas stemming from the event. Such exercises could support the development of an overarching approach to ensuring preparedness for nuclear weapons use or the resumption of nuclear testing. Improving preparedness hinges on building upon previously established coordination and communication channels.

There were similarities between all regions in terms of the themes raised at the workshops. Prominent among these was uncertainty over who is responsible for assisting people following nuclear weapons explosions, nuclear tests or nuclear accidents. No clear structures, plans or procedures exist at city, national or regional levels for responding to nuclear incidents. In most of the countries considered, the communities of the IFRC are ill equipped to respond.

The IFRC follows a 'risk-management operational response approach', with the ability to undertake informed risk assessment, take timely decisions, and effectively mobilize resources.[100] This approach aims to minimize risks to staff health, safety and security, ensure continuation of activities, and provide assistance to affected people.[101] Nonetheless, timely, deployable resources are limited: the IFRC is prepared for chemical, biological or radiological incidents, but not for a nuclear catastrophe. A doctrine of prevention still seems paramount. At the IFRC's 2011 general assembly, a resolution was adopted stating that the movement's position was to prohibit and eliminate nuclear weapons and 'to ensure nuclear weapons will never be used again'.[102]

[99] Borrie, J. (2014), 'Preliminary Findings Challenges to United Nations emergency preparedness, humanitarian coordination & response in the event of nuclear detonation events', presentation at Nayarit conference, http://www.reachingcriticalwill.org/images/documents/Disarmament-fora/nayarit-2014/statements/UNIDIR.pdf.
[100] Krottmayer, M. (2015), 'Humanitarian Considerations and Assistance', presentation given at Humanitarian Impacts of Nuclear Testing and Nuclear Weapons Detonations Workshop in Istanbul, Turkey, 9 June 2015.
[101] Ibid.
[102] Council of Delegates of the International Red Cross and Red Crescent Movement (2011), 'Working towards the elimination of nuclear weapons', Resolution, 26 November 2011, CD/11/R1, Geneva. For more information, see International Federation of Red Cross and Red Crescent Societies (2015), *Nuclear and Radiological Emergency Guidelines: Preparedness, Response and Recovery*, Geneva: IFRC, http://www.ifrc.org/Global/Documents/Secretariat/201602/1296000-NuclearRadio.Emer.Guide-Int-EN-LR.pdf.

The IFRC is also involved in capacity-building measures, particularly for its national societies, and in work with civil society organizations in international forums (e.g. the NPT Review Committee and the UN's Open-Ended Working Group). Despite increased efforts, the level of awareness within national societies of the risks associated with the unintentional, unauthorized or intentional use of nuclear weapons is low. Representatives from these societies are eager for a clear call on 'what is expected from them', and on the ways in which they could contribute to the IFRC's mission.[103]

Current modernization efforts go beyond enhancing safety features, instead focusing on maintaining nuclear stockpiles ready for use and extending states' nuclear weapons capabilities for decades; billions of dollars are currently being allocated for this purpose.[104]

The level of awareness within the humanitarian community regarding nuclear weapons testing is still low. An overwhelming number of civil society organizations, especially in developing countries, place all their confidence in the military's ability to provide safety and security in the event of a nuclear catastrophe. This confidence is misplaced, unless there is an improvement in knowledge and capacity at the level of national militaries. A focus on training for military personnel, including development of plans and procedures that draw on the knowledge gained from nuclear weapons testing, would help to establish a more relevant and realistic approach to mitigating such risks.

Systematic policy engagement in the nuclear disarmament arena is lacking in most developing or less developed countries. The degree of involvement varies from one issue to another. Nuclear weapons states bear responsibility for mitigating the risks and minimizing the consequences associated with nuclear weapons testing, and indeed there have been attempts to clean up local sites and compensate victims in certain affected regions.[105] But given the catastrophic effects of nuclear testing, there also needs to be a fundamental international commitment to using the CTBT to prevent further testing. This should be a commitment to the health of all, including indigenous and other communities, and to the protection of cultural heritage.

There is an important connection between the widely supported comprehensive ban on nuclear testing and attempts to ban nuclear weapons altogether. A ban on nuclear testing has been pursued in large part because of tests' unacceptable effects on local populations and the environment, not just in an attempt to promote nuclear non-proliferation and disarmament. Precisely the same concerns are driving current efforts to prohibit nuclear weapons.

[103] Personal communication between the authors with the national societies, at IFRC side-event at the UN General Assembly, Open-Ended Working Group, May 2016.
[104] Kile, S. N. and Kristensen, H. M. (2016), 'Trends in World Nuclear Forces, 2016', SIPRI Fact Sheet, June 2016, SIPRI (Stockholm International Peace Research Institute), https://www.sipri.org/sites/default/files/FS%201606%20WNF_Embargo_Final%20A.pdf.
[105] US Department of Justice (undated), 'Radiation Exposure Compensation Act', https://www.justice.gov/civil/common/reca.

Annex I: Workshop Scenarios

Scenario 1: Nuclear detonation at Adana, city centre, Turkey

At 09:30 on 10 June 2015, on a cloudy day, an enormous explosion occurs in the city centre of Adana, Turkey.

No information on the type of attack is released by the Turkish authorities or other states, but images showing a mushroom cloud circulate quickly on social media. These pictures are taken outside Adana.

There is no electricity in the affected region, and people outside the area are trying to contact friends and families. It is expected that the main highway to the airport has been severely damaged by the explosion. The highway is likely to be blocked by large amounts of debris closer to the detonation in Adana.

News of the attack is being broadcast across almost all Turkish and international media channels. Some of the media coverage reports that the explosion was a deliberate attack. The UN has invoked response mechanisms to coordinate an international response (through the IAEA's Joint Radiation Emergency Management Plan of the International Organizations). The UN Security Council has decided to meet in New York. Heads of UN agencies – the IAEA, World Health Organization (WHO) and World Food Programme, among others – are expected to convene as well.

Within minutes, vast amounts of thermal energy cause spontaneous fires across urban and suburban areas within 4.8 km of the blast. Flammable materials start to burn and cause firestorms. Survivors, many of whom are already injured, are at risk from these fires, which are now engulfing the few buildings that would offer short-term shelter. The fires are causing further second- and third-degree burns, which create a high risk of infection. Victims may need assistance to be evacuated from buildings that are unsafe or at risk of catching fire. Sarıçam Tent City – which houses Syrian refugees – is already full to capacity at the time of the detonation.

Estimates based on previous studies suggest that in this instance there would be at least 250,000 fatalities and 400,000 people with injuries needing urgent treatment. This is a lower-range estimate based on a 20-kiloton explosion, which would directly affect an area of 16.2 sq km with a radius of 2.3 km.

From social media, the world can see images of the mushroom cloud taken from great distances. This causes widespread panic, with speculation about the possibility of a second attack. Experts are saying that the wind will be carrying radioactive particles in the direction of the Middle East. Satellite images reveal a massive flow of people travelling away from the city centre. Some are heading south, others towards the river. The former are at risk of massive radiation exposure. Many are almost certainly already injured and, depending on their level of exposure, may soon begin to suffer the delayed effects of Acute Radiation Syndrome (ARS). This complicates medical triage decisions for those assessing survivors who manage to reach functioning healthcare facilities.

To mitigate the consequences, Turkey initiates the full spectrum of national disaster management capabilities. To this end, the Republic of Turkey Prime Ministry Disaster and Emergency Management Presidency (AFAD) deploys a chemical, biological, radiological and nuclear (CBRN) unit to monitor and assess the impact of the disaster. The Turkish prime minister asks for qualified search-and-rescue units to join in the efforts. An initial AFAD report indicates that all hospitals and medical facilities within 2 sq km of the blast – including burns units – have been destroyed or severely damaged.

The UN issues a press release referencing data received from the International Data Centre of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). This reveals that the CTBTO has detected a seismic event resembling an explosion in Turkey. Primary seismic stations in Turkey, Tunisia and Iran, and auxiliary seismic monitoring stations in Israel and Jordan, also detect the explosion.

It takes approximately one-and-a-half hours following the explosion for initial data to be made available to CTBTO member states. After monitoring, processing and analysis, the CTBTO makes radionuclide data available within less than 12 hours.

Just under 40,000 Syrian refugees were living in the city centre of Adana at the time of the blast. The UN is unable to provide immediate assistance to them, or to the other affected people in and around the city. Some of its own personnel who were in or near Adana at the time of detonation are also missing. UNHCR is already stretched in providing core relief items, field monitoring and technical advice to over 1.6 million refugees inside Turkey. The nuclear fallout is likely to affect camps in southern Turkey, as well as those near the border in Syria.

One day after the event, agencies in northern Syria responsible for internally displaced persons (IDPs) are reporting symptoms of ARS. Turkey had been providing cross-border humanitarian assistance, mostly in areas close to the border. IDPs, however, were also present in informal settlement areas further from the border, such as in Aleppo, Latakia and Idlib governorates. The fallout is likely to affect these settlements, which are not within the zone of the UN coordination effort.

Earlier USAID and EU Chemicals Agency (EU REACH) reports had documented immense difficulties in providing aid and delivering assistance within these informal settlement areas, even before the nuclear explosion in Adana. Now that the Turkish government faces its own national humanitarian crisis, practical questions arise over the need to generate greater capacity so that Turkey can continue its other international humanitarian relief efforts.

News coverage by the BBC of IDP camps and informal settlements in Syria indicates that IDPs in the region are trapped between the effects of radiation and the violence of the Syrian conflict.

There is evidence that an illness is spreading at various IDP settlements. Although the illness may have a number of causes, including radiation poisoning, WHO officials draw attention to the possibility that it could be an infectious disease. Medical personnel also exhibit symptoms.

Scenario 2: Nuclear detonations at Pine Gap, central Australia, and RAAF Base Darwin, northern Australia

In a major nuclear conflict, nuclear-weapon-related facilities at the US Pine Gap communications and control base in central Australia are targeted. The event occurs on a clear day on 21 April 2016. At first, no information detailing the type of attack is released by Australian authorities or other states, but images showing a mushroom cloud circulate quickly on social media. The pictures are taken hundreds of kilometres from Pine Gap. There is no electricity in the affected region, and people are trying to contact friends and families.

The nearest town to the Pine Gap facilities is Alice Springs, which has a population of around 28,000 and is the third-largest in Northern Territory. The closest major city is Adelaide, with 1.25 million inhabitants. The Alice Springs airport is located 15 km to the south of the town, which is connected by rail to Adelaide in the south and Darwin in the north. It is expected that the main highway to the airport has been severely damaged by the explosions. Pine Gap hosts 14 large antennae and over 800 staff. It is the US's major spy satellite tracking station for one-third of the globe, covering China, parts of Russia and the Middle East. Its role includes signal intelligence gathering, early warning, gathering drone strike targeting information, and nuclear 'alerting'.

The attacks on Pine Gap involve multiple targets, with 10- and 20-kiloton warheads launched from submarines. Three explosions take place on the ground, while two occur in the air (airburst). One missile shuts down the command, control and communication systems at Pine Gap, while another explodes in the Alice Springs area. The explosions are initially believed to have caused immediate casualties of 90 per cent dead and injured at Alice Springs and in surrounding communities.

In a simultaneous attack, Royal Australian Air Force (RAAF) Base Darwin – used frequently by US Air Force and US Marine Corps aircraft – is targeted by a 10-kiloton warhead. First estimates suggest that more than 3,000 people are immediately killed, and that 10,000 are injured. The effects of the explosion reach Darwin International Airport; the roads are severely damaged.

The impacts of these nuclear explosions are experienced more widely too, in New Zealand and adjacent Pacific islands. Apart from the initial blast, radiation, radioactive fallout and firestorms, they include short- and longer-term climatic effects, regional electromagnetic pulse (EMP) effects (e.g. the disabling of electronics and vital communication systems), disruption to the import of essential materials and medical supplies, and the erosion of social cohesion.

In the case of the EMP effects, a 2004 US Congressional Commission on such attacks noted:

> The primary avenues for catastrophic damage [...] are through our electric power infrastructure [...] telecommunications, energy, and other infrastructures. These, in turn, can seriously impact other important aspects [...] including the financial system; means of getting food, water, and medical care to the citizenry; trade; and production of goods and services.[106]

[106] Foster, J. S., Gjelde, E., Graham, W. R., Hermann, R. J., Kluepfel, H. M., Lawson, R. L., Soper, G. K., Wood, L. L. and Woodard, J. B. (2004), *Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack, Volume 1: Executive Report*, EMP Commission, http://www.empcommission.org/docs/empc_exec_rpt.pdf.

Scenario 3: Nuclear detonations at Burma Camp, southeastern Ghana, and Airborne Base, northern Ghana

In a major conflict involving nuclear weapons, critical military infrastructure is targeted in Ghana. Two main army bases are attacked: Burma Camp on the outskirts of the capital, Accra, in the southeast; and Airborne Base in Tamale, in the north. These host two of Ghana's three air force bases, and are the locations of organizational military facilities for aerial warfare, including command, control, communication, computers and intelligence bases for Ghana's Ministry of Defence. The intelligence bases are headquartered at Burma Camp, along with the Ghanaian armed forces.

The air force base at Burma Camp serves a variety of duties related to flying, engineering, supply and administration. Major operations of the base include maintaining fighter-ground attack capability, providing close air support during operations, conducting surveillance over Ghana's airspace and exclusive economic zone, and assisting with medical evacuation and air rescue. The camp is the largest military base in the country, comprising many military units and barracks, and has over 2,000 staff.

Accra is the largest city in the country, with a population of over 2 million. Tamale, another of six metropolitan cities in Ghana, is the capital of Northern Region and has a population of about 250,000. Both Burma Camp and the northern Airborne Base would be pre-emptive targets for enemies seeking to incapacitate or destroy vital assets, systems and networks. Their destruction would have a debilitating effect on security, the economy and public health in Ghana.

Burma Camp is attacked on a clear day on 11 August 2016. Initially no details of the attack are released by the Ghanaian authorities or by other states. However, images of a mushroom cloud, taken hundreds of kilometres from Burma Camp, circulate quickly via social media across the 15 member countries of the Economic Community of West African States (ECOWAS). No electricity supplies remain operational in the affected region, and people are trying to contact their families, friends and colleagues.

The attacks on Burma Camp involve multiple targets, with 10-kiloton warheads launched from submarines. Three explosions take place on the ground and two in the air. One of these airbursts is at a high altitude and succeeds in shutting down the command, control and communication systems, while the others explode on the ground or at a lower altitude over the Airport Hills area. The explosions are anticipated to have caused immediate casualties (fatal and non-fatal) of 90 per cent at Burma Camp and in surrounding communities. The nearest settlement, Airport Hills, is a modern and sparsely populated residential area containing numerous offices, including those of international NGOs and embassies. Apart from Accra, the closest major city to Burma Camp is Tema, which has a population of approximately 160,000. Accra Kotoka International Airport is located 6 km to the northwest of Burma Camp. It is connected by collector road to Tema, and by arterial road, rail and air transport links to Tamale. It is expected that the main highway to the airport has been severely damaged by the explosions. The highway is likely to be blocked by large amounts of debris closer to the detonation at Burma Camp.

In a simultaneous attack, the Airborne Base in Tamale – used frequently by Ghanaian combat, reconnaissance, transport and trainer aircraft and helicopters – is also targeted by a 10-kiloton nuclear warhead. First estimates are that more than 3,000 people are killed immediately, with 10,000 injured. The effects of the explosion also reach Tamale International Airport.

The wider and longer-term impacts are experienced not only within Ghana but also regionally (in adjacent Côte d'Ivoire, Togo and Burkina Faso). They include the effects of the initial blast, radiation and radioactive fallout, firestorms, climate change caused by the blast (both short- and longer-term), regional EMP effects (e.g. the disabling of electronics and vital communication systems), disruptions to the import of essential materials and medical supplies, and the erosion of social cohesion.

Annex II: Current Approaches to Nuclear Disarmament and Non-proliferation

The 'step-by-step' and 'progressive' approaches

The nuclear weapons states are among the chief supporters of the step-by-step approach to nuclear disarmament. This approach argues that states follow 'independent steps … providing adequate security assurances for non-nuclear weapon states, halting the production of fissile material, and negotiating verifiable arms reduction treaties' in realizing the eventual goal of nuclear disarmament.[107] This process is not bound by a specific timeline, and its supporters argue that nuclear disarmament can only succeed if the steps are taken in sequential order. As the steps are to be taken chiefly by the nuclear weapons states, progress is contingent on their political will and cooperation.

The negotiation of the CTBT represents one of these steps. In theory, ratifying the CTBT to bring the treaty into force should be a high priority – especially among nuclear weapons states that are supportive of the step-by-step process, since the sustainable prohibition on nuclear testing is a significant building block. Yet as mentioned above, eight of the Annex 2 states required to ratify the CTBT to bring it into force still have not done so.

Domestic and international politics have stood in the way of complete ratification, preventing the treaty from entering into law. When negotiations began in 1993, the US took the lead, saying that it was 'out front, pulling'. Despite India's veto against the adoption of the treaty in the Conference on Disarmament (CD) in 1996, most states, including the US, supported its adoption at the UN General Assembly in that year. However, in 1999 the US Senate decided against ratification, citing concerns about the CTBT's verification mechanisms. The CTBTO has since demonstrated and established that these mechanisms are highly effective, capable of detecting even small-scale nuclear explosions. The verification regime is composed of a mixture of technical methods including seismic, hydro-acoustic, radionuclide and infrasound monitoring networks within the International Monitoring System, along with the use of on-site inspections. Despite these advances in the CTBTO, the US has yet to restart the process of ratification.[108]

Another obstacle to complete ratification of the CTBT is the situation in the Middle East, where Israel, Iran and Egypt have bound their arms control and non-proliferation policies to an intractable diplomatic dilemma. Israel supports establishing a peace and security process in the Middle East as a prerequisite for discussing nuclear disarmament. Egypt, however, insists that Israel renounce its unacknowledged nuclear weapons programme and join the NPT, as a condition for Egypt agreeing to a wider peace and security framework. Neither country will therefore take further steps towards ratification of the CTBT, even though both signed the treaty in 1996. Other

[107] Borrie, Caughley, Torbjørn, Løvold, Nystuen and Waszink (2016), *A Prohibition on Nuclear Weapons: A Guide to the Issues*, p. 23.
[108] After the Cold War, in 1992, the US suspended all types of nuclear weapons testing in a unilateral moratorium. See US Department of State (undated), 'Comprehensive Nuclear Test-Ban Treaty (CTBT)', http://www.state.gov/t/avc/c42328.htm.

states in the region are following suit: Iran signed in 1996 but has yet to ratify, and neither Syria nor Saudi Arabia has signed yet. These antithetical views are visible also at the CD. Israel's status as a non-member of the NPT also complicates regional discussions.

China, India and Pakistan are in similar predicaments. India's nuclear weapons programme is directed against threats both from China and, although these are not always articulated, Pakistan. Pakistan's nuclear posture and policies are understood to stem from the perceived threat from India's nuclear weapons capability and international acceptance of India's nuclear status.[109] In both India and Pakistan, threat perception and increasingly entrenched nuclear postures and policies serve to create narratives against ratification of the CTBT. Although China, like India, maintains an official no-first-use policy, this posture has been called into question given its plans to develop a credible at-sea second-strike capability via the development of the JIN-class SSBN (Type 094 submarine).[110] Even if there were to be progress on CTBT ratification in Asia – for example, if India were to ratify – rivalries with the US and Russia would be a stronger factor in any treaty decisions by China.[111] It regards the US as a potential threat to its national security and is unlikely to ratify first. For its part, the US appears to prefer to wait on other Annex 2 states to ratify before it does so itself. Bringing the CTBT into force is therefore contingent on the political will of these remaining Annex 2 states, which are themselves locked within regional and global structures of insecurity.

The CD is the only formal multilateral negotiating body for nuclear disarmament treaties. It is composed of 65 states, and has not expanded its membership since 1999 in spite of requests from a number of countries to join. It is governed by the rule of consensus, which means that individual states have the ability to block progress.

Nuclear weapons states and allied countries view the prohibition of fissile materials for weapons purposes (highly enriched uranium and plutonium being the most significant such materials) as the next logical step towards nuclear disarmament. The CD, however, has not yet been able to agree on moving forward with the Fissile Material Cut-off Treaty (FMCT) negotiations. For 20 years, despite the 'Shannon Mandate'[112] that provides an agreed basis for negotiations, deep divisions have persisted among CD member states regarding the potential treaty's 'scope, definition, verification requirements, and legal obligations and institutional arrangements'.[113] The treaty would go some way to reducing the discriminatory nature of the non-proliferation regime by dealing with all weapons-purposed fissile materials, including those in nuclear weapons possessor countries.

[109] See Nagal, B. (2016), 'India and Ballistic Missile Defense: Furthering a Defensive Deterrent', Carnegie Endowment for International Peace, 30 June 2016, http://carnegieendowment.org/2016/06/30/india-and-ballistic-missile-defense-furthering-defensive-deterrent-pub-63966.
[110] Office of Naval Intelligence (2015), *The PLA Navy: New Capabilities and Missions for the 21st Century*, http://www.oni.navy.mil/Portals/12/Intel%20agencies/China_Media/2015_PLA_NAVY_PUB_Print_Low_Res.pdf?ver=2015-12-02-081233-733. See also Woolgar-James, R. (2015), 'China's Nuclear Submarines: The End of "No-First Use?"', *Bulletin of the Atomic Scientists,* Voices of Tomorrow Series, 19 November 2015.
[111] Acton, J. (2013), 'The Future of Multilateral Arms Control Verification, 2013 CTBT Diplomacy and Public Policy Course', 15–19 July 2013, Vienna.
[112] The Shannon Mandate established an ad hoc committee to find effective ways of negotiating a ban on the production of fissile materials for nuclear weapons. See Shannon, G. E. (1995), 'Report of Ambassador Gerald E. Shannon of Canada on Consultations on the Most Appropriate Arrangement to Negotiate a Treaty Banning the Production of Fissile Material for Nuclear Weapons or Other Nuclear Explosive Devices', CD/a1229, 24 March 1995, http://www.acronym.org.uk/old/official-and-govt-documents/shannon-report-mandate.
[113] UN General Assembly (2015), 'Group of Governmental Experts to make recommendations on possible aspects that could contribute to but not negotiate a treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices', seventieth session, A/70/81, 7 May 2015, http://fissilematerials.org/library/gge15.pdf. Canada, for instance, channels its efforts into the negotiation of an FMCT and views the prohibition of nuclear materials as a step towards nuclear disarmament. See Permanent Representative of Canada (2015), 'Working Paper: Questions to stimulate discussion of the elements of a treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices', Conference on Disarmament, CD/2025.

Moreover, the step-by-step approach to nuclear disarmament has become complicated and complex. For example, it has generated steps within steps, such as 'strategic stability', 'peace first', 'dialogue first', 'nuclear disarmament first' or 'verification first'.

The nuclear weapons states have not fully engaged in the various attempts to kick-start multilateral disarmament discussions. Although this lack of engagement has created frustration, most non-nuclear weapons states continue to put their faith and efforts into tirelessly promoting renewed visions of nuclear disarmament. In 2016, the 20th anniversary of the last treaty negotiated in the CD, a number of countries, many of which are in nuclear alliance relationships such as NATO or with the US in the Pacific, proposed a new initiative, which they dubbed the 'progressive approach'. This is in essence similar to the step-by-step approach, but without a strict sequence of steps, and favours nuclear disarmament only once a 'minimization point' is reached.[114] It proposes 'an international reliable verification regime with effective verification techniques and methods'[115] and recommends pursuing negotiations on a 'legally-binding instrument to prohibit nuclear weapons' as an 'interim step towards nuclear disarmament'.[116]

The 'humanitarian impacts of nuclear weapons initiative' and 'effective legal measures' approach

As the step-by-step approach has failed to deliver any concrete outcomes at the CD in over two decades, a number of states have demanded a new forum and approach for discussing nuclear disarmament. The frustrations and lack of effective mechanisms for moving the nuclear disarmament agenda forward led them to introduce the concept of the 'humanitarian impacts of nuclear weapons' as part of the 2010 NPT Action Plan.

In 2013, Norway hosted the first international conference on the humanitarian impacts of nuclear weapons. This conference in Oslo, and the following two in Nayarit, Mexico and Vienna (both held in 2014), provided factual and scientific analysis and included discussions on the 'potential use and the physical effects of nuclear weapons' in international and public domains.[117] At the Vienna conference, the Austrian government pledged to work with various actors 'in efforts to stigmatise, prohibit and eliminate nuclear weapons in light of their unacceptable humanitarian consequences and associated risks'. Following the 2015 NPT review conference, this commitment became known as the 'Humanitarian Pledge'; to date it has been endorsed by 127 states.[118]

A somewhat neglected dimension in the humanitarian initiative thus far has been consideration of the full effects and significance of the prohibition on nuclear testing. All the negotiations that led to the CTBT – including the 1963 PTBT, the various limiting agreements between the US and the

[114] UN General Assembly (2016), 'Open-Ended Working Group Taking Forward Bilateral Nuclear Disarmament Negotiations', 24 February 2016, A/AC.286/WP.9. See also Perkovich, G. and Lewis, P. (2009), 'The Vantage Point', International Commission on Nuclear Non-proliferation and Disarmament, icnnd.org/Documents/Vantage_Point.pdf.
[115] UN General Assembly (2016), 'Open-Ended Working Group Taking Forward Bilateral Nuclear Disarmament Negotiations'.
[116] OEWG (2016), 'Report of the Open-ended Working Group Taking Toward Multilateral Nuclear Disarmament Negotiations', A/RES/70/33.
[117] Williams, H., Lewis, P. and Aghlani, S. (2015), *The Humanitarian Impacts of Nuclear Weapons Initiative: The 'Big Tent' in Disarmament*, Research Paper, London: Royal Institute of International Affairs, https://www.chathamhouse.org/sites/files/chathamhouse/field/field_document/20150331HumanitarianImpactNuclearWilliamsLewisAghlani.pdf.
[118] International Campaign to Abolish Nuclear Weapons (undated), 'Humanitarian Pledge', http://www.icanw.org/pledge/.

Soviet Union (and later Russia), and the Antarctic Treaty[119] – have a humanitarian imperative at their core. Yet today, the polarization between nuclear and non-nuclear weapons states is greater than in the past, reflecting in part widening differences in their interpretations of their responsibilities and duties under the NPT, especially in regard to Article VI on nuclear disarmament, which calls on states to 'pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament'.[120] One of the main responsibilities of the nuclear weapons states is to pursue disarmament – including the elimination of nuclear weapons – in good faith through 'effective measures'; both nuclear weapons states and non-nuclear weapons states agree that the ratification and entry into force of the CTBT would represent an 'effective measure'.

Nuclear weapons tests during and after the Cold War have had immediate, short-term and long-term humanitarian consequences – affecting people's health, the environment (e.g. contamination of water, soil and vegetation, etc.), society and culture. Indigenous populations have been hit particularly hard. They have been subjected to 'forced displacement',[121] and compelled to change their diets owing to contamination of food sources. They have been prevented from pursuing traditional livelihoods, and have lost their land and connection to it. The level of compensation awarded to indigenous populations has varied: the US has given compensation to affected civilians and military personnel, whereas China, for instance, has not awarded compensation to affected Uighur populations in Central Asia.[122] In some cases, compensation has been paid only for land loss and not to the people directly affected.

Achieving a complete, sustainable prohibition on nuclear weapons testing through the entry into force of the CTBT would demonstrate a clear commitment to the disarmament obligations that have been agreed by nuclear weapons states and those outside the NPT. It would indicate that nuclear weapons possessors are genuinely moving towards disarmament. Verification procedures and monitoring are already established in the CTBT structure. As such, a legal prohibition on nuclear testing would be in line with both the 'step-by-step' and 'progressive' approaches.[123]

A proactive discourse on nuclear disarmament is one that seeks new effective measures – both legal and practical – to reduce the risks posed by nuclear weapons, including the risks of a future resumption of nuclear weapons tests and potential detonations of nuclear weapons in conflict. The act of conducting nuclear tests – as seen today in the case of North Korea – is as much political as technical, aimed at demonstrating military power to other states. It therefore embeds nuclear weapons policies within pre-existing political practices, decision-making processes and doctrines. Nuclear test simulations to predict, through computer modelling, the accuracy, efficiency and safety

[119] US Department of State (undated), 'Antarctic Treaty', Bureau of Arms Control, Verification and Compliance, https://www.state.gov/t/avc/trty/193967.htm.
[120] UN Office for Disarmament Affairs (undated), 'Treaty on the Non-Proliferation of Nuclear Weapons (NPT)', http://www.un.org/disarmament/WMD/Nuclear/NPTtext.shtml.
[121] Bagshaw, S. (2014), 'Population Displacement: Displacement in the aftermath of nuclear weapon detonation events', ILPI-UNIDIR Vienna Conference Series, Paper No. 4, https://www.files.ethz.ch/isn/186112/population-displacement-en-619.pdf.
[122] China has conducted 45 nuclear weapons detonations in Lop Nor, 23 of which were atmospheric tests. See CTBTO (undated), 'China's Nuclear Testing Programme', https://www.ctbto.org/nuclear-testing/the-effects-of-nuclear-testing/chinas-nuclear-testing-programme/; also see Unrepresented Nations and Peoples Organization (2012), '50 Years After Test 596: The Effects of Nuclear Testing in East Turkestan', http://www.unpo.org/downloads/371.pdf.
[123] UN Security Council (2016), Resolution 2310, S/RES/2310.

of nuclear weapons and delivery systems have led to a continuing reliance on nuclear weapons within military doctrines.

The example of North Korea demonstrates that the normative moratorium against nuclear testing is insufficient to prevent nuclear weapons tests when a country considers itself to be under existential threat. In the past decade, North Korea has conducted five underground nuclear weapons tests. At times of high tension, states are more likely to resort to extraordinary measures and send increasingly belligerent signals to one another; nuclear weapons tests have been used in this way before.[124]

During the 71st session of the First Committee Meeting of the UN General Assembly in November 2016, the UN adopted Resolution L41 and called for a conference to be held in 2017 (from 27 to 31 March, and from 15 June to 7 July) in New York to negotiate effective legal measures on the way towards nuclear disarmament.[125]

With 123 states voting in favour, the resolution was passed. Nuclear weapons states and nuclear alliance countries – those that are under the security umbrella of the US and NATO – voted against the resolution. This pattern, however, is not an indicator of a regional approach. The discussions on nuclear weapons risks have changed the discourse and created non-regional postures. In considering the value of nuclear weapons, today it is not only the voice of governments that matters, but also the opinion of parliaments, civil society, lawyers, physicians and the public.

Resolution L41 showed that there is no single European approach towards nuclear disarmament. Countries that are members of organizations such as the EU or NATO follow different policies. Ireland and Austria vocally drove the Open-Ended Working Group (OEWG) process; while small European states, such as Malta and Cyprus, supported the drive for disarmament by voting in favour of Resolution L41.

Nor are nuclear weapons host countries – Belgium, Germany, the Netherlands, Italy and Turkey – unanimous. The narrative of a single nuclear posture within the NATO alliance is false. In reality, NATO's nuclear posture does not resonate among all its members. Its 2010 Strategic Concept refers to deterrence as a 'mix of conventional and nuclear capabilities', and nuclear burden-sharing is not a prerequisite for NATO membership.[126] France follows its own nuclear weapons policy, and the UK and Greece have already renounced the hosting of tactical nuclear weapons in their territories. The Netherlands, another NATO member and nuclear weapons host country, abstained from voting for Resolution L41. Moreover, on 28 April 2016 the Dutch parliament held a debate on the prohibition

[124] For example, before the Cuban missile crisis, more than 175 nuclear tests were conducted in 1962 by both the US and the Soviet Union — the highest number per year in nuclear testing history. For more information, see CTBTO (undated), 'The Cuban Missile Crisis and Nuclear Testing', https://www.ctbto.org/press-centre/highlights/2012/the-cuban-missile-crisis-and-nuclear-testing/ (accessed 22 Sep. 2016).
[125] The resolution passed with 123 in favour, 38 against and 16 abstentions. For the resolution, see UN General Assembly (2016), 71st Session First Committee, 'General and complete disarmament: taking forward multilateral nuclear disarmament negotiations', A/C.1/71/L.41, 14 October 2016, http://www.un.org/ga/search/view_doc.asp?symbol=A/C.1/71/L.41.
[126] NATO (2010), 'Strategic Concept For the Defence and Security of The Members of the North Atlantic Treaty Organisation', http://www.nato.int/lisbon2010/strategic-concept-2010-eng.pdf.

of nuclear weapons; it was reported that the 'vast majority of the House wanted to start working' towards this goal.[127]

Countries that have experienced nuclear weapons testing by an outside country on their territory do not hold common nuclear disarmament policies either. For instance, despite a high level of awareness in civil society and expert groups, Australia strongly opposed the OEWG's final paper, suggesting that new legal measures would create legal overlaps; in contrast, Pacific island states – notably the Marshall Islands – have strongly supported a move towards nuclear weapons prohibition.

[127] Pax for Peace (2016), 'Dutch Parliament: the Netherlands needs to negotiate an international nuclear weapons treaty', 28 April 2016, https://www.paxforpeace.nl/stay-informed/news/dutch-parliament-the-netherlands-needs-to-negotiate-an-international-nuclear-weapons-ban-treaty.

Acronyms and Abbreviations

AFAD	Republic of Turkey Prime Ministry Disaster and Emergency Management Presidency
AFRICSIS	African Centre for Science and International Security
CBRN	chemical, biological, radiological and nuclear
CD	Conference on Disarmament
CTBT	Comprehensive Nuclear-Test-Ban Treaty
CTBTO	Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization
ECOWAS	Economic Community of West African States
EMP	electromagnetic pulse
FMCT	Fissile Material Cut-off Treaty
IAEA	International Atomic Energy Agency
ICRC	International Committee of the Red Cross
IDP	internally displaced person
IFRC	International Federation of Red Cross and Red Crescent Societies
ILPI	International Law and Policy Institute
NATO	North Atlantic Treaty Organization
NPT	Non-Proliferation Treaty
OEWG	Open-Ended Working Group
PTBT	Partial Test Ban Treaty
RAAF	Royal Australian Air Force
SDGs	Sustainable Development Goals
UNGA	UN General Assembly
UNHCR	UN High Commissioner for Refugees
UNIDIR	UN Institute for Disarmament Research
USGS	United States Geological Survey
WHO	World Health Organization

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Cover image: Aboriginal elder Eileen Kampakuta Brown, joint winner of the 2003 Goldman Environmental Prize for her struggle to stop construction of a nuclear waste dump in South Australia.

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