Facing Fallout

Principles for Environmental Remediation of Nuclear Weapons Contamination

Harvard Law School International Human Rights Clinic
Conflict and Environment Observatory

Cover Illustration
From 1977-1980, the US military dumped radioactive soil from its earlier nuclear weapons tests in Enewetak Atoll of the Marshall Islands into a bomb crater and covered it with the concrete Runit Dome. Some experts now have concerns about the ongoing stability of the dome, particularly given rising sea levels due to climate change. © US Defense Special Weapons Agency, 1980.

Design
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Contents

Table of Acronyms

ALARA	As low as reasonably achievable
CCW	Convention on Conventional Weapons
CEDAW	Convention on Elimination of All Forms of Discrimination Against Women
CEOBS	Conflict and Environment Observatory
CRPD	Convention on the Rights of Persons with Disabilities
IAEA	International Atomic Energy Agency
ICCPR	International Covenant on Civil and Political Rights
ICERD	International Convention on the Elimination of All Forms of Racial Discrimination
ICESCR	International Covenant on Economic, Social and Cultural Rights
ICRP	International Commission on Radiological Protection
IHRC	Harvard Law School International Human Rights Clinic
ILO	International Labour Organization
IMAS	International Mine Action Standards
ISIS	Islamic State
NEA	Nuclear Energy Agency
NGOs	Nongovernmental organizations
OECD	Organization for Economic Co-operation and Development
TPNW	Treaty on the Prohibition of Nuclear Weapons
UN	United Nations
UNFCCC	UN Framework Convention on Climate Change

Executive Summary

The effects of nuclear weapons are catastrophic for the environment and the humans who depend on it. The blasts of nuclear weapons can flatten cities and cause earthquakes and hurricane-force winds that wreak havoc on the environment. Radioactive contamination pollutes the air, water, and earth, devastating local ecosystems. In contaminated environments, flora and fauna experience death, sickness, depressed reproduction rates, and morphological changes. The human beings who are exposed to contaminated environments suffer comparable health effects, including death, cancer, vascular diseases, strokes, genetic disorders, and psychological trauma. Radioactive contamination has social and economic impacts as well. It may forcibly displace entire communities, destroy local livelihoods, and deny indigenous peoples access to traditional lands, irrevocably damaging cultural heritage.

While previous treaties sought to prevent further use and testing of nuclear weapons, they had not included provisions to deal with contamination from past detonations and its consequences.[1] Inspired by humanitarian disarmament precedent and growing concern for the environmental impacts of military activities, the 2017 Treaty on the Prohibition of Nuclear Weapons (TPNW) took a broader approach. It both prohibited nuclear weapons and included positive obligations to assist victims and take steps to remediate the environment[2].

This report identifies 19 Principles for implementing measures to remediate the environment contaminated by nuclear weapons and includes an in-depth accompanying commentary. The environmental remediation described here seeks to address existing harm and unacceptable risks of future harm to the environment and affected communities caused by nuclear weapons contamination. It achieves its goal by targeting the underlying causes of the harm, the pollution that degrades the environment and in turn affects people.

This report complements a 2020 report by the same authors entitled *Confronting Conflict Pollution: Principles for Assisting Victims of Toxic Remnants of War*.[3] Victim assistance supplements environmental remediation efforts by working to mitigate the health, socioeconomic, and other impacts people have experienced. It seeks to respond to the needs of affected individuals, families, and communities and promote the full realization of their human rights. The principles in *Confronting Conflict Pollution* apply to all toxic remnants of war, which are exemplified by nuclear weapons contamination.[4] While the new report applies specifically to the byproducts of nuclear weapons, its Principles could be adapted to the remediation of other toxic remnants of war.

This report was written in the context of the First Meeting of State Parties for the TPNW, scheduled for June 2022, but it offers long-term guidance for environmental remediation, a process that will take place over years or decades. Its Principles are relevant not only for

1 See, e.g., Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (Treaty of Tlatelolco), opened for signature February 14, 1967; South Pacific Nuclear Free Zone Treaty (Treaty of Rarotonga), opened for signature August 6, 1985, entered into force December 11, 1986; Treaty Banning Nuclear Tests in the Atmosphere, in Outer Space and Under Water (Partial Test Ban Treaty), opened for signature August 5, 1963, entered into force October 10, 1963.

2 Treaty on the Prohibition of Nuclear Weapons (TPNW), adopted July 7, 2017, A/CONF.229/2017/8, entered into force January 22, 2021, arts. 1, 6, 7.

3 Harvard Law School International Human Rights Clinic (IHRC) and Conflict and Environment Observatory (CEOBS), *Confronting Conflict Pollution: Principles for Assisting Victims of Toxic Remnants of War* (September 2020), http://hrp.law.harvard.edu/wp-content/uploads/2020/09/Confronting-Conflict-Pollution.pdf (accessed May 20, 2022).

4 "Toxic remnants of war are toxic or radiological substances resulting from military activities that form a hazard to humans or ecosystems." Ibid., Principle 2.

states parties implementing TPNW Articles 6 and 7, but for any state affected by the use or testing of nuclear weapons that seeks to address contamination in its territory. It may also serve as a guide for organizations working in the field.

The Principles are divided into six categories, which:

- Articulate the purpose and character of environmental remediation in the context of radioactive contamination;
- Define the types of harm caused by contamination from the use and testing of nuclear weapons;
- Outline a framework of shared responsibility under which affected states work with other states and non-state actors to achieve the goals of environmental remediation;
- Establish the steps of environmental remediation that states should take to address the harm caused by radioactive contamination;
- Highlight the importance of information handling, including data collection, dissemination, and preservation; and
- Present three guiding principles—inclusivity, non-discrimination, and transparency—that are fundamental to effective processes of environmental remediation and underlie all of the other Principles.

To develop the 19 Principles, the Harvard Law School International Human Rights Clinic (IHRC) and the Conflict and Environment Observatory (CEOBS) examined the environmental effects of the use and testing of nuclear weapons and undertook an in-depth study of relevant law, policy, and practice. Humanitarian disarmament norms and international environmental law provided the foundation for the Principles. Humanitarian disarmament is an approach to governing weapons that "seeks to prevent and remediate arms-inflicted human suffering and environmental harm."[5] These sources were bolstered by precedent from international human rights law and international humanitarian law. The authors' previous work on the TPNW's positive obligations also informed the Principles.[6] IHRC and CEOBS adapted these models to address the distinctive characteristics of radioactive contamination, such as the longevity of radiation, its geographic migration, and the scientific uncertainty of its long-term effects.

Part I lists the Principles that resulted from this process. Part II offers a detailed commentary. The commentary discusses the meaning and importance of each principle and provides precedent drawn from relevant law, policy, and practice.

5 Humanitarian Disarmament, "About," https://humanitariandisarmament.org/about/ (accessed May 22, 2022).
6 See, e.g., IHRC, "Victim Assistance and Environmental Remediation in the Treaty on the Prohibition on Nuclear Weapons: Myths and Realities," April 2019, https://hrp.law.harvard.edu/wp-content/uploads/2019/05/TPNW_Myths_Realities_April2019.pdf (accessed May 20, 2022); IHRC, "Environmental Remediation under the Treaty on the Prohibition of Nuclear Weapons," April 2018, http://hrp.law.harvard.edu/wp-content/uploads/2018/04/Environmental-Remediation-short-5-17-18-final.pdf (accessed May 20, 2022).

PART I:
PRINCIPLES

Purpose and Character

Principle 1: Purpose of Environmental Remediation

Environmental remediation should address existing harm and unacceptable risks of future harm to the environment and affected communities caused by contamination from the use and testing of nuclear weapons.

Principle 2: Character of Environmental Remediation

Scientific understanding of the effects of radiation exposure and the human exposure pathways at individual sites is far from complete. To account for and mitigate this limited and evolving knowledge, states should follow the precautionary principle and take an iterative approach to environmental remediation.

Affected states should also follow international standards and best practices, including ensuring worker safety, and use the best available technologies at each step of the environmental remediation process.

Definition

Principle 3: Definition of Harm

Contamination from the use and testing of nuclear weapons causes a range of harm to the environment and people. Harm includes but is not limited to: environmental degradation; loss of biodiversity; physical and psychological injuries and death; social marginalization; economic loss; loss of access to natural resources; obstacles to participation in cultural life; displacement of local communities; and substantial impairment of the realization of the human rights.

Framework of Shared Responsibility

Principle 4: Responsibility

States should take necessary and appropriate measures for the environmental remediation of areas under their jurisdiction or control that have been contaminated as a result of the use or testing of nuclear weapons.

Other states, including but not limited to states that have used or tested nuclear weapons, should cooperate with and provide technical, material, financial, and other assistance to "affected states"—i.e., states with contaminated areas—to help them meet their environmental remediation responsibilities.

Principle 5: Exchange of Scientific and Technical Information

States, international organizations, nongovernmental organizations, and other actors should exchange scientific and technical information with affected states regarding nuclear contamination and environmental remediation measures.

Principle 6: Capacity Building

States, international organizations, nongovernmental organizations, and other actors should promote capacity building to ensure long-term and effective environmental remediation.

Steps of Environmental Remediation

Principle 7: National Strategy

Affected states should develop, implement, and periodically review and update a comprehensive and coordinated national environmental remediation strategy, which includes designating a focal point, delegating responsibilities, developing a budget, creating a timeline, and adopting and implementing laws and policies.

Principle 8: Assessing, Surveying, and Recording

Affected states should assess, survey, and record the nature, extent, and effects of contamination and any discernable exposure pathways at each site in order to prioritize their responses and develop effective action plans for remediation.

Principle 9: Optimization

When planning the remediation of a contaminated site, affected states should evaluate a range of potentially effective options and implement the option that produces the greatest benefit to the affected communities and the environment. This evaluation should include considerations of costs and benefits related to the environment, human health, society, culture, and the economy, and it should be guided by the preferences of affected communities and other stakeholders.

Principle 10: Risk Education

Affected states should ensure that clear, comprehensive, tailored risk education programs are available to all communities affected by or at risk of radioactive contamination from the use or testing of nuclear weapons.

Principle 11: Preventing Radiation Exposure Pathways

Affected states should prevent exposure by breaking, disrupting, or removing the pathways by which people are exposed to contamination from nuclear weapons use or testing. Such measures may include limiting access to contaminated sites, such as through marking and fencing, and controlling food and water sources.

Principle 12: Addressing Contamination

When an affected state determines that comprehensive environmental remediation is necessary and appropriate, the state should address the contamination itself through measures such as containment or other forms of treatment.

Principle 13: Material Handling and Waste Management

Affected states should ensure that contaminated material is properly managed during handling, transport, and storage.

Principle 14: Long-Term Site Management

Affected states should actively manage each remediation site and waste storage facility while residual contamination poses a risk of harm to people or the environment. Such long-term site management should include: staffing, monitoring, and maintenance of sites and facilities; funding; risk education; data collection, dissemination, and preservation; and other elements as needed.

Handling of Information

Principle 15: Data Collection and Dissemination

Affected states engaged in any phase of the remediation process should collect data and information about affected sites and communities and remediation measures, and disseminate that data in accessible forms to all stakeholders.

Principle 16: Data Preservation

Affected states should implement measures designed to preserve, for the conceivable radiological life of contaminated waste, all data or institutional knowledge needed for the long-term operation and maintenance of each remediation or waste storage site. Given the length of management necessary at most sites, data and knowledge should be recorded in a form accessible to the international community so that uninterrupted management does not depend on a single state.

Guiding Principles

Principle 17: Inclusivity

Affected states should meaningfully consult with and actively involve affected communities, their representative organizations, nongovernmental organizations, and other stakeholders at all stages of the remediation process.

Principle 18: Non-Discrimination

Affected states should adhere to the principle of non-discrimination in planning and implementing remediation measures. Affected states should ensure that their environmental remediation measures do not discriminate based on race, color, language, ethnicity, sex, sexual orientation, gender identity or expression, age, national origin, religion, disability, geographic location, socioeconomic class, or other status.

Principle 19: Transparency

Affected states should ensure transparency with respect to the design, administration, implementation, monitoring, and evaluation of environmental remediation programs.

PART II:

COMMENTARY

Purpose and Character

Principle 1: Purpose of Environmental Remediation

> Environmental remediation should address existing harm and unacceptable risks of future harm to the environment and affected communities caused by contamination from the use and testing of nuclear weapons.[7]

Discussion

The use and testing of nuclear weapons gravely damage the environment and harm the people who live in it in a variety of ways. Blast effects can produce hurricane-force winds and earthquakes that damage natural features.[8] Contamination from nuclear weapons can pollute the air, water, and soil, disrupt ecosystems, and reduce biodiversity. It can also infiltrate the food chain, cause devastating impacts on human health and well-being, and displace entire communities.[9]

In the context of these Principles, environmental remediation seeks to address both existing harm and unacceptable risks of future harm associated with contamination from the use and testing of nuclear weapons. As discussed under Principle 3, existing harm can encompass, for example, decimation of local ecosystems, immediate effects on people's health, and the disruption of aspects of individuals' daily lives. Harm can extend beyond the most directly affected areas. Radioactive fallout from the more than 2,000 nuclear test explosions since 1945 has spread across the world, particularly to downwind and down-current states.[10] Fallout from Chinese nuclear tests at Lop Nur has been found in Kazakhstan; fallout from Soviet tests in Russia and Kazakhstan has spread to North America and Scandinavia.[11] In French Polynesia, a single nuclear test in 1974 exposed the entire population of Tahiti to radioactive fallout.[12]

There is also a risk of future harm. Because some isotopes have decades- or even centuries-long half-lives, radiation can continue to harm the environment and its inhabitants long after the use or testing of nuclear weapons has ended.[13] Given the ways in which contamination can migrate and infiltrate ecosystems and food chains over time, affected states should account for risks of future environmental or human harm based on present contamination pathways.[14] Affected states should undertake an assessment of the present hazards, the likelihood of exposure to those hazards, the severity or consequence of the impact, and the

7 The obligations under Article 6(2) of the TPNW encompass the use and testing of both "nuclear weapons and other nuclear explosive devices." For brevity, references to "nuclear weapons" in the Principles should be read to include "other nuclear devices."
8 Matthew B. Bolton and Elizabeth Minor, "Addressing the Ongoing Humanitarian and Environmental Consequences of Nuclear Weapons: An Introductory Review," *Global Policy*, vol. 12 (February 2021), p. 88; Article 36, "Banning Nuclear Weapons," February 23, 2013, https://article36.org/wp-content/uploads/2020/12/Report_web_23.02.13.pdf (accessed May 15, 2022), p. 1.
9 Nuclear Weapons Ban Monitor, "The Obligation to Remediate Affected Territory," https://banmonitor.org/positive-obligations-1/the-obligation-to-remediate-affected-territory (accessed May 22, 2022).
10 Bolton and Minor, "Addressing the Ongoing Humanitarian and Environmental Consequences of Nuclear Weapons: An Introductory Review," *Global Policy*, pp. 81, 91.
11 Ibid.
12 Adrian Cho, "France Grossly Underestimated Radioactive Fallout from Atom Bomb Tests, Study Finds," *Science* (2021).
13 Bolton and Minor, "Addressing the Ongoing Humanitarian and Environmental Consequences of Nuclear Weapons: An Introductory Review," *Global Policy*, p. 88.
14 For further discussion of contamination pathways, see Principle 11 and accompanying commentary.

risk that exposure will result in adverse consequences to those exposed.[15] Determining whether there is an unacceptable risk of future harm to an affected community or environment should involve consultations with the affected community. The boundaries and acceptability of a level of risk may vary across stakeholders, depend on societal concerns, and be governed by certain circumstances, such as changes in standards, economic conditions, and public expectations. Some risks are regarded as unacceptable because they entail too high a likelihood that harm will occur or the consequences are too severe should the event or exposure occur, even though the likelihood may be low.

Environmental remediation seeks to address the harm and unacceptable risk of harm from nuclear weapons contamination by addressing the source. After taking several preparatory steps, it can follow the process outlined below to prevent exposure pathways, as discussed in Principle 11, and deal with the contamination itself, as discussed in Principles 12-14. The Principles in this report seek to provide guidelines and standards for environmental remediation programs. Remediation measures are unlikely to return a contaminated site to its pre-contamination state, but countries should ensure that the site is suitable for its intended use and does not pose unacceptable, ongoing risks to the wider environment.[16] The environmental and human harm caused by nuclear weapons use and testing necessitates that states work together to adopt the strongest possible environmental remediation measures.

Precedent

Precedent for environmental remediation appears in humanitarian disarmament treaties, international human rights law, international environmental law, and domestic environmental practice.

Environmental remediation of nuclear weapons contamination parallels the "clearance and destruction" of explosive ordnance obligations of the 2008 Convention on Cluster Munitions and the 1997 Mine Ban Treaty—the humanitarian disarmament treaties responsible for banning the use, stockpiling, production, and transfer of cluster munitions and antipersonnel mines, respectively.[17] Environmental remediation and clearance both address the dangerous remains of weapons. Clearance entails the removal or destruction of cluster munition remnants or antipersonnel landmines. Similarly, environmental remediation encompasses measures performed to reduce exposure to contamination resulting from nuclear weapons use or testing. The Principles in this report draw heavily on those two treaties as well as directly on the Treaty on the Prohibition of Nuclear Weapons, the most recent humanitarian disarmament instrument, which includes a specific obligation to remediate the environment contaminated by the use or testing of nuclear weapons.[18]

15 For further discussion of risk assessments, see Principle 2 and accompanying commentary.
16 International Atomic Energy Agency (IAEA), "Guidelines for Remediation Strategies to Reduce the Radiological Consequences of Environmental Contamination," Technical Reports Series No. 475, 2012, p. 2. The IAEA emphasizes that remediation does not imply that "the conditions that prevailed before the contamination can be achieved again and unconditional use of the land area can be restored," but rather that it should return the land to a state in which the "conditions [are] suitable for limited use under *institutional control*." IAEA, *IAEA Safety Glossary: Terminology Used in Nuclear Safety and Radiation Protection,* 2018, p. 198 (emphasis in original).
17 Convention on Cluster Munitions, adopted May 30, 2008, 2688 U.N.T.S. 39, entered into force August 1, 2010, art. 4(1) ("Each State Party undertakes to clear and destroy, or ensure the clearance and destruction of, cluster munition remnants . . ."); Convention on the Prohibition of the Use, Stockpiling, Production, and Transfer of Anti-Personnel Mines and on Their Destruction (Mine Ban Treaty), adopted September 18, 1997, entered into force March 1, 1999, art. 5 ("Each State Party undertakes to destroy or ensure the destruction of all anti-personnel mines in mined areas . . .").
18 TPNW, art. 6(2).

International human rights law also supports the principle of remediating the environment after nuclear weapons contamination. Many regional agreements and national constitutions explicitly recognize a right to a healthy environment,[19] and many human rights depend on having a safe, clean environment. The Human Rights Committee, the treaty body for the 1966 International Covenant on Civil and Political Rights (ICCPR), has indicated that the implementation of the covenant's right to life necessitates measures that address threats such as environmental degradation.[20] The 1966 International Covenant on Economic, Social and Cultural Rights (ICESCR) adds that states parties should take steps necessary to improve "environmental and industrial hygiene" to maintain the right to "the highest attainable standard of physical and mental health."[21] As noted by John H. Knox, then special rapporteur on human rights and the environment, the human rights "to an adequate standard of living, to adequate food, to safe drinking water and sanitation, to housing, and to participation in cultural life and to development," also depend on a "safe, clean, healthy and sustainable environment."[22]

At least two non-binding international documents have noted the link between environmental cleanup and armed conflict. The Draft Principles on the Protection of the Environment in Relation to Armed Conflicts, adopted by the International Law Commission in 2022, include a principle on remnants of war that requires parties to a conflict to "remove or render harmless toxic or other hazardous remnants of war under their jurisdiction or control that are causing or risk causing damage to the environment."[23] A 2016 UN Environment Assembly resolution "stresses" the importance of restoring the environment after a conflict.[24]

Numerous international environmental agreements include obligations for the remediation or management of degraded areas, albeit outside of the conflict context. As discussed further under Principle 3 on Definition of Harm, the 1992 Convention on Biological Diversity requires states parties to clean up damaged ecosystems.[25] The 1979 Convention on the Conservation of Migratory Species of Wild Animals obliges states parties "to conserve and, where feasible and appropriate, restore" critical habitats.[26] In its Annex III on waste disposal

19 Human Rights Council, Report of the Special Rapporteur on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment, A/HRC/37/59, January 24, 2018, Annex, para. 4 (citing Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention), art. 1; African Charter on Human and Peoples' Rights, art. 24; Additional Protocol to the American Convention on Human Rights in the Area of Economic, Social and Cultural Rights, art. 11; Arab Charter on Human Rights, art. 38; and ASEAN Human Rights Declaration, art. 28. More than 100 states have recognized the right at the national level.)

20 Human Rights Committee, General Comment No. 36 (2018) on Article 6 of the ICCPR, on the Right to Life, CCPR/C/GC/36, October 30, 2018, paras. 62, 26. See also International Covenant on Civil and Political Rights (ICCPR), adopted December 16, 1966, G.A. Res. 2200A (XXI), 21 U.N. GAOR Supp. (No. 16), U.N. Doc. A/6316 (1966), 999 U.N.T.S. 171, entered into force March 23, 1976, art. 6. The ICCPR is a multilateral treaty that commits states parties to uphold the civil and political rights of individuals, such as the right to life, freedom of religion, freedom of speech, freedom of assembly, electoral rights, and rights to due process and a fair trial.

21 International Covenant on Economic, Social and Cultural Rights (ICESCR), adopted December 16, 1966, 993 U.N.T.S. 3, entered into force January 3, 1976, art. 12(2)(b). The ICESCR is a multilateral treaty that commits its states parties to respect, protect, and fulfill economic, social and cultural rights, such as labor rights and the right to health, the right to education, and the right to an adequate standard of living.

22 Human Rights Council, Report of the Special Rapporteur on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment, A/HRC/37/59, January 24, 2018, Annex, para. 4.

23 International Law Commission, Draft Principles on the Protection of the Environment in Relation to Armed Conflicts, A/CN.4/L.968, May 20, 2022, Principle 26.

24 UN Environment Assembly, "Protection of the Environment in Areas Affected by Armed Conflict," Resolution 2/15, UNEP/EA.2/Res.15, August 4, 2016, para. 1 ("Stresses the critical importance of protecting the environment at all times, especially during armed conflict, and of its restoration in the post-conflict period, including from the unintended collateral impacts of human displacement resulting from armed conflict").

25 Convention on Biological Diversity, adopted May 22, 1992, 1760 U.N.T.S. 79, entered into force December 29, 1992, art. 8(f).

26 Convention on the Conservation of Migratory Species of Wild Animals, signed June 23, 1979, 1651 U.N.T.S. 28, entered into force November 1, 1983, art. III (4)(a). See also ibid., art. V(5)(e).

and management, the 1991 Protocol on Environmental Protection to the Antarctic Treaty establishes a framework for remediating waste "so as to minimise impact on the Antarctic environment and to minimise interference with the natural values of Antarctica."[27] The 2001 Stockholm Convention on Persistent Organic Pollutants and the 2013 Minamata Convention on Mercury both require remediation measures to be "environmentally sound."[28] The 1992 Convention on the Transboundary Effects of Industrial Accidents mandates that states parties take "restoration measures" and other steps "to protect human beings and the environment against industrial accidents."[29] The 1992 Convention for the Protection of the Marine Environment of the North-East Atlantic requires states to, "when practicable, restore marine areas which have been adversely affected."[30]

Several of the principles of the 1972 Stockholm Declaration, a foundational document of international environmental law, also suggest that states have an obligation to neighboring states to safeguard the environment within their control or jurisdiction. Principles 1 and 2 establish that states protect the environment for current and future generations through planning and management, and Principle 21 calls on states to exercise due regard to ensure "that activities within their jurisdiction . . . do not cause damage to the environment of other states."[31] Environmental remediation can help prevent the transboundary migration of radiological contaminants and thereby ensures that radioactive material within affected states does not adversely affect neighboring states.

Regional and national environmental practices also recognize the importance of remediation and preventative measures in the cases of environmental harm or risk of environmental harm. For instance, the United Kingdom's Environmental Protection Act of 1990 provides a risk-based approach to the identification and remediation of land where contamination poses an unacceptable risk to human health or the environment.[32] Similarly, the European Union's Directive on Environmental Liability establishes a framework of environmental liability that requires preventative measures even in cases where environmental damages has not yet occurred but there is an imminent threat of such damage occurring.[33]

27 Annex III to the Protocol on Environmental Protection to the Antarctic Treaty: Waste Disposal and Waste Management, signed October 4, 1991, entered into force January 14, 1998, art. 1(2).

28 Stockholm Convention on Persistent Organic Pollutants (POPS), adopted May 22, 2001, 2256 U.N.T.S. 119, entered into force May 17, 2004, art. 6(1)(e); Minamata Convention on Mercury, adopted January 19, 2013, entered into force August 16, 2017, art. 12(2).

29 Convention on the Transboundary Effects of Industrial Accidents, adopted March 17, 1992, 2105 U.N.T.S. 457, entered into force April 19, 2000, art. 3(1). See also International Law Commission, "Draft Articles on Prevention of Transboundary Harm from Hazardous Activities, with Commentaries," *Yearbook of the International Law Commission* (2001), vol. II, part 2, p. 163 ("States should consider suitable means to restore, as far as possible, the situation existing prior to the occurrence of harm. It is considered that this should be highlighted as a factor to be taken into account by States concerned which should adopt environmentally friendly measures.").

30 Convention for the Protection of the Marine Environment of the North-East Atlantic, adopted September 22, 1992, entered into force March 25, 1998, art. 2(1).

31 Declaration of the UN Conference on the Human Environment (Stockholm Declaration), June 16, 1972, Principles 1-2, 21.

32 Environmental Protection Act 1990, Part 2A (United Kingdom).

33 Directive 2004/35/CE of the European Parliament and of the Council on Environmental Liability with Regard to the Prevention and Remedying of Environmental Damage, art. 5.

Principle 2: Character of Environmental Remediation

Scientific understanding of the effects of radiation exposure and the human exposure pathways at individual sites is far from complete. To account for and mitigate this limited and evolving knowledge, states should follow the precautionary principle and take an iterative approach to environmental remediation.

Affected states should also follow international standards and best practices, including ensuring worker safety, and use the best available technologies at each step of the environmental remediation process.

Discussion

Contamination from nuclear weapons threatens future serious and often irreversible damage to exposed people and the environment. Rarely, however, is there definitive scientific information about whether specific harm will occur and whether a particular remediation measure will eliminate all such risks. Principle 2 therefore advocates for two complementary approaches to managing uncertainty and adapting to changing circumstances: precaution and iteration. In addition, to ensure the quality of remediation, Principle 2 underlines the importance of the states adopting current international standards, best practices, and best available technologies.

Precaution should guide state action because uncertainty is inherent to contamination from nuclear weapons and the process of environmental remediation. In other words, in keeping with environmental law's precautionary principle, when facing threats of serious or irreversible damage, states should not postpone or refuse action due to scientific uncertainty.[34] Instead, affected states should perform detailed assessments of the potential risk,[35] engage in the optimization process (described in Principle 9), including consulting with communities about their level of risk tolerance,[36] and prioritize measures that minimize the likelihood of serious or irreversible damage, whether the damage is certain or not.

Risk is a function of the likelihood and severity or consequence of a particular hazard. For example, higher levels of radiological contamination increase both the likelihood and consequence of any exposure. Accordingly, when planning remediation projects, affected states should employ a risk assessment to understand "the potential health effects and environmental impacts"[37] associated with a contaminated site. Effective risk assessments will cover the initial state of the site, the process of decontamination and containment, and the residual risk after all remediation measures have been implemented.[38]

Even effective risk assessments, however, cannot compensate for the inherent uncertainties present in environmental remediation programs. For example, it will often be unclear:

34 See, e.g., UN General Assembly, "Report of the United Nations Conference on Environment and Development: Rio Declaration on Environment and Development," A/CONF.151/26 (Vol. I), August 12, 1992, Principle 15.
35 OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," 2016, https://www.oecd-nea.org/jcms/pl_14984 (accessed May 22, 2022), pp. 60-62.
36 Andrew Stirling, "Risk, Precaution and Science, Towards a More Constructive Policy Debate," *EMBO Reports* (2017). Stirling references citizen participation as part of a precautionary framework.
37 OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," p. 61.
38 Ibid.

- How much contamination has traveled from the initial site and where it has traveled;[39]
- How much contamination will remain after a given remediation measure;[40]
- What level of exposure people and the environment will suffer from residual contamination;[41]
- Through what pathways people and the environment will be exposed;[42] and
- How vulnerable the people and environment at a particular site are to radiological exposure.[43]

States should systematically assess their level of uncertainty about both project-specific information and general information, such as current exposure standards. States should ensure that comprehensive surveys and risk assessments are carried out to reduce uncertainties and information gaps, as far as possible. Where uncertainties remain, their effect on the robustness and reliability of a risk assessment should be taken into consideration and a precautionary approach taken.

In addition to precaution, states should also treat environmental remediation as an iterative process. An iterative approach means that environmental remediation can become more effective through time and continue to respond to the needs of new generations.[44] States should constantly review key elements such as scientific knowledge, standards, technology, and the needs of stakeholders, as they will all change over time. For example, iterative projects can be adapted to reflect:

- Improved site-specific knowledge about the movement of pollutants, the level of residual contamination, exposure pathways, and the actual exposure of nearby people and the environment. Ongoing monitoring and study will often lead to improvements in such knowledge;
- Updated national or international exposure standards, which reflect new knowledge about the effects of prolonged or acute radiological exposure;
- New remediation technologies, or changes in the cost or feasibility of existing technologies, which could reduce residual contamination;[45] and
- Changes in local communities' desired future uses, cultural values, or other expressed preferences.

New information should rarely justify reducing the protection afforded by previous remediation measures. In general, it should support equal or higher levels of protection

39 See, e.g., ibid., p. 53 ("Early versions of the [site model], which are usually based on limited or incomplete information, will identify and emphasise the uncertainties that should be addressed.").
40 See ibid., p. 26 ("Complexity also exists because of significant uncertainty with respect to understanding source distribution and contaminant behaviour as well as response to a remedial action.").
41 Such uncertainty arises from limitations in the site model, but also from the lengthy timescale of remediation, which leads to uncertainty about future use. Ibid., p. 48.
42 For example, people may be exposed by proximity to contamination, but also through ingestion of contaminated food or water. The latter form of exposure is significantly more harmful at the same dose of radiation.
43 For example, as discussed in the commentary under Principle 3, women and girls suffer worse effects from radiological exposure.
44 See OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," p. 47 ("The use of [an iterative] plan . . . means that if the situation deviates from the plan due to new information or due to uncertainty in a particular aspect, the plan can be modified using an adaptive approach, to ensure that the plan considers the revised situation.").
45 Remediation technologies are still being actively developed, particularly those for effective in-situ management. Sites which have existing in-situ containment should maintain their measures in accordance with the latest technological developments and may consider updating measures in response to new options, especially as existing measures age and become more difficult to maintain. Sites with or without existing in-situ containment should consider implementing new technologies that provide a higher level of protection, are more cost-effective, or are otherwise appropriate where previous technologies were not.

while affording the same or greater level of access for local communities. There may be instances where new information supports increased access to a contaminated site at the same level of protection;[46] deciding to adjust remediation in this way should be the result of a robust process that actively engages with local community stakeholders—much like initial remediation decisions.

Finally, when implementing environmental remediation actions, states should maximize the effectiveness of the process. They should comport with international standards and best practices and use the best available technology. In particular, projects should ensure the ongoing protection of workers, the public, and the environment throughout their implementation. At the same time, affected states should consider site-specific factors that affect the distribution and exposure of contamination, as well as the needs of particular communities and the resources available for remediation.

Precedent

The precautionary principle is well-founded in environmental law. Principle 15 of the 1992 Rio Declaration on Environment and Development establishes: "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."[47] The precautionary principle is also integral to Article 3 of the 1992 UN Framework Convention on Climate Change (UNFCCC), which states that "parties should take precautionary measures to anticipate, prevent, or minimize the causes of climate change and mitigate its adverse effects."[48] The UNFCCC affirms that a lack of complete scientific certainty is not a valid reason for postponing measures that prevent serious or irreversible environmental damage.[49] The precautionary principle is also accepted by international courts. For example, the International Court of Justice referenced this principle in the 1995 Nuclear Tests case, a dispute between New Zealand and France over nuclear testing in the South Pacific.[50]

Risk assessments are a widely accepted practice employed by organizations such as the US Environmental Protection Agency and the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD NEA). After the US Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act (also known as "Superfund") in 1980, the Environmental Protection Agency developed a formal risk assessment protocol for calculating the health risks posed by hazardous contamination and waste.[51] The agency's risk assessment is divided into four parts: (1) data collection and evaluation (which studies, including through community involvement, how the site became contaminated and with what), (2) exposure assessment (which calculates the amount of exposure likely for nearby people), (3) toxicity assessment (which assesses the adverse

46 For example, if a remediation project has applied the precautionary principle and implemented highly protective remediation measures, new data showing that the risk of exposure is lower than anticipated should not result in a failure to maintain existing containment infrastructure. Rather, containment should be maintained, but public access could be expanded to reflect the lower risk.

47 Rio Declaration on Environment and Development, Principle 15. Although this articulation of the principle is focused on environmental degradation, health impacts should also be prevented in the context of remediation.

48 Jose Felix Pinto-Bazurco, "The Precautionary Principle," International Institute for Sustainable Development Brief #4, October 2020, https://www.iisd.org/system/files/2020-10/still-one-earth-precautionary-principle.pdf (accessed May 22, 2022), p. 5; UN Framework Convention on Climate Change, adopted May 9, 1992, A/RES/48/189, entered into force March 21, 1994, art. 3(3).

49 Pinto-Bazurco, "The Precautionary Principle," p. 5..

50 Ibid., p. 6.

51 US Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation, "Superfund Radiation Risk Assessment: A Community Toolkit," May 2014, https://semspub.epa.gov/work/HQ/176332.pdf (accessed January 16, 2022), p. 4.

health effects and the level of exposure that constitutes a significant risk to people), and (4) risk characterization (which, based on information gathered in other steps, "calculate[s] the risk of potential health effects from exposure . . . at the site").[52] The OECD NEA has adopted the same four steps to risk assessments for the purposes of understanding the situation at the beginning of the remediation process and the residual risk after implementation of each option.[53]

The iterative process has also been recognized as the best approach to environmental remediation by international organizations and practitioners. OECD NEA proposes that planning and data collection in remediation must be "adaptive and iterative."[54] The US Sustainable Remediation Forum has also advocated that environmental remediation should be iterative.[55]

References to international standards and best practices are commonplace in disarmament treaties. For example, the Convention on Cluster Munitions, the Mine Ban Treaty, and the 2003 Protocol V on Explosive Remnants of War to the Convention on Conventional Weapons (CCW) all rely on the International Mine Action Standards (IMAS), either by direct reference or incorporation in subsequent action plans.[56] The IMAS are a set of standards endorsed by the UN Inter-Agency Coordination Group on Mine Action and followed in all UN mine action operations. Moreover, the 2021 Lausanne Action Plan and 2015 Dubrovnik Action Plan, adopted by the Second and First Review Conferences of the Convention on Cluster Munitions, respectively, specify that states parties should take into account international best practices when undertaking problem assessments and developing resourced plans for their cluster munition clearance strategies.[57]

The 1993 Chemical Weapons Convention illustrates the importance of environmental and worker safety standards in the weapons of mass destruction context. The convention obliges states parties to "assign the highest priority to ensuring the safety of people and to protecting the environment" when engaging in the destruction of chemical weapons and their production facilities as well as when implementing the convention more broadly.[58]

Nuclear organizations and agencies encourage the integration of best practices for environmental remediation. The Safety Guides of the International Atomic Energy Agency (IAEA) are based on international best practices designed to help member states achieve the highest levels of safety when dealing with radioactive materials, especially in their

52 Ibid., pp. 1-7.

53 OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," pp. 60-61.

54 Ibid.

55 Framework for Integrating Sustainability Into Remediation Projects, US Sustainable Remediation Forum (SURF), http://www.cresp.org/wordpress/wp-content/uploads/2012/02/Framework-20288_ftp.pdf (accessed March 28, 2022), p. 201.

56 See, e.g., Convention on Cluster Munitions, art. 4(3); Oslo Action Plan, adopted at Fourth Review Conference of Mine Ban Treaty, APLC/CONF/2019/5/Add.1, November 29, 2019, action #5; Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May be Deemed to be Excessively Injurious or to Have Indiscriminate Effects, Protocol V on Explosive Remnants of War (CCW Protocol V), adopted November 28, 2003, entered into force November 12, 2006, art. 3(4).

57 Lausanne Action Plan, adopted at the Second Review Conference of the Convention on Cluster Munitions, September 2021, actions #6, 26; Dubrovnik Action Plan, adopted at the First Review Conference of the Convention on Cluster Munitions, September 2015, actions #3.1(c), 3.3(a).

58 Chemical Weapons Convention, adopted January 13, 1993, entered into force April 29, 1997, arts. IV (10), V(11), and VII(3).

environmental remediation efforts.[59] Among the IAEA's fundamental safety principles and safety requirements are ensuring the protection and safety of workers, the public, and the environment.[60] Additionally, in a joint report, the OECD NEA and IAEA said that clearance of radioactive material and environmental remediation of uranium production facilities should follow international and national codes of practice.[61] The agencies stressed that worker safety must be strictly observed in remediation efforts and that workers ought to be managed under national codes of practice.[62]

59 See, e.g., IAEA, "Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements Part 3, 2004, https://www-pub.iaea.org/MTCD/publications/PDF/Pub1578_web-57265295.pdf (accessed January 17, 2022); IAEA, "Policy and Strategies for Environmental Remediation," IAEA Nuclear Energy Series No. NW-G-3.1 2015, https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1658_web.pdf (accessed April 11, 2022).

60 See, e.g., IAEA, "Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards," Requirements 38, 44, and 48, and Principles 1 and 7.

61 OECD NEA and IAEA, "Environmental Remediation of Uranium Production Facilities," 2002, https://www.oecd-nea.org/jcms/pl_13466/environmental-remediation-of-uranium-production-facilities?details=true (accessed January 18, 2022), p. 33.

62 Ibid.

Definition

Principle 3: Definition of Harm

> Contamination from the use and testing of nuclear weapons causes a range of harm to the environment and people. Harm includes but is not limited to: environmental degradation; loss of biodiversity; physical and psychological injuries and death; social marginalization; economic loss; loss of access to natural resources; obstacles to participation in cultural life; displacement of local communities; and substantial impairment of the realization of the human rights.[63]

Discussion

The detonation of a nuclear weapon creates three main sources of potential damage, death, and injury: (1) the blast wave, (2) the thermal wave, and (3) the release of radiation. Notwithstanding the significant amount of destruction the blast and thermal waves create, Principle 3 focuses primarily on the short-, medium-, and long-term harm generated by the ionizing radiation released by the detonation.

Both animals and plants feel the effects of radioactive contamination, leading to damage to a functioning ecosystem and the ecosystem services it supports. As studies of nuclear test and accident sites show, fauna living in radiologically contaminated environments may experience, among other impacts, depressed reproduction rates, reduced access to food sources, and morphological changes.[64] For example, researchers have discovered that birds living within the Chernobyl Exclusion Zone have measurably smaller brains than those of the same species living outside the Exclusion Zone.[65] Flora experience similar deleterious effects when exposed to radiation: after the Chernobyl accident, the forest canopy within the affected area absorbed a significant amount of the initial radiation. In areas with the highest doses, scientists reported the mass death of the pine trees, while trees that survived after exposure to lower doses were unable produce seeds for several years.[66]

Environmental degradation in turn causes harm to the humans that depend on it. According to the International Court of Justice, "[t]he environment is not an abstraction but represents the living space, the quality of life and the very health of human beings."[67] Exposure to

63 This definition of harm overlaps with but is not identical to that in Principle 4 of *Confronting Conflict Pollution*, the IHRC-CEOBS report on principles of victim assistance. This definition does not use the term "victim" because it is not as relevant to environmental remediation and thus is not defined in the current Principles. This definition also includes harm to the environment and the harm it in turn causes harm to people, rather than focusing on human harm, the subject of victim assistance. See IHRC-CEOBS, *Confronting Conflict Pollution*, Principle 4.

64 See, e.g., Henrik von Wehrden et al., "Consequences of Nuclear Accidents for Biodiversity and Ecosystem Services," *Conservation Letters*, vol. 5 ((2012), pp. 81-84; "Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards," IAEA Technical Report Series No. 332, 1992, https://inis.iaea.org/collection/NCLCollectionStore/_Public/23/039/23039160.pdf (accessed May 12, 2022); Harrison J. Schmitt et al., "Chronic Environmental Contamination: A Systematic Review of Psychological Health Consequences," *Science of the Total Environment*, vol. 772 (2021), p. 8; A.P. Møller et al., "Chernobyl Birds Have Smaller Brains, *PLOS ONE*, vol. 6 (2011).

65 This study also investigated the brain development of birds that lived in the Exclusion Zone for generations. Researchers discovered that younger individuals had significantly smaller brains than their older counterparts did at the same age. Møller et al., "Chernobyl Birds Have Smaller Brains, *PLOS ONE*, p. 1.

66 Nicholas A Beresford and David Copplestone, "Effects of Ionizing Radiation on Wildlife: What Knowledge Have We Gained Between the Chernobyl and Fukushima Accidents?" *Integrated Environmental Assessment and Management*, vol. 7 (2011), p. 371.

67 International Court of Justice, Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, 1996 I.C.J. Rep. (July 8) p. 226, para. 29.

radioactive contaminants has severe health consequences for humans including death, the worsening of other health conditions,[68] and an increased risk of certain cancers, vascular diseases, strokes, and genetic disorders.[69] Studies have noted that women exposed to ionizing radiation in childhood are ten times more likely to suffer from cancer than their male counterparts.[70]

Although many affected communities will be geographically close to testing sites, contaminated foodstuffs may also pose health effects to distant communities if those products are incorporated into large-scale distribution systems. In the United States, the states with the highest levels of contaminated soil from testing—Nevada, Utah, Colorado, Wyoming, New Mexico, and Arizona—are not the states with the highest incidence of thyroid cancer from exposure to radioactive iodine (a by-product of the nuclear testing).[71] Researchers have concluded that these geographical inconsistencies were likely caused by the industrial processing and distribution of contaminated milk products from cows who consumed contaminated vegetation to areas around the country.[72] Such widespread effects may occur less frequently in areas where contaminated wildlife and vegetation do not enter the food chain, such as in Semipalatinsk, Kazakhstan. Nevertheless, Principle 3 emphasizes that exposure pathways in each situation are unique and communities may be affected in any number of ways.[73]

In addition to the adverse physiological consequences of radiation exposure, fear of the dangers of chronic environmental contamination, or the perceived existence of contamination,[74] may have a psychological impact even when contaminants do not pose a physical threat to inhabitants.[75] The denial or delegitimization of these concerns can cause further psychological harm, particularly for marginalized communities because of the indirect or direct discrimination they face.[76]

The contamination caused by nuclear weapons use and testing can also cause non-health-related harm. For example, it can lead to marginalization because affected individuals are sometimes stigmatized by society. It can deprive people of livelihoods by making farmland or fisheries unusable. It can deny indigenous peoples access to traditional lands or sacred sites, destroying their cultural heritage. Environmental contamination can forcibly displace entire communities. In an attempt to mitigate these types of effects, local inhabitants will sometimes continue to use contaminated land, which can create other rebound harms.

Finally, environmental contamination may substantially impair the realization of individuals' and communities' human rights. This broad category of harm overlaps in many ways with the types of harm discussed above. Radiation may directly infringe on a victim's right to life

68 Kotaro Ozasa et al., "Epidemiological Studies of Atomic Bomb Radiation at the Radiation Effects Research Foundation," *International Journal of Radiation Biology*, vol. 95 (2019), p. 885.
69 Kenji Kamiya et al., "Long-Term Effects of Radiation Exposure on Health, *Lancet*, vol. 386 (2015), pp. 469-70, 74.
70 Mary Olson, "Females Exposed to Nuclear Radiation Are Far Likelier Than Males to Suffer Harm," *Pass Blue* (2017).
71 The highest cancer thyroid dose values per population are in Idaho, Montana, North Dakota, and South Dakota. See Remus Pravalie, "Nuclear Weapons Tests and Environmental Consequences: A Global Perspective," *AMBIO*, vol. 43 (2014), pp. 739-40.
72 Ibid., pp. 739-41.
73 An exposure pathway is "[a] route by which radiation or radionuclides can reach humans and cause exposure." IAEA, *Safety Glossary*, p. 90.
74 Schmitt et al., "Chronic Environmental Contamination," *Science of the Total Environment*, p. 8.
75 A survey of studies on the psychological impact of chronic environmental contamination noted that only half of the studies had respondents who also reported adverse physical effects from such contamination. Ibid., p. 6.
76 Ibid., p. 8.

or health or, by denying it access to traditional land, a community's ability to participate in its culture or religion.[77] Many other human rights may be indirectly undermined by environmental contamination. For instance, an individual who develops cancer from radiation exposure may be unable to keep a job due to physical limitations or social stigma, infringing on the individual's right to work.[78] In addition, the person's child may need to drop out of school to support his or her family—undermining the realization of the child's right to education.[79]

Precedent

International environmental, humanitarian disarmament, indigenous rights, and international human rights law recognize a range of harm arising from contamination.

There are several international treaties that address environmental degradation and the loss of biodiversity. For example, the Protocol on Environmental Protection to the Antarctic Treaty seeks to preserve flora and fauna in the Antarctic and prevent them from being harmed by contamination from mining.[80] The Convention on Biological Diversity obliges states parties not only to preserve ecosystems and protect them from future harm, but also to "[r]ehabilitate and restore degraded ecosystems," promote the recovery of threatened ecosystems, and support the development and implementation of remedial actions in areas where biological diversity has been degraded or otherwise reduced.[81]

International environmental law and organizations have also noted the link between environmental and human health and well-being. The Convention on Biological Diversity acknowledges that there is a "close and traditional dependence" of local communities on biological resources and that sustainable use of biological diversity is necessary for the benefit of present and future generations.[82] With regard to conflict pollution, the UN Environment Assembly's Resolution 3/1, adopted in 2017, notes:

> [T]he long-term social and economic consequences of the degradation of the environment and natural resources resulting from pollution caused by armed conflict or terrorism, which include, inter alia, the loss of biodiversity, the loss of crops or livestock, and lack of access to clean water and agricultural land, and the negative and sometimes irreversible impacts on ecosystem services and their impact on sustainable recovery, contributing to further forced displacement related to environmental factors.[83]

Humanitarian disarmament law outlines a breadth of human harm that can arise from weapons-related contamination. The Convention on Cluster Munitions defines "cluster munition victims" to include all persons who have "suffered physical or psychological injury, economic loss, social marginalisation or substantial impairment of the realisation of their rights caused by the use of cluster munitions."[84] The definition covers not only "persons directly impacted" by cluster munitions, but also their "affected families and communities."[85]

77 ICCPR, arts. 6(1) 18; ICESCR, arts. 12(1), 15(1)(a).
78 ICESCR, art. 6.
79 Ibid., art. 13.
80 British Antarctic Survey, "Also in Environmental Protocol: Protocol on Environmental Protection to the Antarctic Treaty (1991)," https://www.bas.ac.uk/about/antarctica/the-antarctic-treaty/environmental-protocol/ (accessed May 13, 2022).
81 Convention on Biological Diversity, arts. 8(f), 10(d).
82 Ibid., pmbl., paras. 12, 23
83 UN Environment Assembly, "Pollution Mitigation and Control in Areas Affected by Armed Conflict or Terrorism," Resolution 3/1, UNEP/EA.3/Res.1, December 4-6, 2017, pmbl., para. 13.
84 Convention on Cluster Munitions, art. 2(1).
85 Ibid.

The Mine Ban Treaty and the TPNW implicitly address similar categories of harm given the types of assistance states parties are required to provide. Article 6(1) of the TPNW obliges states parties to provide victims with "medical care, rehabilitation and psychological support, as well as provide for their social and economic inclusion."[86] Similarly, Article 6 of the Mine Ban Treaty mandates that every state party, in a position to do so, provide assistance for the "care and rehabilitation, and social and economic reintegration, of mine victims."[87] The preamble of the Mine Ban Treaty also mentions ending the suffering associated with displacement among its goals.[88]

International legal instruments on indigenous peoples' rights underscore the link between between indigenous peoples' cultures and land and, in so doing, show why contamination from nuclear weapons can create obstacles to the ability to participate in cultural life. The 1989 Indigenous and Tribal Peoples Convention, for example, obliges states parties to "respect the special importance for the cultures and spiritual values of the peoples concerned of their relationship with the lands or territories, or both."[89] The convention further requires states parties to adopt "[s]pecial measures" to "safeguard[] the persons, . . . cultures and environment of the peoples concerned."[90] The 2007 UN Declaration on the Rights of Indigenous Peoples states that "[i]ndigenous peoples have the right to practice and revitalize their cultural traditions and customs,"[91] and specifically acknowledges the land rights of indigenous peoples.[92] The 2016 American Declaration on the Rights of Indigenous Peoples states: "Indigenous peoples have the right to maintain and strengthen their distinctive spiritual, cultural, and material relationship with their lands, territories, and resources and to uphold their responsibilities to preserve them for themselves and for future generations."[93] These rights are significant in the context of these Principles of environmental remediation because, as the TPNW notes, nuclear weapons-related activities have causes a "disproportionate impact . . . on indigenous peoples."[94]

Contamination implicates other indigenous peoples' rights. It interferes with multiple rights related to indigenous peoples' ability to use their land as they see fit. For example, the UN Declaration on the Rights of Indigenous Peoples articulates the "right to determine and develop priorities and strategies for the development or use of their lands or territories and other resources."[95] The American Declaration on the Rights of Indigenous Peoples echoes that right and adds that indigenous peoples have "the right to be guaranteed the enjoyment of their own means of subsistence."[96] Radioactive contamination frequently prevents both development and reliance on local flora and fauna for food.

International human rights law is relevant to Principle 3's reference to impairment of the realization of human rights more broadly. In 2021, the Human Rights Council recognized that "the right to a safe, clean, healthy and sustainable environment as a human right . . .

86 TPNW, art. 6(1).
87 Mine Ban Treaty, art. 6.
88 Ibid., pmbl., para. 1.
89 International Labour Organization (ILO) Convention No. 169 concerning Indigenous and Tribal Peoples in Independent Countries, adopted June 27, 1989, 1650 U.N.T.S. 383, entered into force September 5, 1991, art. 13(1).
90 Ibid., art. 4(1)
91 UN Declaration on the Rights of Indigenous Peoples, UNGA Res. 61/295, A/RES/61/295, September 13, 2007, art. 11(1).
92 Ibid., arts 11(1) and 10 ("Indigenous peoples shall not be forcibly removed from their lands or territories.").
93 Organization of American States, American Declaration on the Rights of Indigenous Peoples, AG/RES. 2888 (XLVI -0/16), June 15, 2016, art. XXV(1).
94 TPNW, pmbl., para. 7.
95 UN Declaration on the Rights of Indigenous People, art. 32.
96 American Declaration on the Rights of Indigenous Peoples, art. XXIX(1).

is important for the enjoyment of human rights . . . [and] related to other rights that are in accordance with existing international law."[97] Environmental degradation can infringe on numerous human rights, which are enshrined, inter alia, in the ICCPR and the ICESCR. As discussed under Principle 1, basic human rights, such as those to health, water and sanitation, and food, all depend on a healthy environment.[98] In 2017, the UN special rapporteur on human rights and the environment, for example, stated that biodiversity is necessary for ecosystem services that support the full enjoyment of human rights, including the rights to life, health, food, water, and culture.[99]

97 Human Rights Council, The Human Right to a Safe, Clean, Healthy and Sustainable Environment, Resolution 48/13, A/HRC/48/L.23/Rev.1, October 5, 2021, paras. 1-2. The American Declaration on the Rights of Indigenous Peoples guarantees this right to indigenous peoples. American Declaration on the Rights of Indigenous Peoples, art. XIX(1).
98 Committee on Economic, Social and Cultural Rights, General Comment No. 14, The Right to the Highest Attainable Standard of Health (Art. 12), E/C.12/2000/4, August 11, 2000, para. 11 (interpreting the right to health as encompassing "underlying determinants of health" such as a healthy environment); Human Rights Council, Report of the Special Rapporteur on the Issue of Human Rights Obligations Relating to the Enjoyment of a Safe, Clean, Healthy and Sustainable Environment, A/HRC/37/59, January 24, 2018, Annex, para. 4. The Framework Principles on Human Rights and the Environment, prepared by the special rapporteur and listed in the annex of the report, include Framework Principle 1: "States should ensure a safe, clean, healthy and sustainable environment in order to respect, protect and fulfil human rights," and Framework Principle 2: "States should respect, protect and fulfil human rights in order to ensure a safe, clean, healthy and sustainable environment." Ibid., pp. 7-8.
99 Human Rights Council, Report of the Special Rapporteur on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment, A/HRC.34/4 (January 2017), p. 3.

Framework of Shared Responsibility

Principle 4: Responsibility

States should take necessary and appropriate measures for the environmental remediation of areas under their jurisdiction or control that have been contaminated as a result of the use or testing of nuclear weapons.

Other states, including but not limited to states that have used or tested nuclear weapons, should cooperate with and provide technical, material, financial, and other assistance to "affected states"—i.e., states with contaminated areas—to help them meet their environmental remediation responsibilities.

Discussion

Principle 4 explains the roles and responsibilities of different actors regarding environmental remediation. As under humanitarian disarmament treaties, each affected state should have the primary responsibility for conducting environmental remediation of contaminated areas under its jurisdiction or control. An affected state is a state with area(s) under its jurisdiction or control with contamination due to the use or testing of nuclear weapons. Other states should assume responsibility for assisting affected states in meeting their environmental remediation duties.

Affected states should take "necessary and appropriate measures" to remediate contaminated areas.[100] In other words, affected states should engage in substantive and meaningful actions to address the environmental effects of nuclear weapons use and testing. The word "necessary" ensures that the most essential steps are undertaken, while "appropriate" indicates that the measures taken are tailored and suited to the situation at hand. Environmental remediation can be costly, dangerous, and difficult. Determining what is appropriate involves consideration of the environmental, health, social, cultural and economic costs and benefits as discussed under Principle 9 on Optimization.

Principle 4 assigns affected states the responsibility to lead environmental remediation efforts for several reasons. First, this approach is pragmatic. Affected states' physical proximity facilitates assessments of the damage, delivery of necessary technology and equipment, containment of contaminated areas, and removal of nuclear waste. Affected states often have better access to affected communities. This access promotes inclusivity in the environmental remediation process and allows remediation strategies to be tailored to the specific needs of the local residents.

Second, assigning affected states primary responsibility respects state sovereignty by reaffirming an affected state's authority over activities within its borders. It also acknowledges state agency because it encourages affected states to set domestic remediation policies while empowering them to seek outside support.

[100] TPNW, art 6(2).

Third, the approach accords with international legal precedent. As discussed below, it draws directly from an approach used in humanitarian disarmament and is articulated in the TPNW,[101] the Convention on Cluster Munitions,[102] and the Mine Ban Treaty.[103] International human rights law also obliges states to ensure that persons in their territory enjoy their human rights, an obligation that extends to persons "subject to [a state's] jurisdiction."[104] Because environmental remediation seeks to remove barriers to the full realization of affected communities' human rights, such as the right to a healthy environment, it offers an important avenue for affected states to comply with this obligation.

Determining which states are affected requires scientific expertise and community input. The threshold between acceptable and unacceptable risk, also discussed in Principle 1,[105] should take into account what levels and types of exposure researchers have concluded are unsafe, as well as societal concerns, informed by the collective decision-making in a community. In some cases, a state may choose to declare itself as affected and should be treated as so. Simply because a state has not declared itself to be affected, however, does not mean that it should be considered unaffected. Other elements, such as current scientific standards, knowledge about the level of contamination and exposure, and local community concerns and expectations should also be used to determine whether a state is affected by nuclear fallout. As scientific knowledge in the field advances, thresholds and standards may change, and states that were previously understood to be "unaffected" may become "affected" as a result. Similarly, radioactive contaminants may disperse or migrate over time—e.g., via fallout, weather, or moving water—and contaminate other areas.[106] Furthermore, climate change will alter patterns of precipitation, temperatures, and erosion rates, and increase sea levels and the frequency of extreme weather events, risking the creation of new exposure routes.

The burden of environmental remediation does not fall on affected states alone, however. Principle 4 also outlines the responsibilities of other states to assist affected states. Assistance can come in different forms and should be adapted to an affected state's needs and donor state capacity. It may include technical, material, financial, and other assistance. For example, a state with little expertise in nuclear contamination may be able to supply an affected state with funds it can use for different aspects of environmental remediation. Alternatively, a state may be able to provide the affected state with equipment necessary for remediation, such as protective gear or technology for aerial surveys of radioactivity. A state that has dealt with nuclear contamination in its territory may be able to provide valuable technical expertise. Given the range of forms assistance can take, almost every state should be able to contribute to an affected state's remediation efforts in some way.

[101] Ibid., art. 6(1).
[102] Convention on Cluster Munitions, art. 4(1).
[103] Mine Ban Treaty, art. 5(1).
[104] See, e.g., ICCPR, art. 2(1); Human Rights Committee, General Comment No. 31 [80], The Nature of the General Legal Obligation Imposed on States Parties to the Covenant, CCPR/C/21/Rev.1/Add. 13, May 26, 2004, para. 10 (discussing Article 2(1) of the ICCPR).
[105] See Principle 1, which uses the phrase "unacceptable risks of future harm to the environment and affected communities caused by contamination."
[106] For example, environmental studies of Kazakhstan's southern Semipalatinsk region have discovered that, in addition to the expected pollution from tests at the Semipalatinsk site, the area has been contaminated by radioactive dust from Chinese tests undertaken at Lop Nur (in Xinjiang, China). See Pravalie, "Nuclear Weapons Tests and Environmental Consequences: A Global Perspective," *AMBIO*, p. 736. The Semipalatinsk region is approximately 1,361 kilometers from Lop Nur. See Fédération Aéronautique Internationale, World Distance Calculator (2021).

Principle 4 recognizes that all states parties should provide assistance, but states that have used or tested nuclear weapons have an enhanced responsibility to provide support to affected states. These states have a moral and ethical responsibility to the affected state, its environment, and its people, regardless of the legality of their conduct.

The shared responsibility framework established by Principle 4 is designed to provide an efficient and effective process of environmental remediation. Under this framework, progress on environmental remediation does not depend on proving that use or testing violated international law or was caused by a certain party. The approach focuses on achieving results rather than placing blame. This distinction is significant because processes to obtain remedies for legal wrongs can be time-intensive and expensive. The shared responsibility framework does not, however, preclude affected states or individuals from seeking other forms of redress for reparations or remedies against states responsible for contamination.

Precedent

For the framework of shared responsibility, Principle 4 draws on humanitarian disarmament law and policy, international human rights law and principles of international environmental law.

Humanitarian disarmament law has typically placed primary responsibility for clearance of remnants of war on affected states. The Convention on Cluster Munitions tasks a state party that has "cluster munition remnants located in cluster munition contaminated areas under its jurisdiction or control" with leading clearance efforts.[107] Similarly, the Mine Ban Treaty vests primary clearance responsibilities with the affected state by requiring "[e]ach state party . . . to destroy or ensure the destruction of all anti-personnel mines in mined areas under its jurisdiction or control."[108] The TPNW similarly obliges states parties, "with respect to areas under [their] jurisdiction or control," to take "necessary and appropriate measures towards the environmental remediation of [contaminated] areas."[109]

Humanitarian disarmament law also situates the affected state's obligations in a framework of shared responsibility. The Convention on Cluster Munitions, the Mine Ban Treaty, and the TPNW each include international cooperation and assistance obligations. Under all three instruments, affected state parties are entitled to "seek and receive assistance" from other states parties,[110] and other state parties "in a position to do so shall provide assistance" to the affected state.[111] These treaties also all establish that assistance can take a variety of forms, including "technical, material and financial assistance."[112] The Maputo Declaration, adopted at the Mine Ban Treaty's Third Review Conference in 2014, attributed part of the treaty's success to its grounding in a "combination of national ownership and international cooperation."[113]

[107] Convention on Cluster Munitions, art. 4(1). The earlier Chemical Weapons Convention took a different approach. Although it did not include a requirement to clear contamination from the use of chemical weapons, in a related provision, it placed responsibility on each state party to destroy any chemical weapons it abandoned in the territory of another state party. Chemical Weapons Convention, art. I(3).
[108] Mine Ban Treaty, art. 5(1).
[109] TPNW, art 6(2).
[110] Convention on Cluster Munitions, art. 6(1); Mine Ban Treaty, art. 6(1); TPNW, art 7(2).
[111] Convention on Cluster Munitions, art. 6(5); Mine Ban Treaty, art. 6(4); TPNW, art 7(3).
[112] Convention on Cluster Munitions, art. 6(2); TPNW, art 7(3).
[113] Maputo Declaration, adopted at the Third Review Conference of the Mine Ban Treaty, June 27, 2014, para. 5.

Some humanitarian disarmament treaties have specifically highlighted the responsibility of user states to assist with clearance activities. The Convention on Cluster Munitions "strongly encourages" states parties that used cluster munitions to provide "technical, financial, material or human resources assistance to the [affected] State Party."[114] Article 7(6) of the TPNW creates obligations for "state[s] part[ies] that ha[ve] used or tested nuclear weapons" to aid affected states.[115]

Other disarmament treaties also lend support to this approach. Under CCW Protocol V, states parties and parties to the armed conflict are responsible for clearance activities in "territory under [their] control." As in the above frameworks, they have a right to seek and receive assistance and other states parties "in a position to do so" shall provide it.[116] The Chemical Weapons Convention establishes a process by which a state party may request emergency assistance from other states parties if chemical weapons have been used against it or if faces the threat of use.[117]

Like humanitarian disarmament law, international human rights law supports assigning responsibility to affected states and requiring international cooperation. Under the ICCPR, each "State Party . . . undertakes to respect and to ensure to all individuals within its territory and subject to its jurisdiction the rights recognized" in the covenant.[118] The ICCPR establishes the principle that states are responsible for guaranteeing the rights of its people. The ICESCR requires states parties to "undertake[] to take steps, individually and through international assistance and co-operation" to ensure the realization of economic, social, and cultural rights.[119]

The Common Concern of Mankind Principle in international law supports a framework of shared responsibility similar to that in Principle 4.[120] For instance, the 1972 UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage establishes that "parts of the cultural or natural heritage are of outstanding interest and therefore need to be preserved as part of the world heritage of mankind as a whole."[121] To protect World Heritage Sites, the convention gives primary responsibility and agency to the state where the cultural and natural heritage is located, while also placing an obligation on other states parties to cooperate and assist.[122] "It is incumbent on the international community as a whole to participate in the protection of the of the cultural and natural heritage of outstanding universal value."[123] While international environmental law generally assigns responsibility through the polluter pays principle or common but differentiated responsibility, the World Heritage Convention advances environmental protection by placing primary responsibility on the state whose territory contains the World Heritage Site, while establishing a framework that spreads the burden among other states parties.

[114] Convention on Cluster Munitions, art. 4(4).
[115] TPNW, art. 7(6)
[116] CCW Protocol V, arts. 3, 7.
[117] Chemical Weapons Convention, art. X(8).
[118] ICCPR, art. 2(1).
[119] ICESCR, art. 2.
[120] See, e.g., UN Framework Convention on Climate Change, pmbl, para. 6.
[121] UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention), adopted November 16, 1972, entered into force December 17, 1975, pmbl., para. 6.
[122] Ibid., art. 6.
[123] Ibid., pmbl., para. 7.

Principle 5: Exchange of Scientific and Technical Information

States, international organizations, nongovernmental organizations, and other actors should exchange scientific and technical information with affected states regarding nuclear contamination and environmental remediation measures.

Discussion

All states should cooperate in the exchange of scientific and technical information to ensure that the goals of environmental remediation are fully realized. States along with international organizations, nongovernmental organizations (NGOs), and other actors should provide information that helps affected states identify and assess contaminated sites, develop a response, and engage in remediation efforts.

States whose actions generated radioactive contamination should proactively share relevant information. They often possess valuable knowledge about the situation at hand, such as the fissile core material, detonation altitude and yield of the weapon tested, the location of contaminated sites, historical weather patterns, and the possible effects of exposure.[124] As the IAEA stresses in one remediation safety guide, it is important to obtain accurate data about sites and tests, especially early on in the process, because "[d]ifferences among sites due to the heterogeneous character of the natural environment and to the nature and history of contamination are enough to require different approaches."[125] Furthermore, when it comes to handling radioactive contamination that has already happened, there is some evidence that during the Cold War states tested weapons clandestinely to evade testing moratoria.[126] As a result, the actual extent of nuclear contamination or the location of testing sites may not be known.[127] They should make information available to expedite and improve the quality of assistance.

Other states may also have a range of scientific and technical expertise and information they can share with affected states. In particular, certain states may have experience managing radioactive waste, monitoring contaminated sites, or conducting environmental remediation in related situations. Unlike some other toxic weapons components, radioactive materials are widely used in civilian applications. As a result, many states may have experience or expertise in the treatment of radioactive waste or the clean-up of nuclear accidents such as power plant meltdowns.

International organizations and NGOs may have specialized knowledge—drawn from substantive expertise or practical experience—that can improve an affected state's ability to conduct environmental remediation. These organizations can share technical advice and

124 Samuel Glasstone and Philip J. Dolan, *The Effects of Nuclear Weapons* (3d ed., 1977) pp. 414-418.
125 IAEA, "Characterization of Radioactively Contaminated Sites for Remediation Purposes," IAEA-TECDOC-1017, (1998), https://www-pub.iaea.org/MTCD/publications/PDF/te_1017_prn.pdf (accessed May 15, 2022), p. 13.
126 See Central Intelligence Agency, "The Possibility of Soviet Nuclear Testing during the Moratorium," SNIE-11-9-1 (April 25, 1961), https://www.cia.gov/readingroom/docs/DOC_0000272879.pdf (accessed May 15, 2022), pp. 2-3 ("Proof that nuclear weapons tests have occurred is difficult to obtain without collection of debris since the other indicators of testing activity are susceptible to alternative explanations. Conversely, proof that tests have not occurred has not been possible.").
127 See ibid. ("The most suspicious evidence relates to Southern Turkestan, in particular around Osh, and to Semipalatinsk. The data are most consistent with the thesis that the Soviets had conducted one or more large HE explosions bear Osh in the winter of 1959-1960 as a part of their seismic improvement program or to study methods of clandestine nuclear testing, but the conduct of an actual nuclear test cannot be ruled out.").

support capacity building (as discussed in Principle 6) through well-established and funded mechanisms. For example, the IAEA notes that it receives requests for assistance from some affected states that "lack[] the infrastructure or expertise necessary for evaluating the significance of radiation risks . . . and for making decisions on remediation."[128] Other affected states have expertise but need independent third-party opinions on situations for social or political legitimacy.[129]

Precedent

Principle 5 draws on disarmament and international environmental law to support the exchange of relevant technical and scientific information regarding nuclear contamination and responses with affected states.

Disarmament law and policy promote robust information sharing among states, international organizations, NGOs, and private actors. The Chemical Weapons Convention, the Mine Ban Treaty, and the Convention on Cluster Munitions grant states parties "the right to participate in the fullest possible exchange of . . . scientific and technological information."[130] Under the Convention on Cluster Munitions, Article 4(4) "strongly encourages" user states parties to provide "information on types and quantities of the cluster munitions used, precise locations of cluster munition strikes and areas in which cluster munition remnants are known to be located."[131] In addition, states parties can request that international organizations and NGOs use their information and expertise to help determine the nature and extent of cluster munition contamination and gather other data necessary to plan for clearance.[132] While the TPNW does not include a provision specifically on the exchange of scientific and technical information, Article 7(3) does oblige states parties in a position to do so to provide technical assistance, which could encompass such information, to affected states parties.[133]

Information sharing on hazardous activities and toxic substances is also a well-established international environmental norm. For example, the 1989 Basel Convention on transboundary hazardous waste requires immediate notification to possible affected parties after an accident that may affect human health or the environment.[134] The International Law Commission's 2001 Draft Articles on Prevention of Transboundary Harm from Hazardous Activities similarly encourage states to provide information related to hazardous activities, beginning when the hazardous activity occurs and continuing as long as appropriate.[135] While these obligations and norms are limited to transboundary harm, they are nonetheless instructive even where

128 IAEA, *Radiological Conditions at the Former French Nuclear Test Sites in Algeria: Preliminary Assessment and Recommendations* (March 2005), https://www-pub.iaea.org/MTCD/publications/PDF/Pub1215_web_new.pdf (accessed May 15, 2022).
129 See, e.g., ibid.
130 Chemical Weapons Convention, art. X(3); Mine Ban Treaty, art. 6(2); Convention on Cluster Munitions, art. 6(3).
131 Convention on Cluster Munitions, art. 4(4).
132 Ibid., art. 6(11).
133 TPNW, art. 7(3).
134 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, adopted March 22, 1989, 1673 U.N.T.S. 126, entered into force May 5, 1992, art. 13.
135 International Law Commission, "Draft Articles on Prevention of Transboundary Harm from Hazardous Activities, with Commentaries," pp. 164–65. Similar information-sharing provisions are emphasized in the International Law Commission's Principles on the Allocation of Loss in the Case of Transboundary Harm Arising out of Hazardous Activities. Under those principles, the state with jurisdiction or control over the sources of transboundary damage or any state or international organization with experience in mitigating harms of that type should provide relevant information. International Law Commission, "Draft Principles on the Allocation of Loss in the Case of Transboundary Harm Arising out of Hazardous Activities, with Commentaries," *Yearbook of the International Law Commission* (2006), vol. II, part, p. 83 ("Principle 5. Response measures. Upon the occurrence of an incident involving a hazardous activity which results or is likely to result in transboundary damage: (a) the State of origin shall promptly notify all States affected or likely to be affected of the incident and the possible effects of the transboundary damage").

environmental harm is limited to one country. The UN General Assembly has also called for states that have used depleted uranium weapons to provide information to identify and help manage contaminated sites.[136]

In addition, Principle 5 relates to the International Law Commission's Draft Principles on the Protection of the Environment in Relation to Armed Conflicts. According to Draft Principle 23, "[s]tates and relevant international organizations shall share and grant access to relevant information" to facilitate remedial measures.[137] Principle 5 embraces this duty to exchange information so that affected states receive the support necessary to engage in timely and effective environmental remediation.

Finally, programs administered by international organizations, including the IAEA and the OECD NEA, serve as models for organizations providing external assistance to states, especially ones that lack infrastructure or experience. The IAEA's Technical Cooperation Programme provides tailored technical assistance to member states to improve capabilities in a number of areas, including radiological safety and security.[138] The IAEA has recently led projects with member states to upgrade radiation monitoring systems, hold expert workshops for training and research, draft nuclear safety legislation, and design remediation plans.[139] In addition, the OECD NEA regularly facilitates opportunities for states to exchange scientific and technical information in realm of environmental remediation.[140] The NEA's workshops serve as precedent for exchanging technical knowledge and lessons learned, especially among states that have remediation knowledge from nuclear applications in the civilian sphere.

Principle 6: Capacity Building

> States, international organizations, nongovernmental organizations, and other actors should promote capacity building to ensure long-term and effective environmental remediation.

Discussion

Building state and local capacity to address the long-term effects of contamination from the use and testing of nuclear weapons is an important element of environmental remediation. The environmental impacts of nuclear radiation can last years or decades if not centuries. Radioactive isotopes can have centuries-long half-lives and can thus persist in the environment

136 UN General Assembly, "Effects of the Use of Armaments and Ammunitions Containing Depleted Uranium," UNGA Res. 71/70, A/RES/71/70, December 14, 2016, https://undocs.org/A/RES/71/70 (accessed January 7, 2020), para. 6 ("Invites Member States that have used armaments and ammunitions containing depleted uranium in armed conflicts to provide the relevant authorities of affected States, upon request, with information, as detailed as possible, about the location of the areas of use and the amounts used, with the objectives of facilitating the assessment and clearance of such areas").
137 International Law Commission, Draft Principles on the Protection of the Environment in Relation to Armed Conflicts, Principle 23.
138 IAEA, "Technical Cooperation Programme," https://www.iaea.org/services/technical-cooperation-programme (accessed May 12, 2022).
139 Ibid.
140 See, e.g., OECD NEA, "NEA Workshop on Stakeholder Involvement: Risk Communication," https://www.oecd-nea.org/jcms/pl_29289/nea-workshop-on-stakeholder-involvement-risk-communication (accessed May 22, 2022).

long after the nuclear weapons use or testing that produced them.[141] Moreover, remediation does not occur instantaneously. In many cases, returning contaminated environments to their original state is impossible, and waste removed from contaminated sites must be carefully managed in its new location for decades after its removal. Effective environmental remediation thus requires sustainability, which in turn depends on effective capacity building.

Capacity building enables affected states to implement environmental remediation over an extended period of time as they acquire, develop, and retain technology, infrastructure, and skills. As the following principles indicate, environmental remediation involves a series of complex steps that often require specialized knowledge and tools. Capacity building ensures that states and other entities providing technical, material, financial, or informational assistance to affected states empower the latter to engage in environmental remediation measures in their territories. For example, donors could share technical knowledge, train experts, or establish monitoring networks and research labs to analyze relevant data.

Capacity building can occur nationally and locally. At the national level, other states, international organizations, and NGOs can help an affected state fill gaps in its capacity to remediate the contaminated environment, making it less dependent on outside support over time. Building capacity should also give affected communities tools that allow them to help address the harm they face. Doing so not only bolsters remediation efforts but also empowers affected communities and recognizes victims' dignity and agency.[142] In some cases, building capacity on environmental remediation may complement efforts to build capacity on victim assistance.[143]

Precedent

Disarmament law and policy and international environmental practice highlight the importance of capacity building.

Disarmament law implicitly supports building an affected state's capacity to address remnants of war. Recognizing the critical role of international actors, the Convention on Cluster Munitions and the Mine Ban Treaty require states parties to facilitate the exchange of "scientific and technological information" and the delivery of equipment.[144] The Chemical Weapons Convention includes a similar provision.[145] This obligation helps furnish affected states parties with the knowledge and tools necessary to carry out sustainable clearance programs.

The action plans of the cluster munition and landmine treaties explicitly address the importance of capacity building. For example, the Lausanne Action Plan for the Convention on Cluster Munitions commits state parties to "share their experiences and best practices, establish partnerships at all levels and explore opportunities for cooperation . . . in order to develop capacity building and national expertise."[146] Similarly, the Dubrovnik Action Plan for the Convention on Cluster Munitions states that states parties seeking assistance should

141 Bolton and Minor, "Addressing the Ongoing Humanitarian and Environmental Consequences of Nuclear Weapons: An Introductory Review," *Global Policy*.
142 Civilian science exemplifies an empowering community tool. See generally Doug Weir, Dan McQuillan, and Robert A. Francis, "Civilian Science: The Potential of Participatory Environmental Monitoring in Areas Affected by Armed Conflict," *Environmental Monitoring and Assessment*, vol. 191 (2019) p. 618.
143 See IHRC-CEOBS, *Confronting Conflict Pollution*, Principle 10.
144 Convention on Cluster Munitions, art. 6(3); Mine Ban Treaty, art. 6(2).
145 Chemical Weapons Convention, art. X(3).
146 Lausanne Action Plan, action #39.

ensure that their requests for cooperation and assistance "include a focus on capacity building" at national and local levels.[147] The Oslo Action Plan, adopted at the Mine Ban Treaty's Fourth Review Conference in 2019, calls on states parties to "build national capacity"[148] and to "ensure that national strategies and work plans for completion make provisions for a sustainable national capacity to address previously unknown mined areas."[149] The Maputo Action Plan, adopted at the Mine Ban Treaty's Third Review Conference in 2014, encourages states parties in a position to do so to empower and provide other states parties with the "human, financial and material capacity to carry out their obligations under the convention."[150]

With regard to radioactive contamination specifically, the IAEA has developed a series of capacity building programs aimed at environmental remediation of nuclear legacy sites. Capacity building is required by the IAEA's statutory mandate and is a cornerstone of the agency's Technical Cooperation Program.[151] IAEA capacity building activities include training courses and workshops for member states, sponsored fellowships, visits by IAEA scientists, and special expert missions.[152] For example, as part of an IAEA capacity building program aimed at resolving the nuclear legacy problems in territories affected by uranium mining in Europe, the agency organized a series of training workshops between 2016 and 2018 where individuals from countries across the region learned how to manage and oversee environmental remediation efforts.[153] Additionally, the IAEA has also provided 17 million Euros since 1990 to support Ukraine contain, treat, and remove radioactive material in the Exclusion Zone associated with the 1986 Chernobyl nuclear power plant accident, including training and capacity building to strengthen Ukraine's nuclear safety framework.[154]

International environmental programs designed to deal with other radioactive waste from armed conflict have also recognized the importance of capacity building. In the early 2000s, UNEP worked to build the Iraqi government's capacity to assess the impacts of depleted uranium use.[155] The program sought to promote the Iraqi government's ability to identify contaminated sites and test soil, water, and vegetation samples by hosting training workshops for Iraqi Ministry of Environment personnel and supplying field equipment, such as monitoring instruments.[156] In 2018, UNEP initiated a new program to assist Iraq with cleaning up oil contamination from the conflict with the Islamic State (ISIS).[157] UNEP trained Iraqi officials on site assessments and carried out joint analyses to prioritize sites for cleanup.

147 Dubrovnik Action Plan, para. 40(b).
148 Oslo Action Plan, action #31.
149 Ibid., para. 26.
150 Maputo Action Plan, adopted at the Third Review Conference of the Mine Ban Treaty, June 27, 2014, para. 19.
151 Statute of the IAEA, art. III, § A(4).
152 Jing Zhang, "Overview of the IAEA's Technical Cooperation Programme," IAEA, May 2019, https://www.ujv.cz/file/edee/2019/05/2_zhang_overall-presentation-on-tc-projects-in-tceu_may-2019.pdf (accessed May 22, 2022), p. 15.
153 Ibid., p. 67; Yana Moysak, "IAEA Builds Human Capacity for Environmental Remediation of Nuclear Legacy Sites," IAEA, February 27, 2018, https://www.iaea.org/newscenter/news/iaea-builds-human-capacity-for-environmental-remediation-of-nuclear-legacy-sites#_ftn1 (accessed January 14, 2022).
154 IAEA, "IAEA, EBRD Commit to Further Support Decommissioning, Safety Projects at Chornobyl," April 27, 2021, https://www.iaea.org/newscenter/news/iaea-ebrd-commit-to-further-support-decommissioning-safety-projects-at-chornobyl (accessed January 10, 2022).
155 UN Environment Programme, "Technical Report on Capacity-building for the Assessment of Depleted Uranium in Iraq" (August 2007), https://postconflict.unep.ch/publications/Iraq_DU.pdf (accessed January 7, 2020), pp. 7–9.
156 Ibid., pp. 5, 7–17.
157 UN Environment Programme, "Iraq Officials Trained in Assessing Oil Contaminated Sites from the ISIL Conflict," September 27, 2018, https://www.unep.org/news-and-stories/press-release/iraq-officials-trained-assessing-oil-contaminated-sites-isil (accessed May 15, 2022).

Steps of Environmental Remediation

Principle 7: National Strategy

Affected states should develop, implement, and periodically review and update a comprehensive and coordinated national environmental remediation strategy, which includes designating a focal point, delegating responsibilities, developing a budget, creating a timeline, and adopting and implementing laws and policies.

Discussion

A comprehensive and coordinated national strategy is key to effective environmental remediation. While affected states should retain the flexibility to design strategies to fit their particular needs and resources, each national strategy should contain five practical elements. Strategies should include (1) a focal point, (2) a clear delegation of responsibilities, (3) a budget, (4) a timeline for implementation, and (5) dedicated laws and policies for implementing the strategy.

Every national strategy should designate a focal point (often a specific ministry) and delegate responsibilities among different actors. Having a centralized body in charge of managing the state's remediation efforts enhances coordination, facilitates monitoring of spending, and promotes accountability in implementation. A clear division of tasks more broadly reduces duplication of efforts and increases efficiency of environmental remediation efforts.

A national strategy should also include a budget and timeline for implementation. Clarity regarding a project's budget will allow for the development of realistic remediation plans as well as anticipation of future funding gaps. As part of their national planning, states should consider what external support to request from other states and how best to utilize the assistance they receive. Timelines promote efficiency and accountability by giving project managers goals for which to plan and by setting deadlines that governments have pledged to meet.

Finally, a national strategy needs laws and policies that provide mechanisms for the implementation and enforcement of environmental remediation measures. These laws and policies should, for example, require consultations with local communities about remediation processes and set standards for the long-term management of contaminated material, and could also restrict the trade of goods created in contaminated areas.

It is important for states to periodically review their environmental remediation programs to ensure that they remain effective.[158] National strategies may need to evolve over time in response to new information, scientific developments, or changing circumstances, such as those caused by climate change. For efficiency's sake, national remediation strategies should, where possible, be aligned with, and integrated into, existing policies for environmental cleanup and waste management, in order to ensure the efficient operation of these

158 IAEA, "Management of Long Term Radiological Liabilities: Stewardship Challenges," Technical Reports Series No. 450, 2006, https://www-pub.iaea.org/MTCD/Publications/PDF/TRS450_web.pdf (accessed January 10, 2021), p. 97.

programs.[159] It may also be useful to coordinate with national victim assistance strategies, given they also deal seek to deal with the harm associated with nuclear weapons contamination.[160]

Precedent

National strategies for clearing the remnants of war are a well-established feature of humanitarian disarmament law and policy. Article 4(2)(b) of the Convention on Cluster Munitions requires state parties to develop a national plan early in the clearance process.[161] It requires states parties to "[a]ssess and prioritise needs in terms of marking, protection of civilians, clearance and destruction," and to "take steps to mobilise resources and develop a national plan to carry out these activities. . . ."[162] The Lausanne Action Plan elaborates on Article 4(2) by calling on parties to develop "evidence-based, costed and time-bound national strategies" in order to their meet their clearance obligations under the Convention on Cluster Munitions.[163] The Nairobi Action Plan, adopted at the Mine Ban Treaty's First Review Conference in 2004, calls on states parties to implement national plans—demonstrating that they are an important step even when not obligated by a specific treaty provision—and the Oslo Action Plan calls for the development of "evidence-based, costed and time-bound national strategies and work plans to fulfill and implement [the] Convention. . . ."[164] The Oslo Action Plan further calls on parties to assist other parties in the development of their national strategies, where feasible.[165]

Humanitarian disarmament has analogous national strategy requirements for victim assistance programs, which can be extended to the realm of environmental remediation. The Convention on Cluster Munition, which identifies key elements of such a national strategy, obliges states parties to "develop a national plan and budget, including timeframes to carry out [victim assistance activities] . . . while respecting the specific role and contribution of relevant actors."[166] States parties are further obligated to designate a central authority, or "focal point," within the government for coordination of victim assistance, and to adopt "necessary national laws and policies."[167] There is also precedent for integrating victim assistance programs into existing frameworks and national policies. The Dubrovnik Action Plan and the Mine Ban Treaty's Maputo Action Plan both call for states to integrate victim assistance programs with existing programs where possible.[168]

National plan requirements are also common in international environmental law. The 2015 Paris Agreement to the UNFCC requires states parties to submit "nationally determined contributions," which describe the national efforts of each party to reduce domestic greenhouse gas emissions.[169] The contributions are required to be clear, transparent, and understandable, and the must be revisited and updated by states parties every five years.[170]

159 OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," p. 22.
160 See IHRC-CEOBS, *Confronting Conflict Pollution*, Principle 9.
161 Convention on Cluster Munitions, art. 4(2).
162 Ibid. (emphasis added).
163 Lausanne Action Plan, p. 21.
164 "Ending the Suffering Caused by Anti-Personnel Mines: Nairobi Action Plan 2005-2009," adopted at the First Review Conference of the Mine Ban Treaty, in "Final Report," APLC/CONF/2004/5, February 9, 2005, http://undocs.org/APLC/CONF/2004/5 (accessed January 20, 2020), action #19; Oslo Action Plan, action #2.
165 Oslo Action Plan, action #7.
166 Convention on Cluster Munitions, art. 5(2)(c).
167 Ibid., art. 5(2)(g, b).
168 Dubrovnik Action Plan, action #4.1; Maputo Action Plan, para. 6.
169 Paris Agreement under the UN Framework Convention on Climate Change, adopted December 12, 2015, C.N.63.2016. TREATIES-XXVII.7.d, entered into force November 4, 2016, art. 4.2.
170 Ibid., arts. 4(8-9).

Both the Stockholm Convention on Persistent Organic Pollutants and the 1997 Montreal Protocol on Substances that Deplete the Ozone Layer require states parties develop national plans to implement their obligations.[171] The Stockholm Convention further requires each party to "review and update, as appropriate, its implementation plan on a periodic basis."[172]

Principle 8: Assessing, Surveying, and Recording

> Affected states should assess, survey, and record the nature, extent, and effects of contamination and any discernable exposure pathways at each site in order to prioritize their responses and develop effective action plans for remediation.

Discussion

States should undertake an environmental assessment, at a minimum, at any site where there is a reasonable expectation that contamination from the use or testing of nuclear weapons persists. Though countries may design their own assessments, the IAEA recommends that initial assessments consist of two parts: a broad "historical site assessment" and a site-specific "characterization survey." States should make every effort to identify all contaminated areas under their jurisdiction or control, and they should ensure rigorous data recording throughout the assessment process.[173]

Under the IAEA's framework, affected states should first conduct a historical site assessment, reviewing available information about the nature and extent of contamination in their territory.[174] These assessments should be broad reviews of all potentially affected areas within the state's jurisdiction. The IAEA suggests that these assessments have several objectives:

(a) To identify possible sources of radiological and non-radiological contamination and other hazards;
(b) To identify the characteristics of the contaminants;
(c) To identify related past activities or accidents that occurred in the area;
(d) To determine whether the site poses a threat to human health or the environment;
(e) To provide input into the design of the characterization survey;
(f) To provide an assessment of the likelihood of migration of contaminants;
(g) To determine possible responsible parties.[175]

The broad nature of historical site assessments will help states to determine which sites are likely to require remediation under national and international standards and to identify what additional information may be necessary to minimize uncertainties in assessments, and to enable an evaluation of the area to be performed.

171 Stockholm Convention, art. 7; Montreal Protocol on Substances that Deplete the Ozone Layer, adopted September 16, 1987, 1522 U.N.T.S. 3, entered into force January 1, 1989, art. 10(3).
172 Stockholm Convention, art. 7(1)(c).
173 See Convention on Cluster Munitions, art. 4(2)(a).
174 IAEA, "Remediation Process for Areas Affected by Past Activities and Accidents," IAEA Safety Standards Series No. WS-G-3.1, 2007, https://www.iaea.org/publications/7537/remediation-process-for-areas-affected-by-past-activities-and-accidents (May 22, 2022), paras. 3.14-3.17.
175 Ibid., para. 3.15.

After performing a historical site assessment, it is recommended that states conduct individual site characterization surveys.[176] The goal of these more targeted surveys should be:

(a) to determine the nature and extent of contamination;
(b) to identify receptors and provide input to pathway analysis and dose assessment or risk assessment models;
(c) to identify various options for remediation;
(d) to evaluate environmental, occupational and public health and safety issues during remediation;
(e) to evaluate and select remediation technologies;
(f) to classify and quantify potential waste; and
(g) to assist in the final survey design.[177]

Given the lack of scientific clarity around the flow of contaminants, and especially radioactive contaminants, assessments should be reperformed periodically.[178]

Where there are unacceptable risks, comprehensive remediation measures, discussed later in this report, may be required. Procedures for remediation will vary with the media in which contaminants are located—usually soil or water—as well as the type of environment being affected—e.g., urban or agricultural. Given this, information from historical site assessments and characterization surveys will be crucial to the remediation process.[179]

States should ensure detailed and accurate recording throughout the assessment and surveying process. States should record information on any site on which they collect data, perform a remediation-related action, or render a remediation-related decision, regardless of whether in-depth remediation functions are ultimately performed on that site. The methods and requirements of data collection are elaborated in Principle 15. The documentation should include the history of nuclear weapons testing or use, the results of both initial surveys, the boundaries and areas in question, and follow-up assessments and updates on the remediation process at the site.[180] Data should be relevant, sufficient, reliable, and transparent. This record-keeping is crucial, inter alia, for sharing data with affected local communities, informing landowners, recording uncertainties identified in the remediation process, and for managing sites long term.[181] Those responsible for historical site assessments and characterization surveys should record assumptions in their data or modeling, data gaps, and limitations or lack of knowledge. These steps are vital to ensure that future generations will have the ability to use these records effectively, as discussed in Principle 16 on Data Preservation.

The assessment process is likely to run in parallel with the development of the national strategy discussed in Principle 7. It is difficult to begin a detailed assessment of the extent of a state's contamination without first establishing mechanisms for funding that assessment and regulations for properly undertaking the assessment. Likewise, it is challenging to design a complete national strategy, or to allocate resources in support of that strategy,

176 Ibid., paras. 3.24-3.27.
177 Ibid., para. 3.24.
178 See US Nuclear Regulatory Commission Risk Management Task Force, "A Proposed Risk Management Regulatory Framework," April 2012, https://www.nrc.gov/docs/ML1210/ML12109A277.pdf (accessed April 13, 2022), sections 3-6.
179 Sergey Fesenko et al., "Site Characterisation and Measurement Strategies for Remediation Purposes," Radioactivity in the Environment, vol. 14 (2009), pp. 42-43.
180 See OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," p. 64-65.
181 Ibid. See also IAEA, "Remediation Process for Areas Affected by Past Activities and Accidents," paras. 5.17-5.18.

without developing a clear understanding of the extent of a region's contamination. These principles should therefore be conducted in tandem, by establishing a framework for developing a plan, then undertaking an assessment in keeping with that framework, then allowing that assessment to inform the development of a more complete national strategy, and repeating that process as many times as necessary.

Assessment, surveying, and recording are also necessary first steps to creating an optimized remediation program, discussed more thoroughly under Principle 9 on Optimization. At a national level, and within each site, countries should use assessments to gather the information necessary for them to prioritize remediation for sites likely to pose the greatest risk of harm to human health or the environment, based on available resources.[182]

Finally, gathering information about contamination is valuable for victim assistance efforts as well. Therefore, coordinating assessments and exchanging findings with those in charge of victim assistance programs is important. The data collected can inform treatments of medical problems, allow people to take precautionary measures, and give local communities more certainty about the situations they face.

Precedent

Disarmament law and nuclear policy stress the importance of assessments. Assessing contamination and recording data prior to clearing remnants of war is a common aspect of disarmament treaties. For example, in order to fulfill their obligations under the Convention on Cluster Munitions, states parties are obligated to "survey, assess and record the threat posed by cluster munition remnants, making every effort to identify all cluster munition contaminated areas under its jurisdiction or control."[183] The Dubrovnik Action Plan elaborates that such assessments should occur within two years of the First Review Conference, and the Lausanne Action Plan adds that states parties should exchange best practices on environmental impact assessments as part of their efforts to enhance international cooperation and assistance under the convention.[184] The Dubrovnik Action Plan further notes that affected states parties should record information on "the scope, extent and nature of all cluster munition contaminated areas."[185] The Mine Ban Treaty similarly requires parties to identify areas with known or suspected antipersonnel mines in order to block the areas from civilians and destroy the mines.[186] The Oslo Action Plan supports the contention that assessments should be reperformed periodically by calling on states parties to "[t]ake appropriate steps to improve the effectiveness and efficiency of survey[s]."[187] CCW Protocol V requires states parties to and parties to the conflict to "survey and assess the threat posed by explosive remnants of war."[188]

Precedent links these assessments to prioritization. The Convention on Cluster Munitions requires states parties to assess and prioritize needs for clearance and destruction.[189] The Dubrovnik Action Plan explains that states parties should "[n]ote, to the extent possible, the location, scope and extent of any contamination where contaminated land is identified" in order to "allow for effective prioritization of ongoing clearance activities, taking into account

182 See OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," p. 66.
183 Convention on Cluster Munitions, art. 4(2)(a).
184 Dubrovnik Action Plan, action #3.1; Lausanne Action Plan, action #39.
185 Dubrovnik Action Plan, action #3.5.
186 Mine Ban Treaty, art. 5(2).
187 Oslo Action Plan, action #27.
188 CCW Protocol V, art. 3(3).
189 Convention on Cluster Munitions, art. 4(2)(b).

needs, vulnerabilities as well as realities and different priorities on local and national levels."[190] The IMAS similarly make clear that technical surveys of contaminated environments should support "land release prioritisation and decision making processes through the provision of evidence."[191]

Studies and recommendations produced by the IAEA provide models for performing assessments as part of environmental remediation in areas affected by radioactive contamination. IAEA safety guides require both an initial site assessment and updated site characterization surveys "to collect current information and to validate the information provided in the historical site assessment."[192] The responsible party should design the survey based on "the conditions in the area, the type and extent of on-site contaminants and the available resources," and the survey should "utilize all types of techniques for collecting the necessary data properly."[193] Such surveys are a necessary prerequisite to planning remediation, as they are used "to determine the nature and extent of radiological contamination" and to guide the remediation process.[194] Moreover, site surveys are used to set priorities for remediation "in accordance with the level of risk to human health and the environment" in the national remediation plan.[195] For its affected sites in Nevada, the United States uses site characterization to guide its method and timeline for environmental remediation.[196]

IAEA and OECD NEA both offer standards for detailed record keeping. IAEA guidelines for safe remediation require organizations conducting environmental remediation to keep records on remediation activities as well as "the locations, configurations, types and amounts of radionuclides remaining in the area after remediation."[197] The OECD NEA similarly suggests recording information on the project background and design; operations and accidents; health, safety, and environmental information; and waste storage and disposal.[198] The collection, dissemination, and preservation of data are discussed further under Principles 15 and 16.

Principle 9: Optimization

> When planning the remediation of a contaminated site, affected states should evaluate a range of potentially effective options and implement the option that produces the greatest benefit to the affected communities and the environment. This evaluation should include considerations of costs and benefits related to the environment, human health, society, culture, and the economy, and it should be guided by the preferences of affected communities and other stakeholders.

190 Dubrovnik Action Plan, action #3.4.
191 UN Mine Action Service, "International Mine Action Standards (IMAS) 08.20, Technical Survey," June 10, 2009, Amendment 4, February 2019, pp. 1-2.
192 IAEA, "Remediation Process for Areas Affected by Past Activities and Accidents," para. 3.24.
193 Ibid., para. 3.25.
194 Ibid., para. 3.24.
195 Ibid., paras. 2.11-2.14.
196 Jinming Zheng, Bin Long, and Fengyu Xie, "General Mechanisms for Policy-Making on Environmental Remediation at the Post-Closure Nuclear Test Sites in the USA," *Environmental Science and Pollution Research*, vol. 27 (2020), pp. 11487-11488.
197 IAEA, "Remediation Process for Areas Affected by Past Activities and Accidents," paras. 5.17-5.18.
198 See OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," p. 64.

Discussion

The process of optimization consists of two phases. In the first phase, a state should assess whether to undertake a comprehensive approach to environmental remediation. In the second phase, it should determine which of its available robust remediation options will yield the greatest possible benefits. Both of these phases should look at quantitative and qualitative factors, and they should take special consideration of the needs and desires of the affected communities, as expressed by those communities. Environmental remediation should be optimized to be practical, effective, and durable, while producing benefits to people and the environment.

During the first phase of optimization, the affected state should determine whether going beyond gathering information on contamination to treating it, as discussed in Principles 12-14, will benefit affected communities and the environment. The benefits that a state considers in this analysis might be quantitative in nature, as when more robust remediation measures would lead to a clear decrease in a community's cancer rates, or they might be more qualitative, as when remediation would restore a community's ties to important cultural sites. In some rare cases, a state, in consultation with affected communities, may determine that the best course of action is to limit or entirely cease some remediation activities. Even in these cases, foundational remediation functions, such as the assessment and monitoring of affected sites and retention of relevant data, should always be performed. Furthermore, while there should be an effort to reduce uncertainty in the remediation process, when uncertainty remains as to whether comprehensive remediation measures are necessary, affected states should follow the precautionary principle discussed in Principle 2 and pursue more in-depth remediation.

Once an affected state chooses to engage fully in environmental remediation, it should then select the remediation plan that produces the greatest benefit to the affected communities and the environment. As discussed below, affected states should consider environmental, health, social, cultural, and economic benefits and costs, as well as the preferences of the affected communities and other stakeholders, while making this selection. In addition to affected communities and their representative organizations, relevant stakeholders should include environmental and other civil society groups, remediation workers, and scientists and other experts.

The most obvious benefits of remediation are those that accrue to the environment, human health, and the economy. Environmental and health benefits of remediation include the reduction of radiation exposure to humans, other animals, and plants as well as subsequent improvements in the physical and mental health of human beings, repair of any physical damage to the environment, and restoration of biodiversity.[199] Economic benefits include access to and potential productive use of previously contaminated land or water, job creation, and reduced long-term healthcare costs.

Remediation can also offer social and cultural benefits, both by addressing historic wrongs and by providing present-day value to affected communities. States have historically located their nuclear testing operations in or near the territory of politically marginalized communities, and they have overlooked or discounted the harm radiological exposure testing has caused

199 Ibid., pp. 19-20.

in those communities.[200] For example, indigenous populations in Australia, the Pacific, and the United States have borne a disproportionate burden from nuclear weapons testing.[201] Remediation campaigns can help to remedy this historic harm by acting as a formal recognition of the harm done, working to restore trust among local communities, the national government, and the international community, and helping to reduce the burden on affected communities. In addition, environmental remediation can help to reunite some communities with cultural sites that had to be abandoned and to promote lost traditions if those communities have been displaced as a result of nuclear weapons use or testing. This process is in keeping with Principle 18 on Non-Discrimination. Achieving such benefits can help states meet their legal obligations to progressively realize social and cultural rights.[202]

Environmental remediation can also have costs, especially economic and social ones. For example, remediation activity may have its own environmental impact. It is also often expensive and resource intense, and a complete restoration of the land may be economically, and sometimes technically infeasible.[203] Energy, resources, and space may also be diverted to remediation measures from other initiatives.[204] As a result, prolonged remediation may, in some cases, lead to unacceptably high costs.

At any step in the optimization process, a state may conceivably encounter a situation in which the benefits of a remediation effort accrue disproportionately to one community while the harm of that effort are shouldered disproportionately by a different community. In such a case, the state can take into account the relative political power of each of these communities, as well as the current and historic harm experienced by those communities.

Assessment of these benefits and costs should be both qualitative and quantitative in nature. Affected states should strive to provide empirical and objective data (quantitative), especially when consulting with stakeholders. These states should recognize, however, that although certain benefits and costs—especially the cultural and the social—cannot be quantified, they remain essential considerations.[205] Therefore, affected communities, their representative organizations, NGOs, remediation personnel at risk of nuclear exposure, scientists, and other experts should all be actively and meaningfully involved in the remediation process from the beginning.

Precedent

The principle of optimization is reflected in contemporary guidance on radiological protection and in humanitarian disarmament law.

200 "Nuclear Testing Legacy Is 'Cruellest' Environmental Injustice, Warns Rights Expert," UN news release, July 16, 2020, https://news.un.org/en/story/2020/07/1068481 (accessed May 15, 2022); "75th Anniversary of the Trinity Nuclear Tests, 16 July 2020," UN Office of the High Commissioner for Human Rights news release, July 16, 2020, https://www.ohchr.org/en/press-releases/2020/07/75th-anniversary-trinity-nuclear-tests-16-july-2020?LangID=E&NewsID=26103 (accessed May 15, 2022).

201 Ibid.

202 ICESCR, art. 2(1).

203 See IAEA, "Policy and Strategies for Environmental Remediation," IAEA Nuclear Energy Series No. NW-G-3.1, https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1658_web.pdf (accessed April 11, 2022), pp. 20-21.

204 Ibid., pp. 12, 14-15, 20-21.

205 States should further acknowledge that the so-called "cost-benefit analysis" can be flawed and that even the most "objective" and "quantifiable" of considerations may obscure the subjective assumptions and desires that gave rise to them. For one of many critiques on this subject, see, e.g., Giulia Wegner and Unai Pascual, "Cost-Benefit Analysis in the Context of Ecosystem Services for Human Well-Being: A Multidisciplinary Critique," *Global Environmental Change*, vol. 21 (2011), p. 491.

Optimization is a well-embedded principle of radiological protection—the protection of people from harm caused by radiation.[206] The International Commission on Radiological Protection (ICRP), IAEA, and the OECD NEA all use similar definitions of optimization. The ICRP defines optimization as "the source-related process to keep the magnitude of individual doses, the number of people exposed, and the likelihood of potential exposure "as low as reasonably achievable" (ALARA) below the appropriate dose constraints, with economic and social factors being taken into account."[207] This ALARA formulation, which the IAEA and OECD NEA use as well,[208] seeks to ensure that all reasonable steps are taken to protect people from radiation.[209] It is similar to the idea of maximizing benefits described in the discussion section above. The ICRP recommends that the implementation of the optimization principle "should ensure the selection of the best protection strategy under the prevailing circumstances, i.e. maximising the margin of good over harm."[210] The IAEA, for its part, recommends that states or organizations conducting remediation should ensure that their remedial actions "yield sufficient benefits to individuals and to society . . . that outweigh the cost of such action and any harm or damage caused by the action."[211] This approach parallels the idea that affected states conducting remediation should ensure that the measures they choose produce a benefit.

The ICRP's, IAEA's, and OECD NEA's approaches to optimization of radiological protection also provide support for the consideration of economic, social, and environmental factors; qualitative evaluations of remediation options; and inclusivity. The IAEA and ICRP both note in their definitions of optimization the need to account for economic and social factors.[212] The OECD NEA has recently added environmental circumstances as a consideration and has discussed the need to optimize humans' "overall well-being," not just their dosage levels.[213] The NEA recommends holistic, case-by-case evaluations that incorporate qualitative as

206 The IAEA defines radiological protection as: "*The protection of people from harmful effects of exposure to ionizing radiation, and the means for achieving this*." IAEA, *Safety Glossary*, p. 175 (emphasis in original). In addition to radiological protection, the principle of optimization has also been applied to other topics, such as the workplace safety, maintenance, and nuclear power plant outages. See, respectively, IAEA, "Optimization of Radiation Protection in the Control of Occupational Exposure," Safety Reports Series No. 21, 2002; IAEA, "Maintenance Optimization Programme for Nuclear Power Plants," IAEA Nuclear Energy Series No. NP-T-3.8, 2018; IAEA, "Nuclear Power Plant Outage Optimization Strategy," IAEA TECDOC Series, IAEA-TECDOC-1806, 2016 edition.

207 "The Optimisation of Radiological Protection: Broadening the Process," ICRP Publication 101, *Annals of the ICRP*, vol. 36, no. 3 (2006), https://journals.sagepub.com/toc/ani/36/3 (accessed March 27, 2022), p. 81.

208 IAEA, *Safety Glossary*, p. 160 (defining optimization (of protection and safety) as "[t]he process of determining what level of protection and safety would result in the magnitude of individual doses, the number of individuals (workers and members of the public) subject to exposure and the likelihood of exposure being as low as reasonably achievable, economic and social factors being taken into account."(emphasis removed)); OECD NEA, "Optimisation: Rethinking the Art of Reasonable: Workshop Summary Report," NEA/CRPPH/R(2020)2, October 2021, https://www.oecd-nea.org/jcms/pl_60901/optimisation-rethinking-the-art-of-reasonable-workshop-summary-report (accessed March 27, 2022), p. 8 ("The optimisation of protection, to keep radiological exposures as low as reasonably achievable (ALARA), taking into account social, economic and, more recently, environmental circumstances. . . .").

209 "Application of the Commission's Recommendations to the Protection of People Living in Long-Term Contaminated Areas after a Nuclear Accident or Radiation Emergency," ICRP Publication 111, *Annals of the ICRP*, vol. 39, no. 3 (2009), https://www.icrp.org/publication.asp?id=icrp%20publication%20111 (accessed May 22, 2022), p. 28 ("Optimisation is a frame of mind, always questioning whether the best has been done in the prevailing circumstances, and if all that is reasonable has been done to reduce doses.").

210 Ibid., p. 26. See also "The Optimisation of Radiological Protection: Broadening the Process," ICRP Publication 101.

211 IAEA, "Guidelines for Remediation Strategies to Reduce the Radiological Consequences of Environmental Contamination," p. 3.

212 IAEA, *Safety Glossary*, p. 160; "The Optimisation of Radiological Protection: Broadening the Process," ICRP Publication 101, p. 81.

213 OECD NEA, "Optimisation: Rethinking the Art of Reasonable: Workshop Summary Report," pp. 8, 10. The OECD NEA writes, "Well-being, as defined by the WHO, is not merely the absence of disease or infirmity. It is rather a combination of 'all' aspects of life that lead to a state of complete physical, mental and social well-being in a given circumstance." Ibid., p. 10.

well as quantitative measurements when developing a radiation protection plan.[214] The NEA has further highlighted the need to engage with stakeholders and the importance of "cultural and community-related aspects" for optimization,[215] and the ICRP has noted that the implementation of the optimization process should "reflect the increasing role of individual equity, safety culture, and stakeholder involvement."[216] The emphasis on cultural factors and stakeholder involvement underlines the need for affected communities and other stakeholders to meaningfully guide remediation and radiological protection efforts.

There are critiques of these approaches to optimization,[217] however, and therefore, implementation of environmental remediation programs should seek to exceed, and not merely recreate, standard practice on this point. In particular, states should ensure they prioritize meeting affected communities' needs and respecting, protecting, and fulfilling international human rights as they engage in their optimization analyses.

Humanitarian disarmament law provides additional support for the principle of optimization. Under the Convention on Cluster Munitions and the IMAS, affected states are encouraged to prioritize clearing areas that pose the greatest risk or vulnerability for affected communities. The Dubrovnik Action Plan for the Convention on Cluster Munitions requires "effective prioritization of ongoing clearance activities, taking into account needs, vulnerabilities as well as realities and different priorities on local and national levels. . . ."[218] The IMAS note that authorities and managers "prioritize action reflecting the scale and nature of the risks to people, assets and wider emergency, reconstruction and development programmes."[219] The IMAS for Battle Area Clearance add that "the priorities for clearance should be determined by the impact on the individual community, and the special needs of men, women, and children within it, balanced against national infrastructure priorities."[220] While the technical aspects of explosive ordnance clearance and remediation of nuclear weapons contamination differ, this tradition of allowing the needs of local communities to guide the prioritization of clearance activities provides support for the principle of optimization and its emphasis on the views of affected communities.

214 Ibid., p. 11 (citing OECD NEA, *Management of Radioactive Waste after a Nuclear Power Plant Accident*, 2016); OECD NEA, *Optimisation in Operational Radiological Protection, A Report by the Working Group on Operational Radiological Protection of the Information System on Occupational Exposure* (2005), pp. 7-8.

215 OECD NEA, "Optimisation: Rethinking the Art of Reasonable: Workshop Summary Report," p. 9 ("Optimisation of radiological protection requires a process that engages key stakeholders, resulting in judgement that is informed by 'radiological protection science' but that incorporates, and is often driven by, political, social, economic as well as ethical judgements. . . . Cultural and community-related aspects are a significant part of the prevailing circumstances, and will play a large role in identifying the optimal radiological protection solution.").

216 "The Optimisation of Radiological Protection: Broadening the Process," ICRP Publication 101, pp. 65, 71. The ICRP included this optimization principle in its broader 2007 recommendations on radiological protection as well. "The 2007 Recommendations of the International Commission on Radiological Protection," ICRP Publication 103, *Annals of the ICRP*, vol. 37, nos. 2-4 (2007), https://www.icrp.org/publication.asp?id=ICRP%20Publication%20103 (accessed May 22, 2022), p. 1.

217 Andreas Engström et al., "A Case Study of Cost-Benefit Analysis in Occupational Radiological Protection within the Healthcare System of Sweden," *Journal of Applied Clinical Medical Physics* (2021), https://doi.org/10.1002/acm2.13421 (accessed May 19, 2022), pp. 295-296.

218 Dubrovnik Action Plan, action #3.1(b).

219 UN Mine Action Service, "IMAS 07.10, Guidelines and Requirements for the Management of Land Release and Residual Contamination Operations," First Edition (Amendment 7, June 2018), p. 5. For more on the land release process for mines, including prioritization, see UN Mine Action Service, "IMAS 07.11, Land Release," First Edition (Amendment 5, February 2019).

220 UN Mine Action Service, "IMAS 09.11, Battle Area Clearance (BAC)," First Edition (Amendment 4, January 2020), section 5.1.

Principle 10: Risk Education

> Affected states should ensure that clear, comprehensive, tailored risk education programs are available to all communities affected by or at risk of radioactive contamination from the use or testing of nuclear weapons.

Discussion

Risk education is a crucial component of any program designed to protect people from the effects of radioactive contamination. By informing community members about the dangers they face as a result of radioactive contamination, risk education empowers them to protect themselves. In so doing, risk education helps to prevent or minimize exposure.[221]

Risk education programs should be designed to ensure that people in affected communities are aware of the risks posed by radioactive contamination and are encouraged to behave in ways that reduce the risks to themselves and the environment.[222] Campaigns should include information sufficient to make people aware of: what actions are dangerous and what actions they can take to reduce that danger; what areas are safe to access and which pose an unacceptable risk; whom to contact if they are exposed to radiation; and where they can go to receive further information about the government's remediation efforts. To ensure efficient use of resources and to increase the spread of information, risk education programs can be tied to other remediation activities, such as surveying and fencing.[223] Risk education programs can also be included as standalone parts of school curricula or as public TV, internet, radio, billboard, or print advertisement campaigns.

Risk education need not be limited to addressing only the direct effects of radiation on human populations. Information should also be disseminated to notify people of the risks that contamination poses to the environment and to people through the environment and how they can mitigate them. For example, information on measures to protect livestock and radiation-safe agricultural techniques would be helpful additions to a risk education program.

Affected states should tailor their risk education programs to the needs of their target populations. These programs should be sensitive to age, gender, ability, and culture. Information should be provided in a way that is accessible and comprehensible to its audience. Risk education programs should also be adjusted to counter the complacency that may exist among high-risk communities that are familiar with, and desensitized to, the issue of radioactive contamination. Openness and honesty about site data, including information on the locations of contaminated sites and the level of contamination present at those sites, increases the impact of the risk education programs, builds trust among affected populations, and promotes the guiding principles of inclusivity and transparency (Principles 17 and 19).

221 Risk education also relates to Principle 5 in *Confronting Conflict Pollution*, which lists "access to accurate and comprehensive information regarding the harms and risks associated with [toxic remnants of war]" as a type of victim assistance. IHRC-CEOBS, *Confronting Conflict Pollution*, Principle 5.

222 UN Mine Action Service, "IMAS 12.10, Explosive Ordnance Risk Education," Second Edition, September 2020, p. 8.

223 Ibid.

Risk education should be implemented in all communities that face a risk of exposure, regardless of whether there was previous public awareness about that exposure. While responsible risk education should not create unnecessary fear, disruption, or stress, site-specific risk education should never be neglected for fear of creating stigma around potentially safe sites or inciting concern in the community. Delays in disseminating information should be avoided or minimized to reduce potential additional harm to affected communities.

Affected states should ensure funding and resources for ongoing education efforts, and other states parties should provide support to affected states. States may work with NGOs and other civil society actors to coordinate and run their educational programs. To increase efficiency, affected states can integrate programs into existing educational systems or relief and development activities.

Precedent

Risk education is a common feature of humanitarian disarmament law and policy. For example, the Nairobi Action Plan for the Mine Ban Treaty outlines specific goals of mine risk education, including reducing the number of victims, reducing the risks to populations near contaminated areas, and promoting mutual understanding and reconciliation.[224] The Oslo Action Plan emphasizes the importance of integrating risk education into "wider humanitarian, development, protection and education efforts," and it calls on states to "[b]uild national capacity to deliver mine risk education and reduction programmes with the ability to adapt to changing needs and contexts."[225] It also calls on parties to "[p]rioritize people most at risk by linking mine risk education . . . directly to an analysis of available [data]."[226] The Convention on Cluster Munitions makes risk education a legal obligation, and its Lausanne Action Plan encourages states parties to integrate risk education into survey, clearance, and victim assistance activities.[227] The Lausanne Action Plan further calls for risk education programs that are able to change over time and that are "context-specific," "tailor-made" to address the specific needs of their populations, and sensitive to gender, age, and disability-related issues.[228] These goals and elements of risk education are as relevant to radioactive contamination as they are to landmines and cluster munitions.

CCW Protocol V addresses the importance of information retention to facilitate risk education. Article 4 obliges the parties to an armed conflict to retain information on the use or abandonment of explosive ordnance "to the maximum amount possible" to facilitate, inter alia, risk education efforts.[229] Risk education is just one of the remedial measures established in Protocol V.[230] Inclusion of risk education in Protocol V alongside provisions like the clearance and removal of explosive ordnance illustrates the interdependence of these activities.

Finally, the IMAS set guidelines for risk education in the explosive ordnance context, many of which can translate to the context of nuclear weapons contamination. The IMAS note the fundamental importance of risk education to the remediation process, identifying it as one of the five "pillars" of mine action.[231] The IMAS framework for implementing risk education

[224] Nairobi Action Plan, actions #20-21.
[225] Oslo Action Plan, actions #28, 30.
[226] Ibid., action #30.
[227] Convention on Cluster Munitions, art. 4(2)(e); Lausanne Action Plan, action #27.
[228] Lausanne Action Plan, actions #30, 28.
[229] CCW Protocol V, art. 4(1).
[230] Ibid., arts. 2-4.
[231] UN Mine Action Service, "IMAS 12.10, Explosive Ordnance Risk Education," p. 8.

includes recommendations for conducting a needs assessment to inform risk education plans and forming a socially, culturally, and age-appropriate communication strategy that accounts for things like risk-taking behaviors and the specific type of contamination at issue.[232] Risk education programs related to nuclear weapons contamination should draw from the IMAS framework to ensure the most effective, community-oriented risk education programs possible.

Principle 11: Preventing Radiation Exposure Pathways

> Affected states should prevent exposure by breaking, disrupting, or removing the pathways by which people are exposed to contamination from nuclear weapons use or testing. Such measures may include limiting access to contaminated sites, such as through marking and fencing, and controlling food and water sources.

Discussion

As part of their environmental remediation measures, affected states should seek to prevent the pathways by which people are exposed to the contamination caused by nuclear weapons use or testing. Doing so, advances the goal of addressing existing harm and unacceptable risk of future harm.

To limit direct exposure, affected states should maintain perimeter marking systems around significantly contaminated areas under their jurisdiction or control. They should assess what kind of perimeter marking systems is appropriate for a given site. Perimeter marking systems can include signs, markers (such as colored rocks), and/or physical barriers (such as fencing).[233] They should clearly indicate the line between safe and hazardous areas to increase local community awareness and provide opportunities for people to avoid further contamination.[234] Signs warning of hazards should be visible, legible, durable, and recognizable by the local community. Physical barriers can keep people as well as their animals from exposing themselves to radiation and possibly spreading contamination beyond the site. Perimeter marking systems should be kept up to date as site monitoring and treatment measures provide new information or change the level of risks posed by the site. They should also be regularly maintained to prevent confusion in cases where markers have been damaged or removed. In cases where boundaries of the contamination are unclear, states should follow the precautionary principle as described in Principle 2 to determine where to draw lines.

Interventions should also target food and water sources. Exposure through contaminated food products can harm affected communities for decades after the initial event of contamination, especially when the area of contamination includes rural, agricultural regions.[235] Contamination in drinking water or water used for irrigation can also expose

[232] Ibid., p. 15.
[233] The IMAS recommend that markers can be used "when signs are not available, or when local conditions prevent their effective use—for example when signs are repeatedly removed by the local population." UN Mine Action Service, "IMAS 08.40, Marking Mine and ERW Hazards," Second Edition (Amendment 4, June 2013), p. 2.
[234] Convention on Cluster Munitions, art. 4(2)(c).
[235] "Application of the Commission's Recommendations to the Protection of People Living in Long-Term Contaminated Areas after a Nuclear Accident or a Radiation Emergency," ICRP Publication 111, p. 14.

people to radiation.[236] To prevent exposure, before and even in the initial remediation phases, communities should be warned not to farm their land or raise livestock on it or use contaminated fisheries; instead they should be encouraged to rely instead on imported food. A moratorium on trade of agricultural products to prevent further spread of nuclear radiation may also be appropriate until additional remediation measures are taken. Due to the economic hardship these measures may cause, affected states could consider subsidies to ensure these communities have access to food and mitigate economic harm caused by agricultural and fishery moratoriums. These subsidies and strategies should be consistent with the national strategy and inclusivity guidelines outlined in Principles 7 and 17.

Precedent

Models for measures to protect communities from contaminated areas exist in disarmament and nuclear law and policy. Article 4(2)(c) of the Convention on Cluster Munitions requires states parties to "[t]ake all feasible steps to ensure that all cluster munition contaminated areas under its jurisdiction or control are perimeter-marked, monitored and protected by fencing or other means to ensure the effective exclusion of civilians." The article adds that the warning signs should be recognizable, noticeable, and durable and should clearly communicate a line between safe and unsafe areas.[237] Article 5(2) of the Mine Ban Treaty has very similar language, obliging states parties to ensure that areas with antipersonnel mines are "perimeter-marked, monitored and protected by fencing or other means, to ensure the effective exclusion of civilians."[238] It cites the standards of the 1996 CCW Amended Protocol II on Mines, Booby-Traps and Other Devices, which requires markings to be "of a distinct and durable character and at least visible to a person who is about to enter the perimeter-marked area" and signs to be visible and recognizable by the civilian population.[239] The IMAS provide further guidance for the use of markers (such as colored rocks), signs, and physical barriers to identify mine and explosive remnants of war hazard areas.[240] While explosive ordnance and radioactive materials pose different dangers, the need to deny access to contaminated sites is the same.

The IAEA and OECD NEA also recommend perimeter marking. The IAEA calls for restricting access to contaminated areas "in cases of serious residual contamination."[241] It adds that access restrictions can include warning signs, fencing, and/or guarded control stations.[242] The OECD NEA similarly says that remediation measures that allow significant amounts of contamination to remain on-site necessitate "fencing, caps or other barriers to isolate the source term or contamination, cutting or minimising the pathway to receptors."[243]

ICRP and IAEA publications include guidelines for targeting food and water exposure pathways. The IAEA recommends monitoring the radiological content of food products and

236 IAEA, "Guidelines for Remediation Strategies to Reduce the Radiological Consequences of Environmental Contamination," p. 24.
237 Convention on Cluster Munitions, art. 4(2)(c).
238 Mine Ban Treaty, art. 5(2).
239 Ibid. (citing, as a minimum standard, CCW Amended Protocol II on Prohibitions or Restrictions on the Use of Mines, Booby-Traps and Other Devices as amended on 3 May 1996, art. 5(2)(a) and technical annex, para. 4).
240 UN Mine Action Service, "IMAS 08.40, Marking Mine and ERW Hazards."
241 IAEA, "Remediation Process for Areas Affected by Past Activities and Accidents," para. 6.8.
242 Ibid. See also IAEA, "Advancing Implementation of Decommissioning and Environmental Remediation Programmes," IAEA Nuclear Energy Series No. NW-T-1.10, 2016, p. 14 ("Consideration needs to be given to limiting access to the area by fencing off the perimeter area and establishing security monitoring systems in order to ensure contaminated material is not diverted from the site and the public does not have access to the site, thereby ensuring their protection.")
243 OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," p. 34.

notes that remediation strategies must take into account ingestion doses of radiation in addition to inhalation and external doses.[244] It groups agricultural food chain management interventions into three categories: 1) soil-crop interventions, such as topsoil removal or treatment; 2) livestock interventions, such as changing grazing patterns; and 3) food production, processing, or cooking interventions, such as washing or boiling products.[245] While recognizing that interventions in aquatic systems can be expensive, the IAEA suggests remediation for both drinking water sources and the harvesting of aquatic species for food.[246] According to the ICRP, authorities should provide relevant information and set directly measurable contamination criteria that citizens can use to measure their levels of contamination.[247] Provided that adequate provisions are in place to monitor their effectiveness, measures such as these can help enable populations to continue to rely on local products and to maintain many of their economic and cultural traditions without being exposed to dangerous levels of radiation.

Principle 12: Addressing Contamination

> When an affected state determines that comprehensive environmental remediation is necessary and appropriate, the state should address the contamination itself through measures such as containment or other forms of treatment.

Discussion

A comprehensive environmental remediation program should not only prevent exposure pathways but also address the contamination itself.[248] An affected state has various measures to choose among, notably containment (in situ or ex situ) and other treatment options.

In many cases, the most effective way to treat the contamination from nuclear weapons use or testing is to contain it. Containing it on site (in situ) involves immobilizing it to prevent further dispersal of the radiation.[249] In addition to preventing the problem from spreading, this strategy has the immediate benefit of preventing exposure pathways by denying humans as well as flora and fauna access to the polluted site. Methods include capping, land encapsulation, and the creation of physical and cryogenic barriers.[250] Contaminants can also be removed and transported elsewhere for long-term, off-site (ex situ) containment, which is discussed more under Principles 13 and 14.

244 IAEA, "Guidelines for Remediation Strategies to Reduce the Radiological Consequences of Environmental Contamination," pp. 16, 20.
245 Ibid., pp. 22-24, 82.
246 Ibid., p. 24.
247 "Application of the Commission's Recommendations to the Protection of People Living in Long-Term Contaminated Areas after a Nuclear Accident or a Radiation Emergency," ICRP Publication 111, p. 44. The ICRP adds, "[I]f the contamination only affects a few categories of foodstuffs, the contamination criteria may be set to higher values. Higher contamination criteria may also be set to preserve local production, which may be deeply embedded in traditions or which may be essential to the economy of the entire community."
248 IAEA, "Getting to the Core of Environmental Remediation: Reducing Radiation Exposure from Contaminated Areas to Protect People," https://www.iaea.org/sites/default/files/18/05/environmental_remediation.pdf (accessed May 12, 2022), p. 2.
249 Ibid., p. 37.
250 US Environmental Protection Agency, "Technology Reference Guide for Radioactively Contaminated Media," 2007, https://www.epa.gov/sites/production/files/2015-05/documents/media.pdf (accessed May 15, 2022), p. 6.

Treatment can alternatively or in addition involve applying chemical, biological, biochemical, or thermal agents to treat or stabilize the radioactive material.[251] These techniques include: separating contaminants from non-contaminated features such as soil, water, and air; stabilizing contaminated materials with chemical bonding agents; heating and cooling contaminants to be trapped in glass; introducing microorganisms or plants to remove, transfer, or stabilize radioactive nucleotides; and strategically using natural processes.[252] Full decontamination may not be practical or possible, but these techniques can be used to treat radionuclides to lower contamination levels to safer exposure values, enabling future use of the affected areas.

Chemical treatments have been used to help resume agricultural activities at affected sites. These kinds of treatments can include altering the chemistry of the soil or water bodies, using additives in animal feed, or reducing consumption of contaminated feed by farmed fish.[253] They can supplement or replace the restrictions on land use and husbandry practices, such as keeping animals from grazing in certain areas, discussed in Principle 11 on Preventing Radiation Exposure Pathways.[254] Such control measures may allow communities to rely on local resources and food supplies, which can protect local economies and, in some cases, cultural practices.

Strategies for treatment should be customized to the area based on four major characteristics. The affected state should alter strategies based on ambient activity concentrations of radionuclides in the environment; physical and chemical properties of radionuclides which may influence their mobility in the environment; soil, water, plant and animal characteristics; and farming practices and land use.[255] When evaluating strategies, affected states should also reflect changes in technology and research, and may take into account monetary and the geological and climatic constraints of the area.[256]

Precedent

Humanitarian disarmament law and environmental policy provide support for directly addressing nuclear weapons contamination. Humanitarian disarmament treaties include provisions mandating the cleanup of remnants of war. In the TPNW, which is most on point, Article 6(2) requires each state party to take "necessary and appropriate measures" towards environmental remediation of areas contaminated by "the testing or use of nuclear weapons or other nuclear explosive devices."[257] Earlier humanitarian treaties include analogous provisions for clearing explosive remnants of war and other explosive ordnance. Article 4 of the Convention on Cluster Munitions obliges each affected state party to clear, destroy, or ensure the clearance of cluster munition remnants.[258] Article 5 of the Mine Ban Treaty requires states "to destroy or ensure destruction of all anti-personnel mines in mined areas under its jurisdiction or control."[259] While the latter two treaties include deadlines

251 Ibid.
252 Ibid., pp. 5, 8
253 IAEA, "Guidelines for Remediation Strategies to Reduce the Radiological Consequences of Environmental Contamination," pp. 23-24, 62-70; "Application of the Commission's Recommendations to the Protection of People Living in Long-Term Contaminated Areas after a Nuclear Accident or a Radiation Emergency," ICRP Publication 111, p. 43.
254 Ibid.
255 IAEA, "Guidelines for Remediation Strategies to Reduce the Radiological Consequences of Environmental Contamination," p. 8.
256 OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," pp. 19, 22.
257 TPNW, art. 6(2).
258 Convention on Cluster Munitions, art. 4(1).
259 Mine Ban Treaty, art. 5(1).

for clearance, the TPNW does not because, unlike sites littered with cluster munitions or landmines, sites contaminated by radioactive contamination can rarely, if ever, be completely remediated.

National environmental policies provide models for different remedial treatments for radioactive contamination. For example, the US Environmental Protection Agency has produced a guide of existing technologies proven effective "for treatment of radioactively contaminated media."[260] This guide provides a survey of each technology including process descriptions, operating principles, performance and cost data, target contaminants, and applicable site characteristics.[261]

Principle 13: Material Handling and Waste Management

> Affected states should ensure that contaminated material is properly managed during handling, transport, and storage.

Discussion

Material and waste generated from the process of addressing contamination should be safely managed. Affected states should create a material handling and waste management strategy and prevent the spread of contamination into previously uncontaminated areas. Affected states should therefore ensure that proper planning and care is taken at the stages of handling, transport, and storage to ensure the protection of the environment and local communities.

When planning an ex situ storage project, affected states should take into account the risks associated with moving the contaminated materials and the choice of haulage routes.[262] This form of remediation requires the hazardous waste to be moved at least once, and often more than once because the waste is usually initially stored at a short-term facility while a long-term facility is constructed. Transport exposes people and the environment to risks from hazardous material along haulage routes. To reduce the risk of exposure, planners should consider the volume and nature of contaminated material and optimize the path of transport.[263]

Affected states should also plan the location and design of waste storage facilities to minimize risks to the environment and local communities. When evaluating potential waste storage sites, even temporary ones, states should consider potential disproportionate impacts on nearby communities and the environment, and include local stakeholders in the same way

260 US Environmental Protection Agency, "Technology Reference Guide for Radioactively Contaminated Media," p. i.
261 Ibid., p. 1.
262 See "Radiological Protection of People and the Environment in the Event of a Large Nuclear Accident," ICRP Publication 146, *Annals of the ICRP*, vol. 49, no. 4 (2020), https://www.icrp.org/publication.asp?id=ICRP%20Publication%20146 (accessed May 15, 2022) p. 47 ("The generation of radioactive waste during decontamination should be considered carefully, taking into account available disposal routes and possible alternatives"). Note also that waste management is "typically the largest portion of the cost to remediate a site" and thus may determine whether a project is financially feasible. See OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations."
263 Generated waste will vary depending on the method of remediation, see OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," pp. 57, 60. "Minimizing waste volume will reduce transport requirements . . . [and limit] consequent environmental impact [and] the total costs associated with contaminated material." Ibid., p. 60.

they would during other phases of the remediation process (see Principle 17). Storing or disposing of hazardous materials on indigenous peoples' territory requires their free, prior and informed consent.[264] Because radioactive waste poses risks of radiological harm for hundreds or thousands of years, waste storage facilities should be specifically constructed to provide exceptionally long-term containment.[265] Many states do not have existing facilities capable of such containment and may need to use interim management facilities while more permanent facilities are constructed.[266] Interim facilities should provide effective containment for longer than needed to construct long-term facilities, in case construction is delayed. Since the amount of contaminated material generated by a remediation project may be difficult to predict, planned waste containment facilities should be able to contain more than the anticipated volume of waste.[267]

Remediation projects generate contaminated materials that vary in their level of radioactivity and how long they will pose a radiological risk.[268] Given available capacity, states should consider distributing each class of material to facilities that are most appropriate for its management.[269]

All waste management work should be done with appropriate protective equipment and safe systems of work in place in order to protect workers as well as local communities and the environment. Remediation workers, especially those at waste facilities, will generally be exposed to a higher level of radiation than the general public. Worker hours should be set to safe levels and limited. Remediation workers should also be regularly monitored to reduce the occurrence of adverse health impacts resulting from exposure.

Precedent

Nuclear agencies, national practice, and international human rights law offer standards and models for material handling and waste management of nuclear weapons contamination. Both the IAEA and ICRP require states to factor into remediation planning the volume and nature of contaminated material that could be generated by waste management operations. They also require states parties to minimize off-site exposure and contamination during waste management operations including during the waste's period of transit. The ICRP has established dose limits, radiological protection requirements, and action plans for accidental exposure events in addition to other recommendations related to long-term nuclear waste management operations.[270]

The OECD NEA has published recommendations to states that are developing long-term waste management strategies. These recommendations include urging states to plan for and develop interim storage facilities until a final storage facility is available—a strategy that

264 UN Declaration on the Rights of Indigenous Peoples, art. 29(2).
265 See, e.g., IAEA, "Developing Cost Estimates for Environmental Remediation Projects" (2019), https://www.iaea.org/publications/12303/developing-cost-estimates-for-environmental-remediation-projects (accessed May 15, 2022), p. 10 ("[The US EPA] requires that the performance criteria be met over a minimum of 200 years, whereas the typical design life should be 1000 years").
266 See OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," pp. 47, 58.
267 Ibid., p. 49.
268 This is especially true between different remediation projects, but may also be true of a single project.
269 See OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," p. 58.
270 See generally "Radiological Protection Policy for the Disposal of Radioactive Waste," ICRP Publication 77, *Annals of the ICRP*, vol. 27(S) (1997), https://www.icrp.org/publication.asp?id=ICRP%20Publication%2077 (accessed May 22, 2022); "Radiation Protection Recommendations as Applied to the Disposal of Long-Lived Solid Radioactive Waste," ICRP Publication 81, *Annals of the ICRP*, vol. 28, no. 4, https://www.icrp.org/publication.asp?id=ICRP%20Publication%2081 (accessed May 22, 2022); "The 2007 Recommendations of the International Commission on Radiological Protection," ICRP Publication 103, pp. 2-4.

has been adopted in Canada, France, and the United Kingdom.[271] The NEA recommendations also suggest engaging with local stakeholders in drafting waste management strategies.[272] According to the NEA, engaging with stakeholders is a crucial step that may reduce mistrust or excessive demand for high levels of remediation "incommensurate with accepted risk norms."[273] To achieve this goal, engagement should be meaningful, ensuring that local stakeholders' concerns are fully understood and acted upon. Even then, engagement alone may be insufficient.[274]

The IAEA has established strict operational protocols for long-term nuclear waste management that provide standards and guidelines to protect the health of workers and minimize environmental damage.[275] For example, the IAEA requires member states to develop operational radiation protection programs at all disposal facilities and any other facility where radioactive material is handled during the waste management process, especially when radioactive waste is transported through public areas.[276] States should also anticipate and project possible doses and risks to future migration of nuclear material after it has reached a disposal facility.[277]

International human rights law establishes heightened standards for the siting of waste storage sites in indigenous peoples' territories. According to the UN Declaration on the Rights of Indigenous Peoples, "States shall take effective measures to ensure that no storage or disposal of hazardous materials shall take place in the lands or territories of indigenous peoples without their free, prior and informed consent."[278]

National models for ex situ waste management exist, although they can be costly. Finland is developing the world's first deep geological repository for ex situ nuclear waste management. The facility, located in Olkiluoto, will store the spent nuclear fuel from all of Finland's nuclear power reactors nearly 1,500 feet below ground level for thousands of years while it remains radioactive.[279] Although Finland's nuclear waste facility is designed primarily for managing the country's own civilian nuclear energy program, similar strategies could be employed for burying nuclear waste in specially constructed facilities as an exceptionally long-term, ex situ waste management strategy.

271 OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," p. 47.
272 Ibid. p. 30.
273 Ibid.
274 See, e.g., Damian Carrington, "Communities Could Be Paid £40m for Considering Nuclear Waste Dump," *Guardian*, July 24, 2014, https://www.theguardian.com/environment/2014/jul/24/communities-could-be-paid-40m-for-considering-nuclear-waste-dump (accessed May 15, 2022); Adam Vaughan, "Communities Offered £1m a Year to Host Nuclear Waste Dump," *Guardian*, Jaunary 25, 2018, https://www.theguardian.com/environment/2018/jan/25/communities-offered-1m-a-year-to-host-nuclear-waste-dump (accessed May 15, 2022).
275 Statute of the IAEA (1956), art. 3
276 IAEA, "Disposal of Radioactive Waste: Specific Safety Requirements," IAEA Safety Standards Series No. SSR-5, 2011, https://www-pub.iaea.org/MTCD/publications/PDF/Pub1449_web.pdf (accessed Jan 11, 2022) p. 12. See also IAEA, "Regulations for the Safe Transport of Radioactive Material," IAEA Safety Standards Series No. SSR-6 (Rev 1), 2018, https://www.iaea.org/publications/12288/regulations-for-the-safe-transport-of-radioactive-material (accessed May 15, 2022).
277 IAEA, "Disposal of Radioactive Waste: Specific Safety Requirements," p. 15.
278 UN Declaration on the Rights of Indigenous Peoples, art. 29(2).
279 Laura Gil, "Finland's Spent Fuel Repository a 'Game Changer' for the Nuclear Industry, Director General Grossi Says," IAEA news center, November 26, 2020, https://www.iaea.org/newscenter/news/finlands-spent-fuel-repository-a-game-changer-for-the-nuclear-industry-director-general-grossi-says (accessed January 11, 2022).

Principle 14: Long-Term Site Management

Affected states should actively manage each remediation site and waste storage facility while residual contamination poses a risk of harm to people or the environment. Such long-term site management should include: staffing, monitoring, and maintenance of sites and facilities; funding; risk education; data collection, dissemination, and preservation; and other elements as needed.

Discussion

Remediation projects should include long-term management of any site or storage facility with contamination that might pose a residual risk of harm to people or the environment.[280] The length and nature of this management will vary depending on the contamination and the site or facility.[281] Some contamination will take thousands of years before it no longer poses a risk and thus in situ or ex situ containment measures will require active monitoring and upkeep.[282] Other contamination will reach that stage more quickly and thus may require relatively passive monitoring and minimal upkeep. Regardless, long-term management of sites and facilities should always include the following elements.

Trained staff are necessary to fulfill a variety of roles at remediation sites and storage facilities. Many sites and facilities will be off-limits to the public and should be staffed to prevent access; others will allow access of some kind and should be staffed for both supervision of visitors and, if repurposed as historical sites, interpretive purposes. Some sites and facilities will require active oversight of their containment measures,[283] and all will require monitoring and maintenance to ensure that containment maintains its integrity.[284]

Remediation projects should include frequent scheduled monitoring of the in situ or ex situ containment infrastructure and the surrounding area to ensure ongoing integrity of the containment measures. Local community members can be engaged in this monitoring and in the testing and study of a larger area surrounding the containment site.[285] Where appropriate, automated radiological monitoring systems can be used to monitor ambient levels on a site-wide basis. While initial surveys and remediation plans should be designed to address the risk of migration, post-closure monitoring and study may be used to track potential migration or breaches in containment systems and may provide additional knowledge about the remediation site, which is valuable for iterative implementation.[286]

Many remediation measures will require maintenance of infrastructure at some point during the lengthy process of long-term site management. Maintenance will often involve reinforcement of barriers or replacement of various components. Maintenance should be

280 OECD NEA, "Nuclear Site Remediation and Restoration during Decommissioning of Nuclear Installations," August 25, 2014, https://read.oecd-ilibrary.org/nuclear-energy/nuclear-site-remediation-and-restoration-during-decommissioning-of-nuclear-installations_9789264222182-en#page1 (accessed January 11, 2022), p. 34.
281 IAEA, "Management of Long Term Radiological Liabilities: Stewardship Challenges," 2006, https://www-pub.iaea.org/MTCD/Publications/PDF/TRS450_web.pdf (accessed January 10, 2021), p. 6.
282 Ibid.
283 For example, sites that use freezing rods to create a barrier in liquids. US Environmental Protection Agency "Technology Reference Guide for Radioactively Contaminated Media," 2006, https://www.epa.gov/radiation/technology-reference-guide-radioactively-contaminated-media (accessed March 22, 2022), p. 33.
284 OECD NEA, "Nuclear Site Remediation and Restoration," p. 12.
285 Community members should be trained in both monitoring and safety and should only monitor areas that pose a minimal risk of radiological exposure.
286 OECD NEA, "Nuclear Site Remediation and Restoration," p. 12.

scheduled preemptively, well before any failure is expected, but should also be initiated if monitoring reveals a failure of containment. Severe failures may also require new remediation measures to address contamination released or to reinforce or redesign existing containment systems.

Funding should be secured early in the remediation process to facilitate long-term planning.[287] Many remediation projects will also require ongoing allocation of funds.[288] Plans should be in place to distribute funding, and especially to triage in case funds are inadequate to meet all operational needs.

Risk education, data collection and dissemination, and data preservation are other important measures, which are discussed under Principles 10, 15, and 16. Each should continue throughout the life of a project and reflect new knowledge and technology.

Precedent

The importance of long-term site management has been recognized by nuclear agencies and by humanitarian disarmament instruments. Where the end result of environmental remediation necessitates restricting use of the site, both the IAEA and the OECD NEA suggest that long-term stewardship is required to "ensure an acceptable risk level for whatever use is achievable."[289] The duration of long-term management activities is dependent on half-lives of the residual radionuclides of concern, and may effectively last forever with long-lived radionuclides such as many of the isotopes of uranium, thorium and plutonium.[290] Long-term stewardship requires staffing to get a site to achieve a "steady state post-closure workload" and to maintain the site long term.[291] The OECD NEA recommends hiring as staff generalists, who have a "diverse set of tools with which to deal with the wide range of issues that can arise."[292]

The OECD NEA and IAEA both recognize monitoring and maintenance as central components of long-term management.[293] The NEA suggests monitoring both the "long-term stability and performance of barriers which isolate and contain contaminated materials" and the "environmental indicators within and down-gradient of the remediated site."[294] Monitoring the latter can be used to "demonstrate that contamination is behaving in a predictable manner consistent with the conceptual site model and that additional risk is not created by changes over time in contaminant location, contaminant chemistry or receptor behaviours."[295] In addition, the NEA calls for "maintenance of the site and of any ongoing remediation solutions, such as structures."[296]

IAEA and OECD NEA reports also stress the importance of funding and stakeholder input. The IAEA lists "establishment of a legal mandate for funding stewardship activities" as a basis for successful long-term stewardship.[297] After surveying states who had undertaken

287 OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," p. 31.
288 IAEA, "Management of Long Term Radiological Liabilities," p. 29.
289 Ibid., p. 6; OECD NEA, Strategic Considerations for the Sustainable Remediation of Nuclear Installations, p. 27.
290 IAEA, "Management of Long Term Radiological Liabilities," p. 6.
291 OECD NEA, "Nuclear Site Remediation and Restoration," p. 45.
292 Ibid.
293 IAEA, "Management of Long Term Radiological Liabilities," p. 6; OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," p. 28.
294 OECD NEA, "Nuclear Site Remediation and Restoration," p. 44.
295 OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," p. 28.
296 Ibid.; IAEA, "Management of Long Term Radiological Liabilities," p. 6.
297 IAEA, "Management of Long Term Radiological Liabilities," p. 51.

environmental remediation after nuclear accidents, the NEA concluded stakeholder involvement is necessary at every step of the remediation process, including closure and long-term stewardship.[298] Thorough characterization surveys (described under Principle 8) should be conducted again at the closure stage to assure stakeholders that the site is "cleaned to the desired level and that the wastes have been removed or are controlled."[299] Long-term management of sites can also be analogized to humanitarian disarmament's requirements for monitoring areas that are not yet fully cleared of explosive ordnance. Both the Convention on Cluster Munitions and the Mine Ban Treaty oblige states parties to monitor as well as mark and fence contaminated areas to prevent civilian access.[300] Monitoring is a key action to prevent harm to civilians in areas awaiting clearance.[301]

[298] OECD NEA, "Nuclear Site Remediation and Restoration," pp. 11, 26.
[299] Ibid., p. 43.
[300] Convention on Cluster Munitions, art. 4(2)(c); Mine Ban Treaty, art. 5(2).
[301] Nairobi Action Plan, action #21.

Handling of Information

Principle 15: Data Collection and Dissemination

> Affected states engaged in any phase of the remediation process should collect data and information about affected sites and communities and remediation measures, and disseminate that data in accessible forms to all stakeholders.

Discussion

To facilitate effective remediation and public awareness, states should collect and disseminate data during all phases of the remediation process. Because contamination and remediation measures may have effects that are unexpected or hard to measure, states should collect both quantitative and qualitative data throughout all phases of remediation to provide a more complete record of each project. States should implement systematic monitoring regimes that require data to be collected regularly and proactively, set defined targets of monitoring, and provide a framework for recording quantitative and qualitative data.

Data collection should occur from the first assessments through the long-term site management phase. During the initial stages, states should collect information about each site, through processes identified in Principle 8 on Assessing Surveying, and Recording. This information should include detailed data on the level of contamination and risks of exposure at each site. States should also work during the early phases to develop site models, assess risks, explore possible remediation measures, and record local stakeholders' needs and preferences. As they implement their national strategies, states should collect data that includes information on progress made, the effects on surrounding environments and communities, and workers' radiological exposure and consequent health impacts. In the long-term, states should collect data about containment integrity, any decay of remediation infrastructure, maintenance actions taken, the status of surrounding environments, the existence or changes of any individual radiological exposure pathways, and overall community health. Throughout, states should continue to refine their models of remediation sites, in order to improve understanding of exposure pathways and reduce risks. At all stages, data should be relevant, sufficient, reliable, and transparent.

The data collected should be both qualitative and quantitative in nature. Quantitative data, such as information on radiation levels and population-wide cancer rates, is necessary to ensure a clear, transparent, and science-based remediation response. The effects of radiation exposure and the benefits of remediation, however, cannot always be quantified. Damage to culturally significant regions, disruption of daily life, and interference with long-standing traditions, for example, escape simple quantification and require the collection of qualitative data for their full consideration, including during optimization assessments. States should ensure that the data they collect is disaggregated by gender, age, and disability to better assess the needs and priorities of these groups with regard to environmental remediation.[302]

Data dissemination is just as important to environmental remediation as data collection. Remediation measures rarely clear all contamination from a site, and contamination often

[302] See Lausanne Action Plan, action #31.

migrates beyond the boundaries of the originally contaminated site.[303] Consequently, many remediated sites and the environment surrounding them will include substantial areas that are contaminated at a low level, even if the level does not warrant closing off access. As discussed under Principle 10 on Risk Education, dissemination of data and information empowers local community members to make informed, autonomous decisions about their own health while exercising their human right to information.[304]

Furthermore, dissemination supports academic research and promotes government accountability. Although states should engage in research about radiological exposure and the details of each remediation site, private research can play an important role in improving understanding and thus in iterative implementation of remediation projects. Similarly, although states should ensure that their remediation decisions are well-reasoned and protect people and the environment, disseminating data to public interest groups and legislative bodies will provide public oversight for those decisions.

States should regularly disseminate basic information about sites, including risk education and basic monitoring reports, to local communities and other interested groups. This basic information should include, in clear, accessible language, descriptions of the risks posed by the site to people and the environment, the projects the government is undertaking to mitigate those risks, and the timeframes for that mitigation. States should also provide access upon request to more comprehensive data, with minimal administrative barriers. All data that has been collected during remediation should be publicly accessible unless there are reasons for restricting access that meet international human rights standards.

Data should be disseminated through media that are accessible to their primary audience and in ways that are intelligible to that audience. For example, public communication should use a language or languages spoken by local stakeholders and utilize mostly non-technical terms and concepts. Written reports can be an effective communication tool, but data should also be communicated through forms that may reach more citizens or specific groups, such as TV or radio reports or advertisements, social media posts, or in-person presentations. Reports should use graphics to highlight important information. It is important that reports aimed at the public be incorporated into a larger campaign of public education. No person can engage meaningfully with much of the data that would be contained in these reports if that person does not have a sufficient background understanding of the effects of radiation, the pathways through which those effects are created, and the processes necessary for remediating those effects. Data disseminated to scientists and researchers can be more technical but should still be organized and labelled to facilitate ease of use. To this end, national remediation programs should include staff focused on public communication, in numbers sufficient to proactively communicate with the public and quickly respond to individual requests.

Precedent

The principle and practice of data collection and dissemination is supported by humanitarian disarmament, international environmental law, and international human rights law. The Convention on Cluster Munitions requires parties to report relevant data to the UN secretary-

303 OECD NEA, "Nuclear Site Remediation and Restoration," p. 9 ("[R]emediation does not imply complete removal of the contamination or returning the site to its background conditions, something that may be neither achievable nor necessary.").
304 ICCPR, art. 19(2). See the precedent section for this principle for further discussion of the right to information.

general, including data on the size and location of all cluster munition contaminated areas in their jurisdictions or control.[305] The Mine Ban Treaty similarly requires reporting, to the extent possible, on the location of all mined areas containing or suspected to contain antipersonnel mines.[306] Such reports, which are traditionally made public, are required to be updated annually and used to allocate international assistance.[307] Both treaties also require parties to submit updates related to their progress in clearance and destruction. Furthermore, the Convention on Cluster Munitions requires each party to "make every effort to collect reliable relevant data with respect to cluster munitions victims,[308] and the Lausanne Action Plan calls for parties to disaggregate the data in their reports by gender, age, and disability.[309]

The IMAS lay out more detailed guidelines for data collection. They set standards for collecting data on the size and location of minefields, which mines have been destroyed, and what steps mine action programs have taken to reduce the risk of mines on civilians in their jurisdictions. The IMAS recommend that organizations define processes for data collection and specify data recording requirements.[310] These requirements should include information on what data needs to be collected, at which frequency, and in what format and medium.[311] The entity in charge of information management should have trained staff and appropriate hardware and software for data collection and dissemination.[312]

Data collection is a feature of existing guidelines for environmental remediation. The OECD NEA suggests members flag key information for future data preservation (as discussed further in Principle 16) early on in the remediation process, in order to guide data collection.[313] "Key information" includes information on: general project background; design and configuration of remedial program; operations, events, and accidents; health, safety, and environmental effects; final site status information; and waste storage and disposal.[314] The IAEA similarly requires that its members keep records of their remediation activities,[315] and it strongly suggests that members maintain data on the locations, types, and amounts of radionuclides remaining in the area after remediation.[316] Collecting this data throughout remediation allows the organization responsible for implementing remediation to evaluate exposure and safety for workers, the public, and the environment.[317]

Information dissemination is equally important in the field of environmental remediation. The IAEA explains that both the provision of information and the method of communication influence how authorities manage a nuclear incident requiring environmental remediation,

305 Convention on Cluster Munitions, art. 7(1)(h).
306 Mine Ban Treaty, art. 7(1)(c).
307 Nairobi Action Plan, actions #52-53.
308 Convention on Cluster Munitions, art. 5(1).
309 Ibid., art. 7(1)(i); Mine Ban Treaty, art. 7(1)(f); Lausanne Action Plan, actions #7, 31.
310 UN Mine Action Service, "IMAS 05.10, Information Management for Mine Action," Second Edition, February 4, 2019, https://www.mineactionstandards.org/fileadmin/MAS/documents/standards/20190215_IMAS_5.10_Ed2_RB_01.pdf (accessed February 27, 2022), p. 10.
311 Ibid.
312 Ibid., p. 6.
313 OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," p. 64.
314 Ibid.
315 IAEA, "Remediation Process for Areas Affected by Past Activities and Accidents," para. 6.13 ("Such records should include: descriptions of activities performed; data from the monitoring and surveillance programmes; occupational health and safety records for the remediation workers; records of the types and quantities of waste produced and of their management and disposition; data from environmental monitoring; records of financial expenditures; records of the involvement of interested parties; records of any continuing responsibilities for the site; identification of locations that were remediated and those with residual levels of contamination remaining; specifications of any areas that remain restricted and the restrictions that apply; statements of any zoning and covenant restrictions or conditions; and statements of lessons learned.").
316 IAEA, "Remediation Process for Areas Affected by Past Activities and Accidents," para. 5.18.
317 Ibid., paras. 4.14, 5.10.

how the society responds, and the overall success of the remediation strategy.[318] The IAEA suggests that it is critical to create a framework for information communication to create public trust and that "[t]he form of communication should be adapted to different levels of understanding and the prevailing circumstances to address the relevant issues, and should be implemented at the same time as the development of restoration strategies."[319] Furthermore, several international agencies agree that information dissemination at the international level is important to the ultimate goal of environmental remediation, and the IAEA, OECD NEA, and European Commission all play a role in information sharing in the nuclear field.[320]

There are analogous requirements for information sharing regarding environmental consequences in international environmental law. Principle 10 of the Rio Declaration on Environment and Development states that "each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities."[321] The UN Economic Commission for Europe's 1998 Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention) provides for public access to environmental information and requires parties to ensure their public authorities collect and update "environmental information which is relevant to their functions."[322] Such information should be effectively accessible and be made progressively available in publicly accessible electronic databases.[323] In the event of an imminent threat to human health or the environment, the Aarhus Convention obliges states parties to disseminate, without delay, "all information which could enable the public to take measures to prevent or mitigate harm arising from the threat and is held by a public authority" to affected members of the public.[324] These data dissemination requirements are particularly relevant in the nuclear context, where radiation exposure has the potential to cause severe harm, and affected communities need information to protect themselves from that harm.

International human rights law establishes a right to information, which underscores the importance of data collection and dissemination. Article 19(2) of the ICCPR references the "freedom to seek, receive and impart information and ideas of all kinds."[325] The Human Rights Committee interprets that provision to "embrace a right of access to information held by public bodies."[326] The committee says states should be proactive about putting government information of public interest into the public domain. They should also "make every effort to ensure easy, prompt, effective and practical access to such information," and have an efficient process for filing freedom of information requests.[327]

318 IAEA, "Guidelines for Remediation Strategies to Reduce the Radiological Consequences of Environmental Contamination," p. 28.
319 Ibid.
320 OECD NEA, "Nuclear Site Remediation and Restoration during Decommissioning of Nuclear Installations," p. 55.
321 Rio Declaration on Environment and Development, Principle 10.
322 UN Economic Commission for Europe Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention), adopted June 25, 1998, entered into force October 30, 2001, https://ec.europa.eu/environment/aarhus/ (accessed Jan 9, 2022), art. 5(1)(a).
323 Ibid., art. 5(2)-(3).
324 Ibid., art. 5(1)(c).
325 ICCPR, art. 19(2).
326 Human Rights Committee, General Comment No. 34, Article 19: Freedoms of Opinion and Expression, CCPR/C/GC/34, September 12, 2011, para. 18.
327 Ibid., para. 19.

Principle 16: Data Preservation

> Affected states should implement measures designed to preserve, for the conceivable radiological life of contaminated waste, all data or institutional knowledge needed for the long-term operation and maintenance of each remediation or waste storage site. Given the length of management necessary at most sites, data and knowledge should be recorded in a form accessible to the international community so that uninterrupted management does not depend on a single state.

Discussion

Because radioactive contamination requires management lasting many years, it is critical that states preserve data throughout the remediation process, in forms that will be durable and intelligible for at least the duration of the remediation effort.[328] Such data will support the ongoing maintenance and public awareness of existing remediation projects and provide future generations with the information necessary to make informed decisions about managing the sites.[329] States should implement data preservation as part of their remediation programs by identifying key forms of information, establishing administrative processes to record that information, and creating a data storage system that will keep records organized, secure, and redundant.[330] Data preservation programs should employ qualified personnel for long periods of time, and they should include training and transition procedures to preserve institutional knowledge.[331] To ensure that data preservation is continuous and loss-free, states should also implement funding procedures that are cushioned against political and economic turbulence.

Given that contained waste may remain radioactive for even thousands of years, states should engage in the critical process of preserving knowledge about radioactive waste containment into the distant future.[332] Regular review of data storage technologies and ongoing monitoring activities offer a defense against the eventual obsolescence of current preservation methods. Records should also be duplicated and held across as many formats as possible—physical reports, oral histories, multiple web-pages, on-site markers, and long-term public communications—to protect against the loss of information over time.[333] Whatever their form, records should follow international standards.[334] These standards are wide-ranging but emphasize the importance of redundancy—of media types, of the information itself, of locations in which the information is stored, and of the actors and roles responsible for overseeing the long-term preservation of information.[335]

328 See OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," 2016, p. 65 ("The long timescales involved in decommissioning and site remediation . . . mean that it is important to have a strategic approach to managing the training and availability of suitably qualified personnel, and the maintenance of knowledge of all periods of the remediation project.").
329 OECD NEA, "Preservation of Records, Knowledge and Memory (RK&M) across Generations," March 24, 2020, https://doi.org/10.1787/50292bbb-en (accessed January 18, 2022), p. 31.
330 OECD NEA identifies eight forms of key information. OECD NEA, "Strategic Considerations for Sustainable Remediation of Nuclear Installations," p. 64.
331 See ibid., p. 65.
332 See OECD NEA, "Preservation of Records, Knowledge and Memory (RK&M) across Generations," p. 17 ("Preservation . . . across generations is needed to support lengthy and complex decision-making processes across long operational and post-operational lifetimes of radioactive waste repositories.").
333 See ibid., pp. 51-56 (regarding the use of both physical markers and cultural transfer of knowledge).
334 See ibid.
335 See ibid., pp. 51-60.

International efforts at data preservation will likely be critical for the long-term management of radiological contamination.[336] Radioactive contamination will outlast the current geopolitical order; having information stored across the globe, in forms accessible to many countries, will help to ensure that contaminated sites are managed continuously, despite any changes in the political system.[337] Even on shorter timeframes, where management responsibility may remain the same, international data preservation could improve data retention by allowing the same data to be stored in multiple distant locations and in a variety of forms and languages.[338] This data preservation does not need to be limited to state-to-state interactions. Opening data access to the general public provides NGOs and other groups the ability to maintain a crucial role of oversight, and allows for hosting the data in even more locations, thus ensuring greater redundancy and offering the best possible protection against data loss or decay.

Precedent

Nuclear agencies have recognized the importance of long-term data preservation in light of the long timeframe of radioactive contamination cleanup. Both the OECD NEA and the IAEA recommend keeping records from all stages of remediation.[339] In the UK, this information is centralized in one national nuclear archive, which stores records from civil nuclear sites over the long term.[340] The OECD NEA further recommends saving both a "key information file," which is "a single document, produced in a multidisciplinary and participatory manner, meant to inform present and future people without specialised knowledge" and a "set of essential records," which is a "set of actual records, selected to provide sufficient information for current and future generations" to understand the waste repository.[341] In its guidelines to data preservation, the IAEA recommends an assessment of records for their level of importance (e.g., critical, necessary, or useful) to ensure appropriate resources go towards the preservation of important documents.[342]

Experts understand that long-term preservation will require planning for longevity. The OECD NEA recommends its members take actions for the short and medium term.[343] In the short term (i.e., two to three generations), states should archive records in the context of operations and preserve knowledge in an accessible, comprehensible, and relevant manner.[344] In the medium term (i.e., post-operational phase), states should continue preservation efforts.[345] Because it is difficult to know how information will be transmitted in centuries or over millennia, experts highlight the importance of short- and medium-term preservation strategies.[346] The IAEA similarly recommends that states conduct "ongoing and rigorous assessment of the records and information" they have gathered for the long-term survival of this knowledge.[347]

The OECD NEA has established that data preservation requires human resources. The agency emphasizes the importance of developing "a strategic approach to managing the training and availability of suitably qualified personnel" to protect institutional knowledge during active remediation and to maintain knowledge over the long term.[348]

Nuclear agencies have developed guidelines for addressing the challenge of information storage systems and computer hardware and software systems becoming obsolete.[349] The OECD NEA recommends preservation through multiple forms of media, such as paper archives, digitized records, oral traditions, and commemorations.[350] The latter strategies play an important role in preserving awareness of sites in future generations. In the context of decommissioning nuclear power plants, the IAEA recommends operators and regulators both keeping records for redundancy.[351] The US Office of Legacy Management, which was "specifically established to ensure the management of nuclear legacy sites after regulatory closure," exemplifies a government agency charged with maintaining such records after project closeout.[352] The IAEA further recommends storing multiple copies of information "in several locations with independent protection systems."[353]

336 See ibid., p. 60 ("approaching RK&M preservation across generations from an international angle is advisable in light of the long time frames and an internationally shared concern for protecting humans and the environment and informing future generations.").
337 For example, some management responsibility may be transferred to other countries or centralized in an organization that coordinates international effects, such as the OECD NEA or IAEA.
338 Currently, the IAEA manages a range of nuclear data through their Knowledge Management Network and is working to expand the International Nuclear Information System. OECD NEA "Strategic Considerations for Sustainable Remediation of Nuclear Installations," p. 65.
339 Ibid., p. 64; IAEA, "Remediation Process for Areas Affected by Past Activities and Accidents," para. 5.18.
340 OECD NEA, "Strategic Considerations for Sustainable Remediation of Nuclear Installations," p. 64.
341 OECD NEA, "Preservation of Records, Knowledge and Memory (RK&M) across Generations," p. 64.
342 IAEA, "Long Term Preservation for Information for Decommissioning Projects," Technical Reports Series No. 467, 2008, https://www-pub.iaea.org/MTCD/publications/PDF/trs467_web.pdf (accessed January 16, 2022), p. 25.
343 OECD NEA, "Preservation of Records, Knowledge and Memory (RK&M) Across Generations," pp. 47-50.
344 Ibid., p. 49.
345 Ibid., p. 50.
346 Ibid.
347 IAEA, "Long Term Preservation for Information for Decommissioning Projects," p. 24.
348 OECD NEA, "Strategic Considerations for the Sustainable Remediation of Nuclear Installations," p. 65.
349 IAEA, "Long Term Preservation for Information for Decommissioning Projects," p. 29.
350 OECD NEA, "Preservation of Records, Knowledge and Memory (RK&M) Across Generations," pp. 51-52.
351 IAEA, "Long Term Preservation for Information for Decommissioning Projects," pp. 25-26.
352 OECD NEA, "Preservation of Records, Knowledge and Memory (RK&M) Across Generations," p. 42.
353 IAEA, "Long Term Preservation for Information for Decommissioning Projects," p. 27.

Guiding Principles

Principle 17: Inclusivity

Affected states should meaningfully consult with and actively involve affected communities, their representative organizations, nongovernmental organizations, and other stakeholders at all stages of the remediation process.

Discussion

Communities that have experienced the effects of nuclear weapons should have a role in determining how the contamination in their region is remediated. They can be involved directly or represented by organizations. The latter groups, which are generally created by and made up of victims, efficiently pool resources to create a dedicated body for consultation.

Including affected communities in the environmental remediation process advances their human rights by giving them a say in decisions that affect their lives. An inclusive process also has practical value. Affected communities and their representative organizations as well as NGOs, remediation workers, scientists, and other experts bring valuable expertise to the environmental remediation process. These stakeholders can offer insights into how to evaluate options for remediation under the optimization principle and how to maximize the effectiveness of the programs pursued. For example, an affected community can describe how its members previously used the contaminated area and what kind of priority it puts on cleanup; an environmental organization can provide scientific evidence of radiation levels or information on remediation techniques that worked in other countries. These parties should be treated as essential partners in environmental remediation and integrated fully into the design, administration, implementation, monitoring, and evaluation of remediation programs.

Affected states should ensure consultation is genuinely meaningful. Consultation should go beyond merely seeking information from communities and organizations. Meaningful consultation entails an interactive and iterative process that takes place at every stage of environmental remediation. Affected states should collect and document a wide range of perspectives and incorporate those views into the resulting programs. This approach allows affected states to gather an expansive set of data and consider the diversity of interests at stake. Affected states should continue to engage in meaningful consultation as they evaluate and update programs over time.

Going beyond consultation, inclusivity requires actively involving affected communities and other stakeholders in the environmental remediation process. As discussed in Principle 19 on Transparency, affected states should proactively provide information to affected communities, their representative organizations, and other stakeholders. Affected states should hold regularly scheduled community meetings or appoint representatives to standing committees that work with the relevant government officials. The affected communities, their representative organizations, and other stakeholders should have access to planners, policymakers, and implementation personnel.

Precedent

The fields of humanitarian disarmament, human rights, development, and environmental law and policy all support the principle of inclusivity. The duty to consult victims and stakeholders is well established in humanitarian disarmament. The Convention on Cluster Munitions requires states parties providing victim assistance to "[c]losely consult with and actively involve cluster munition victims."[354] The Dubrovnik Action Plan explains that this means "[including] cluster munitions victims and their representative organizations actively in policy-making and decision-making" in a state's work on victim assistance.[355] Though not in the text of the Mine Ban Treaty itself, similar provisions appear in the actions plans for implementing the treaty. The Nairobi Action Plan encourages the "integration of mine victims in the work of the Convention" broadly, including by having victims on the states parties' delegations.[356] The Maputo Action Plan encourages "the inclusion and full and active participation of mine victims . . . in all matters that affect them."[357] Similarly, the 2016 UN Policy on Victim Assistance in Mine Action, which guides UN assistance to mine victims, recognizes that "[m]ine and [explosive remnant of war] victims . . . should be consulted in the planning, implementation and monitoring of victim assistance services."[358] While these provisions relate to victim assistance, environmental remediation will similarly benefit from the active participation of those affected by nuclear weapons use or testing throughout the remediation process.

Human rights and indigenous peoples law provide additional precedent for the duty to consult. This body of law is relevant to the environmental remediation context because, as the TPNW recognizes in its preamble, nuclear weapon activities have had a disproportionate impact on indigenous peoples.[359] The Indigenous and Tribal Peoples Convention requires that states parties "consult the peoples concerned, through appropriate procedures and in particular through their representative institutions, whenever consideration is given to legislative or administrative measures which may affect them directly."[360] The convention also says that the consultations must be in "good faith" and "in a form appropriate to the circumstances, with the objective of achieving agreement or consent to the proposed measures."[361] The UN Declaration on the Rights of Indigenous Peoples calls on states to "consult and cooperate in good faith with the indigenous peoples concerned . . . in order to obtain their free and informed consent" prior to carrying out projects that affect indigenous lands.[362] While states are required to obtain consent when the affected communities are indigenous, in all cases, consultation with relevant stakeholders on environmental remediation should be in good faith, substantive, and interactive.

Precedent from international development programs and international environmental law further supports including affected groups in decision making. The 2014 Guiding Principles on Large Scale Land Based Investments in Africa, policy guidelines developed by the Land Policy Initiative of the African Union to ensure that land investments "benefit Member States

354 Convention on Cluster Munitions, art. 5(2)(f).
355 Dubrovnik Action Plan, para 33(a).
356 Nairobi Action Plan, action 38.
357 Maputo Action Plan, para. 6(e).
358 "The United Nations Policy on Victim Assistance in Mine Action," 2016, https://www.mineaction.org/sites/default/files/un_policy_on_victim_assistance_in_mine_action_2016_update_0.pdf (accessed May 15, 2022,) para. 24(e).
359 TPNW, pmbl., para. 7.
360 ILO Convention No. 169 concerning Indigenous and Tribal Peoples in Independent Countries, art. 6(1)(a).
361 Ibid., art. 6(2).
362 UN Declaration on the Rights of Indigenous Peoples, art. 32(2).

and key stakeholders,"[363] call on relevant parties to base environmental and social impact assessments on "meaningful consultation of affected people."[364] The Aarhus Convention requires parties to provide for early public participation in environmental decision making.[365] This includes decisions related to the processing of high-level radioactive waste.[366] Parties are required to "ensure that in the decision due account is taken of the outcome of the public participation."[367]

In the field of environmental remediation, the OECD NEA has provided guidance for informing and engaging stakeholders for decision making. The agency recommends educating laypeople to ensure a shared understanding of the situation and allow "a participative decision-making process where the stakeholders can influence the decision-making process or assume shared responsibility for the final decision."[368] Informed and meaningful participation of affected communities is not only desirable but is also "necessary to ensure that the end state will be accepted."[369] It requires inclusion at every stage of remediation, including site characterization, definition of end use options, decision-making for remedial options, and evaluation of remedial action.[370] The IAEA similarly recommends states consult interested parties and keep them informed of site specific strategy and activities.[371]

To achieve inclusivity in environmental remediation, it is necessary to engage a broad set of stakeholders. The IAEA defines interested parties to include not only affected individuals, but also environmental groups, labor organizations, academic institutions, representatives of local, regional, and national government, and the scientific and technical expert community.[372] There is precedent for such wide inclusion from the cleanup of the Hanford nuclear production site in the United States. The Hanford Advisory Board gives tribes, local government, universities, and environmental organizations a voice in the clean-up of the site.[373]

Principle 18: Non-Discrimination

> Affected states should adhere to the principle of non-discrimination in planning and implementing remediation measures. Affected states should ensure that their environmental remediation measures do not discriminate based on race, color, language, ethnicity, sex, sexual orientation, gender identity or expression, age, national origin, religion, disability, geographic location, socioeconomic class, or other status.

363 UN Economic Commission for Africa, "Guiding Principles on Large Scale Land Based Investments in Africa," (2014), https://www.uneca.org/sites/default/files/PublicationFiles/guiding_principles_eng_rev_era_size.pdf (accessed January 7, 2020), p. vii.
364 Ibid., p. 22.
365 Aarhus Convention, art. 6(4).
366 Ibid., annex I(1).
367 Ibid., art. 6(8).
368 OECD NEA, "Strategic Considerations for Sustainable Remediation of Nuclear Installations," pp. 21-22.
369 Ibid., p. 32.
370 Ibid.
371 IAEA, "Remediation Process for Areas Affected by Past Activities and Accidents," para. 2.5
372 IAEA, "Management of Long Term Radiological Liabilities," p. 39.
373 "Hanford Advisory Board Membership," March 15, 2021, https://www.hanford.gov/files.cfm/2021_Membership_List_v3.pdf (accessed May 15, 2022).

Discussion

Affected states should uphold the human rights principle of non-discrimination throughout the environmental remediation process. Principle 18 enumerates impermissible bases for discrimination drawn from those identified by international human rights instruments and bodies discussed below.

The impact of decisions to remediate—and not to remediate—can have a major impact on local communities, and thus states should take care not to discriminate when making these choices. For example, they should take this principle into account when weighing the benefits and costs of optimization, choosing a location for a waste storage facility, guaranteeing access to and representation in decision-making processes, and ensuring the perspectives of all stakeholders are considered.

The principle is especially important in the nuclear weapons context because states historically overlooked or discounted the harms of radiological exposure in marginalized communities. These communities, such as the indigenous populations in Australia, the Marshall Islands, and the United States, have borne a disproportionate burden from nuclear weapons testing.[374] In addition, as discussed under Principle 3 on the Definition of Harm, research has shown that woman and girls have experienced greater health effects. Affected states should ensure that they do not exacerbate the discriminatory and disproportionate impacts of testing, even if they did not cause them.

The principle of non-discrimination allows states to distinguish among groups under certain circumstances. Safety regulations, for example, could take into account sex and age given that they can alter the level of harm caused by radiation. In addition, an affected state could consider the historic impact of a disadvantaged community as a factor in its optimization analysis (Principle 9) or recognize indigenous peoples' special relationship to the land when it triggers the requirement of free, prior, and informed consent (Principles 13 and 17).

Precedent

Both human rights and humanitarian disarmament law provide precedent for incorporating the non-discrimination principle into environmental remediation measures.

International human rights law explicitly prohibits discrimination. The ICCPR and ICESCR prohibit discrimination on the basis of "race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status."[375] The 1965 International Convention on the Elimination of All Forms of Racial Discrimination (ICERD) and the 1979 Convention on Elimination of All Forms of Discrimination Against Women (CEDAW) reiterate those prohibitions with regard to race and sex, respectively.[376] Under the 2006 Convention on the Rights of Persons with Disabilities (CRPD), states parties are obliged to "prohibit all discrimination on the basis of disability and guarantee to persons with disabilities equal and

374 "Nuclear Testing Legacy Is 'Cruellest' Environmental Injustice, Warns Rights Expert"; "75th Anniversary of the Trinity Nuclear Tests, 16 July 2020," UN Office of the High Commissioner for Human Rights news release, July 16, 2020, https://www.ohchr.org/en/press-releases/2020/07/75th-anniversary-trinity-nuclear-tests-16-july-2020?LangID=E&NewsID=26103 (accessed May 15, 2022).
375 ICCPR, art. 2(1); ICESCR, art. 2(2).
376 International Convention on the Elimination of All Forms of Racial Discrimination (ICERD), adopted December 21, 1965, 660 U.N.T.S. 195, entered into force January 4, 1969, arts. 1-2; Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), adopted December 18, 1979, 1249 U.N.T.S. 13, entered into force September 3, 1981, arts. 1-2.

effective legal protection against discrimination."[377] In a 2021 report, the UN independent expert on protection against violence and discrimination based on sexual orientation and gender identity details how human rights law protects against any discrimination on those grounds.[378] Drawing on such sources, the Framework Principles on Human Rights and the Environment, developed by the UN special rapporteur on human rights and the environment in 2018, similarly note that "[s]tates should prohibit discrimination and ensure equal and effective protection against discrimination in relation to the enjoyment of a safe, clean, healthy and sustainable environment."[379]

Humanitarian disarmament law applies the principle of non-discrimination to the weapons context. The Convention on Cluster Munitions expressly prohibits states from discriminating "against or among cluster munition victims, or between cluster munition victims and those who have suffered injuries or disabilities from other causes."[380] It allows differential treatment "based only on medical, rehabilitative, psychological or socio-economic needs."[381] The Cartagena Action Plan, adopted at the Second Review Conference of the Mine Ban Treaty in 2009, similarly committed states parties to "not discriminate against or among mine victims, or between mine survivors and other persons with disabilities," and allows differential treatment based only on victim needs.[382] The TPNW's preamble recognizes nuclear-weapon activities' "disproportionate impact" on indigenous peoples and on women and girls in its preamble, and Article 6 of the treaty emphasizes the need to provide "age- and gender-sensitive assistance, without discrimination."[383]

Principle 19: Transparency

> Affected states should ensure transparency with respect to the design, administration, implementation, monitoring, and evaluation of environmental remediation programs.

Discussion

Transparency is necessary at all stages of environmental remediation. As discussed under Principles 15 and 16, in its most basic form, transparency allows for public access to relevant data and information about the current state of contamination and any environmental remediation measures. Transparency also requires affected states to engage in open decision-making processes. For example, states should provide notice of proposals, hold public hearings, share relevant studies and research, and publish rationales for policy decisions.

377 Convention on the Rights of Persons with Disabilities (CRPD), adopted December 13, 2006, A/RES/61/106, entered into force May 3, 2008, art. 5(2).
378 See generally Human Rights Council, Report of the Independent Expert on Protection against Violence and Discrimination Based on Sexual Orientation and Gender Identity, Victor Madrigal-Borloz: The Law of Inclusion, A/HRC/47/27, June 3, 2021. The report states: "Violence and discrimination based on sexual orientation and gender identity are never justified and must be prevented, prosecuted and punished and, if relevant, be at the base of measures of reparation." Ibid., p. 21.
379 Human Rights Council, Report of the Special Rapporteur on the Issue of Human Rights Obligations Relating to the Enjoyment of a Safe, Clean, Healthy and Sustainable Environment, January 24, 2018, p. 8.
380 Convention on Cluster Munitions, art. 5(2)(e).
381 Ibid., art. 5(2)(e).
382 "Ending the Suffering Caused by Anti-Personnel Mines: Cartagena Action Plan 2010-2014," adopted at Second Review Conference of Mine Ban Treaty, in "Final Report," APLC/CONF/2009, December 4, 2009, https://www.cartagenasummit.org/fileadmin/APMBC-RC2/2RC-FinalReport-17June2010.pdf (accessed May 22, 2022), para. 14.
383 TPNW, pmbl., paras. 4 and 7, and art. 6.

Transparency has numerous benefits. First, transparency is essential to the framework of shared responsibility elaborated in Principle 4. Reporting by affected states can reveal gaps in addressing significant environmental problems and help identify what resources are needed to fill those gaps. Reporting also allows other states, international organizations, and foundations to determine how best to tailor their support to affected states and to identify useful information to share.

Second, transparency supports inclusivity. The principle of inclusivity demands that states meaningfully consult affected communities and other stakeholders. Access to data, information, and effective processes are necessary to achieving that goal. By providing such access, transparency builds trust and promotes cooperation with affected communities.

Third, transparency facilitates monitoring and evaluation of the remediation program. When information about environmental remediation is made public, affected communities, their representative organizations, and other stakeholders can better assess the progress and efficacy of remediation programs. For example, if affected states release details about their national implementation strategies, outside parties can review these strategies to determine whether the states' objectives are beneficial to the environment and in line with community needs. Such scrutiny promotes accountability and deters corruption or inefficiency in the process. Transparency also builds trust and encourages cooperation among states by assuring donor countries that their assistance is being put to good use.

Full transparency requires that affected states proactively share information and data, rather than waiting to receive a request for information. Such a proactive approach not only regularizes and expedites the process of information sharing but also eases the burden on affected communities and other stakeholders.

Precedent

Humanitarian disarmament law and practice, as well as international environmental and human rights law, offer precedent for transparency measures.

Humanitarian disarmament law and policy require states to be transparent about their efforts to clear contaminated areas. For example, Article 7 of the Convention on Cluster Munitions requires states parties to report to the UN secretary-general on issues such as: the safety and environmental standards applicable to the destruction of cluster munitions, the conversion or de-commissioning of production facilities for cluster munitions, and the status and progress of programs to clear or destroy cluster munitions.[384] Additionally, Article 7 of the Mine Ban Treaty requires states parties to report to the UN secretary-general on the progress of their clearance programs.[385] These reports should include information on, inter alia, areas that still contain landmines and ongoing risk education measures.[386] Furthermore, in the Nairobi Action Plan, states parties agreed to encourage informal information exchanges that could include sharing experiences on the practical implementation of the treaty as well as publishing additional voluntary transparency reports.[387]

384 Convention on Cluster Munitions, art. 7(1)(d), (e), (i).
385 Mine Ban Treaty, art. 7(1).
386 Ibid.
387 Nairobi Action Plan, actions #26, 55.

International environmental law also provides a strong model for transparency that can be used in the nuclear weapons context. For example, the UN Framework Convention on Climate Change establishes an "enhanced transparency framework" under which parties submit periodic reports containing information relevant to their agreements under the UNFCCC and subsequent conventions.[388] Technical experts then review these reports, and parties undertake multilateral consideration of the reporting country's progress towards its nationally determined contribution.[389] The Aarhus Convention mandates that the public receive information on the environment held by public authorities including on the current state of the environment.[390] In the nuclear weapons context, this mandate provides a model for making data and information on radioactive contamination and the risks it poses available to the public. The convention also affords the public the right to participate in decisions on specific projects planning, and policy-making and obliges governments to incorporate public comments in their decision-making processes.[391] Such measures demonstrate ways to make environmental remediation processes transparent.

International human rights law provides additional support for the principle of transparency. The Human Rights Committee links the principles of transparency and accountability and says both are "essential for the promotion and protection of human rights."[392] In addition to being a prerequisite for other rights, transparency is effectively a right in itself. As discussed under Principle 15 on Data Collection and Dissemination, the ICCPR establishes a right to information, which encompasses access to information held by public bodies.[393] Numerous human rights treaties also provide models for requiring states parties to report on their implementation progress to a dedicated treaty body. For example, the ICCPR requires states parties to submit to the Human Rights Committee (via the UN secretary-general) periodic reports "on the measures they have adopted which give effect to the rights recognized herein and on the progress made in the enjoyment of those rights."[394] Other human rights instruments, including the ICESCR, ICERD, CEDAW, and CRPD, create similar bodies and monitoring mechanisms. In addition, the Human Rights Council requires UN member states to submit reports on their human rights records through a mechanism known as the universal periodic review.[395]

388 UN Climate Change, "Introduction to Transparency," https://unfccc.int/Transparency (accessed May 22, 2022).
389 Ibid.
390 Aarhus Convention, art. 4(1). Note that the Caribbean and Latin American communities have recently adopted a convention containing similar provisions known as the Escazú Agreement.
391 Ibid., arts. 3(1), 6-8.
392 Human Rights Committee, General Comment No. 34, para. 3.
393 See ICCPR, art. 19(2); Human Rights Committee, General Comment No. 34, paras. 18-19.
394 ICCPR, art. 40(1).
395 UN General Assembly, "Human Rights Council," UNGA Res. 60/251 (2006), A/60/L.48 (2006), para. 5(e).

International Humanitarian and Disarmament Law Sources

Principles for Environmental Remediation of Nuclear Weapons Contamination / Sources	*Legal Instruments*						*Interpretation and Implementation Documents*								
	Convention on Conventional Weapons (CCW), Amended Protocol II on Mines, Booby-Traps and Other Devices (1996)	Convention on Conventional Weapons (CCW), Protocol V on Explosive Remnants of War (2003)	Chemical Weapons Convention (1993)	Convention on Cluster Munitions (2008)	Mine Ban Treaty (1997)	Treaty on the Prohibition of Nuclear Weapons (TPNW) (2017)	Cartagena Action Plan, Mine Ban Treaty (2009)	Dubrovnik Action Plan, Convention on Cluster Munitions (2015)	International Mine Action Standards (IMAS)	Lausanne Action Plan, Convention on Cluster Munitions (2021)	Maputo Action Plan, Mine Ban Treaty (2014)	Maputo Declaration, Mine Ban Treaty (2014)	Nairobi Action Plan, Mine Ban Treaty (2004)	Oslo Action Plan, Mine Ban Treaty (2019)	UN Policy on Victim Assistance in Mine Action (2016)
1. Purpose of Environmental Remediation				●	●	●									
2. Character of Environmental Remediation		●	●	●	●			●	●	●				●	
3. Definition of Harm				●	●	●									
4. Responsibility		●	●	●	●	●						●			
5. Exchange of Scientific and Technical Information			●	●	●	●									
6. Capacity Building			●	●	●			●		●	●			●	
7. National Strategy				●	●			●		●	●		●	●	
8. Assessing, Surveying, and Recording		●		●	●			●	●	●				●	
9. Optimization				●				●	●						
10. Risk Education		●		●					●	●			●	●	
11. Preventing Radiation Exposure Pathways	●	●		●	●				●						
12. Addressing Contamination				●	●	●									
13. Material Handling and Waste Management															
14. Long-Term Site Management				●	●								●		
15. Data Collection and Dissemination				●	●				●	●			●		
16. Data Preservation															
17. Inclusivity				●		●		●			●		●		●
18. Non-Discrimination				●		●	●								
19. Transparency				●	●								●		

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Sources	Principles for Environmental Remediation of Nuclear Weapons Contamination																		
	1. Purpose of Environmental Remediation	2. Character of Environmental Remediation	3. Definition of Harm	4. Responsibility	5. Exchange of Scientific and Technical Information	6. Capacity Building	7. National Strategy	8. Assessing, Surveying, and Recording	9. Optimization	10. Risk Education	11. Preventing Radiation Exposure Pathways	12. Addressing Contamination	13. Material Handling and Waste Management	14. Long-Term Site Management	15. Data Collection and Dissemination	16. Data Preservation	17. Inclusivity	18. Non-Discrimination	19. Transparency
Legal Instruments																			
American Declaration on the Rights of Indigenous Peoples (2016)			●																
Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) (1979)																		●	●
Convention on the Rights of Persons with Disabilities (CRPD) (2006)																		●	●
Indigenous and Tribal Peoples Convention (ILO Convention No. 169) (1989)			●														●		
International Convention on the Elimination of All Forms of Racial Discrimination (ICERD) (1965)																		●	●
International Covenant on Civil and Political Rights (ICCPR) (1966)	●		●	●											●			●	●
International Covenant on Economic, Social and Cultural Rights (ICESCR) (1966)	●		●	●														●	●
UN Declaration on the Rights of Indigenous Peoples (2007)			●										●				●		
Interpretation and Implementation Documents																			
Committee on Economic, Social and Cultural Rights, General Comment No. 14 on the Right to Health (2000)			●																
Human Rights Committee, General Comment No. 31 [80] on the Nature of the General Legal Obligation (2004)				●															
Human Rights Committee, General Comment No. 34 on the Freedoms of Opinion and Expression (2011)															●				●

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Interpretation and Implementation Documents																			
Human Rights Committee, General Comment No. 36 on the Right to Life (2018)	●																		
Human Rights Council, Resolution 48/13 on the Human Right to a Safe, Clean, Healthy and Sustainable Environment (2021)			●																
Report of the Independent Expert on Protection against Violence and Discrimination Based on Sexual Orientation and Gender Identity, Victor Madrigal-Borloz: The Law of Inclusion (2021)																		●	

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Sources	Principles for Environmental Remediation of Nuclear Weapons Contamination																		
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Legal Instruments																			
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989)					●														
Convention for the Protection of the Marine Environment of the North-East Atlantic (1992)	●																		
Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention) (1998)	●														●		●		●
Convention on Biological Diversity (1992)	●		●																
Convention on the Conservation of Migratory Species of Wild Animals (1979)	●																		
Convention on the Transboundary Effects of Industrial Accidents (1992)	●																		
Minamata Convention on Mercury (2013)	●																		
Montreal Protocol on Substances that Deplete the Ozone Layer (1987)							●												
Paris Agreement under the UN Framework Convention on Climate Change (2016)							●												
Protocol on Environmental Protection to the Antarctic Treaty (1991)	●		●																
Rio Declaration on Environment and Development (1992)		●													●				
Stockholm Convention on Persistent Organic Pollutants (2001)	●						●												
Stockholm Declaration (1972)	●																		

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Legal Instruments																			
UN Framework Convention on Climate Change (1992)		●																	●
UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention) (1972)				●															
Interpretation and Implementation Documents																			
Framework Principles on Human Rights and the Environment, in Report of the UN Special Rapporteur on Human Rights and the Environment (2018)			●															●	
Guiding Principles on Large Scale Land Based Investments in Africa (2014)																	●		
International Law Commission, Draft Articles on Prevention of Transboundary Harm from Hazardous Activities (2001)	●				●														
International Law Commission, Draft Prinicples on the Allocation of Loss in the Case of Transboundary Harm Arising out of Hazardous Activities (2008)					●														
International Law Commission, Draft Principles on the Protection of the Envrionment in Relation to Armed Conflicts (2022)	●				●														
International Atomic Energy Agency (IAEA) policies, practices, and publications		●			●	●		●	●		●	●	●	●	●	●	●		
International Commission on Radiological Protection (ICRP) policies, practices, and publications									●		●	●	●						

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Sources	Principles for Environmental Remediation of Nuclear Weapons Contamination																		
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Interpretation and Implementation Documents																			
Organization for Economic Co-operation and Development Nuclear Energy Agency (OECD NEA) policies, practices, and publications		●			●		●	●	●		●	●	●	●	●	●	●		
UN Environment Assembly, Resolution 2/15: Protection of the Environment in Areas Affected by Armed Conflict (2016) UN Environment	●																		
Assembly, Resolution 3/1: Pollution Mitigation and Control in Areas Affected by Armed Conflict or Terrorism (2017)			●																

Facing Fallout

Principles for Environmental Remediation of Nuclear Weapons Contamination

The contamination from nuclear weapons pollutes the air, water, and earth, devastating local ecosystems. The people who are exposed to it experience physical and psychological injuries, social, economic, and cultural impacts, and infringement of their human rights. The damage may forcibly displace entire communities.

Facing Fallout identifies 19 principles for remediating the environment contaminated by nuclear weapons; it also includes a commentary that elaborates on the principles and provides legal and policy precedent for each. The principles aim to address existing harm and unacceptable risks of future harm to the environment and affected communities by targeting the underlying causes of the harm, the pollution that degrades the environment and in turn affects people. This report complements a 2020 report by the same authors entitled *Confronting Conflict Pollution: Principles for Assisting Victims of Toxic Remnants of War*.

The principles in *Facing Fallout* are especially relevant for states parties to the 2017 Treaty on the Prohibition of Nuclear Weapons that are implementing their positive obligation to remediate the environment. The principles may also serve as a guide for any affected state that seeks to address nuclear weapons contamination in its territory.

The principles laid out in *Facing Fallout* articulate the purpose and character of environmental remediation, define relevant types of harm, outline a structure for sharing responsibility, establish steps of environmental remediation, highlight the importance of information handling, and present guiding principles fundamental to effective remediation processes. Collectively, the principles offer a framework for implementing environmental remediation that benefits the environment and affected communities from its initial stage through the long-term management phase.