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Photo: Women's March to Ban the Bomb, June 2017 © Alex Glaser

IN THIS ISSUE:

Reaching Critical Will

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Key Findings and Recommendations from the TPNW Scientific Advisory Group 3MSP Working Paper

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For the Third Meeting of States Parties, the Scientific Advisory Group (SAG) prepared a Working Paper on the status and developments regarding nuclear weapons, nuclear weapon risks, the humanitarian consequences of nuclear weapons, nuclear disarmament and related issues. This working paper updates the SAG **report** to 2MSP (TPNW/MSP/2023/8), and is available through the 3MSP meeting website (**TPNW/MSP/2025/WP.5**).

Here we share an edited summary of key findings and recommendations in the SAG Working Paper. These recommendations are intended to inform discussions at 3MSP and more broadly the work of TPNW states parties, the scientific and academic community, and civil society in support of the TPNW and its goals.

Stockpiles and modernisation

As of the beginning of 2025, the nine nuclear-armed states are estimated to have a combined total of about 12,300 nuclear warheads, of which about 9,600 weapons are in military inventories, with roughly another 2,700 additional weapons awaiting dismantlement in the Russian Federation and the United States of America. This is an increase over the estimated global stockpile of 12,120 nuclear warheads in early 2024.

In 2024, the United States of America **declared** that "absent a change in the trajectory of adversary arsenals, we may reach a point in the coming years where an increase from currently deployed numbers is required."

In 2024, neither the Russian Federation nor the United States of America provided aggregate data for their deployed strategic nuclear weapons under the Strategic Arms Reduction Treaty (New START) data exchange rules. This is the first time that no data has been published since the treaty entered into force in 2011. New START is scheduled to expire in February 2026.

The People's Republic of China is believed to be continuing to increase its nuclear weapon arsenal. Independent estimates are that as of the beginning of 2025, China held about 600 nuclear warheads (including deployed, operational, and reserve warheads).

India, Pakistan, and the Democratic People's Republic of Korea (DPRK) are believed to have continued increasing their nuclear weapon stockpiles since 2023. There is no public indication that the United Kingdom of Great Britain and Northern Ireland, France, or Israel have been increasing their arsenals over the past year.

Nuclear arsenal **modernisation efforts** continued in all nuclear-armed states throughout 2024, sometimes with delays and setbacks. Independent research on these issues is relatively scarce. SAG points out that the nature and implications of nuclear-armed states increasing their respective nuclear weapon stockpiles, and their arsenal modernisation activities and plans, need to be understood in more detail.

TPNW states parties should support and seek to develop independent capabilities to analyse current developments in nuclear forces and delivery systems, while also encouraging more transparency from the nuclear-armed states. Action in this regard also could be taken collectively at the regional level and through seeking studies commissioned by the United Nations General Assembly. The last United Nations **study** to review relevant developments in the field of nuclear weapons was published in 1991. This followed the earlier 1980 "**Comprehensive Study on Nuclear Weapons**".

In addition to the nine nuclear-armed states, there are currently **six states** that host nuclear weapons. As of the beginning of 2025, out of 32 North Atlantic Treaty Organization (NATO) states, five countries—Belgium, Germany, Italy, the Netherlands, and Türkiye—host nuclear weapons owned by the United States. The United Kingdom **might** be preparing to resume hosting US nuclear weapons.

Beyond NATO, the United States also provides assurances of the threat and use of nuclear weapons in support of Japan, the Republic of Korea, and Australia. In 2023, a United States nuclear-armed submarine made its **first port visit** to the Republic of Korea in 40 years.

Belarus has hosted Russian Federation nuclear weapons since June 2023, according to **officials** from both **countries**. This is the first time that the Russian Federation has based nuclear weapons abroad. The Soviet Union had deployed nuclear weapons abroad, in Soviet Republics (including Belarus) and in Eastern Europe. At the end of the Cold War, these weapons were withdrawn to Russia (as the successor state to the Soviet Union).

In 2024, Russia and Belarus conducted **joint training exercises** involving preparation for the use of nuclear weapons.

Understanding nuclear risks

Risks posed by nuclear weapons are in a special category. These risks change over time and cannot be seen as static. For example, along with conflict and crises, leadership in nuclear-armed states, new military doctrines, changing demographics, and new technologies influence risk.

Perception of risk also changes when new information that was previously unknown is revealed, and as priorities change, new situations emerge, and new capabilities are pursued and developed. Available data are insufficient to provide meaningful estimates for the risks of the use of nuclear weapons in an actual conflict.

The perception of nuclear risks is shaped by immediate events and expectations about longer-term processes, making nuclear risks hard to understand. One of the major effects of undermining arms control treaties via non-compliance or decreasing engagement or withdrawal is that the impacts take years to be fully understood.

Historical **evidence** indicates that, especially during times of conflict and crisis, military exercises involving nuclear weapon preparedness can increase the risks of misinterpretation and inadvertent action, potentially leading to escalatory responses including nuclear weapon use. Throughout 2024, **several** nuclear-armed states **held** military **exercises** that incorporated preparedness for nuclear weapon use.

TPNW states parties could commission research analysing the risks of inadvertent nuclear use and its relationship to nuclear war exercises, and how to mitigate the risks they create. TPNW states parties could consider proposals for greater transparency and notifications regarding military nuclear exercises,

possible limits on such exercises, and a call for a moratorium on nuclear-weapon-related military exercises in times and regions of crisis involving nuclear-armed states.

Humanitarian consequences of nuclear weapon use and testing

There is a need to improve the understanding of the effects of nuclear war, including by the nuclear-armed states. A 2024 US National Academy **report** "Risk Analysis Methods for Nuclear War and Nuclear Terrorism" found that US government agencies do not include "political, military, economic, social, information, and infrastructure impacts" in current nuclear weapon consequences models that the government uses for its analysis of nuclear weapon risks. The National Academy outlines a need "to improve the understanding of the physical effects of nuclear weapons (e.g., fires, damage in modern urban environments, electromagnetic pulse effects, and climatic effects, such as nuclear winter), as well as the assessment and estimation of psychological, societal, and political consequences of nuclear weapons use."

TPNW states parties should develop within their national scientific communities and collectively the capability to peer-review and conduct national, regional, and global consequence modeling of all aspects of the effects of nuclear weapons for the purpose of improving national and global nuclear weapon risk analysis.

Concerning humanitarian consequences of nuclear weapon use, a key development is the new 2024 United Nations General Assembly **resolution** to establish an international scientific study of the effects of nuclear war. This was a recommendation in the SAG report in 2023.

The 2024 resolution "Nuclear War Effects and Scientific Research" calls for a 21-member Scientific Panel on the Effects of Nuclear War to be appointed by the UN Secretary-General and charged with "examining the physical effects and societal consequences of a nuclear war on a local, regional and planetary scale, including, inter alia, the climatic, environmental and radiological effects, and their impacts on public health, global socioeconomic systems, agriculture and ecosystems, in the days, weeks and decades following a nuclear war." The panel is also tasked to draw key conclusions and identify areas requiring future research.

The resolution further "encourages Member States, relevant international and regional organizations and others to support the work of the Panel, including by providing relevant information, scientific data and analyses; facilitating and hosting Panel meetings, including regional meetings; and making voluntary budgetary contributions, or in-kind contributions."

TPNW states parties could support the work of the Scientific Panel on the Effects of Nuclear War individually and jointly, including by facilitating and hosting Panel meetings, and where feasible, making voluntary budgetary contributions or in-kind contributions.

There is a need for further research to understand the full extent of the long-term contamination and resulting public health and environmental impacts of radioactive fallout from nuclear weapons testing. Recent **work** coordinated by the International Atomic Energy Agency (IAEA) to assess the long-term environmental behaviour and potential impacts of radioactive particles for plants, animals, and people has raised significant questions about prior and existing radioactivity monitoring methods based on local sampling and averaging approaches.

Currently, Kazakhstan and Kiribati are the only TPNW states parties that had nuclear weapon tests conducted on their national territories (Algeria has signed but not ratified the treaty).

Kiribati has yet to understand fully the enduring effects of the **33 nuclear weapon test explosions** by the United Kingdom and the United States on Kiritimati and Malden Islands. There is a need to analyse the extent of the health impacts of testing on the Indigenous population of Kiritimati Island and the potential needs for victim assistance. There have been no comprehensive epidemiological, public health, or medical studies to evaluate the long-term health consequences of these nuclear tests. TPNW states parties should support medical needs assessments and assistance for long-term radiation exposure, and environmental monitoring and sampling of food systems, biota, soil, water, and ocean sediments in Kiribati.

The IAEA has done environmental studies at other test sites, making it a potential candidate for a study of radiological conditions on Kiribati and design of a monitoring programme.

Kazakhstan has within its territory former test sites utilised over a 40-year history of nuclear weapon testing, with damage to human health and the environment. The Semipalatinsk Nuclear Test Site (STS), the largest of the sites, was closed in 1991. The National Nuclear Center of Kazakhstan has been responsible for the radiological investigation of these sites and adjacent territories. Studies have found contamination in parts of STS due to nuclear weapon tests, and identified the boundaries of such contamination and those areas which might be contaminated by radiological migration processes. Kazakhstan plans to continue monitoring the radiological status of STS and adjacent territory as part of an environmental monitoring programme covering the currently defined hazardous territories and their boundaries. The monitoring system will require further modernisation with equipment at fixed sites to gather real-time radiation data.

TPNW states parties should encourage their respective scientific communities to collaborate and work together on this set of issues with Kazakhstan and Kiribati as a part of their Article 7 obligations.

Disarmament measures and verification

In late 2023, the State Duma of the Russian Federation revoked Russia's ratification of the Comprehensive Nuclear-Test-Ban Treaty (CTBT), as a response to the United States showing "no sign of intent to ratify the CTBT in the foreseeable future." Evidence emerged in 2024 that the United States of America, the Russian Federation, and the Republic of China—all signatories to the CTBT—actively **expanded** facilities at their nuclear weapon test sites.

In 2024, at the Second Preparatory Committee for the 2026 Review Conference of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), China submitted a **proposal** on the no-first-use of nuclear weapons. In its proposal, China encouraged the nuclear-armed states parties to the NPT to "actively explore the conclusion of a treaty on no-first-use of nuclear weapons or to issue a political statement to that effect." It suggested some specific elements of such a treaty or statement for discussion, including that "States parties undertake not to be the first to use nuclear weapons against other States parties at any time or under any circumstances and also undertake to support the early negotiation of a convention on the non-use or threat of use of nuclear weapons against non-nuclear-weapon States and nuclear-weapon-free zones."

TPNW states parties could deliberate on how the goals and provisions of the TPNW might benefit from progress towards and achievement of a no-first-use treaty.

In December 2024, the UN General Assembly passed a **resolution** requesting the UN Secretary-General to elicit the views of member states on the possible establishment of a Group of Scientific and Technical Experts on Nuclear Disarmament Verification. Such a group could potentially generate results

supporting the verification of the comprehensive, transparent, and irreversible elimination of nuclear weapon programmes, as required by the TPNW.

TPNW states parties could consider and develop statements on the need for such a Group of Scientific and Technical Experts on Nuclear Disarmament Verification, and possible TPNW-relevant tasks such a group could be assigned.

Work is needed in particular to clarify the end point of weapon programme elimination/conversion and the requirement under Article 4 of the TPNW for any nuclear-armed state joining the treaty to conclude a safeguards agreement with the IAEA to provide credible assurance of the non-diversion of declared nuclear material from peaceful nuclear activities and of the absence of undeclared nuclear material or activities in the state as a whole.

The Scientific Advisory Group plans to produce a report on all these issues for the First Review Conference of the TPNW in 2026.

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