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APRIL
2025

Fragile Consensus?
The Pressure on the Norm Against Nuclear Testing

Security Studies
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Doreen HORSCHIG

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ISBN: 979-10-373-1036-1

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How to quote this publication:

Doreen Horschig, "Fragile Consensus? The Pressure on the Norm Against Nuclear Testing", *Ifri Papers*, Ifri, April 2025.

Ifri

27 rue de la Procession 75740 Paris Cedex 15 – FRANCE

Tel. : +33 (0)1 40 61 60 00 – Fax : +33 (0)1 40 61 60 60

Email: accueil@ifri.org

Website: Ifri.org

Author

Doreen Horschig is a fellow with the Project on Nuclear Issues at the Center for Strategic and International Studies (CSIS). She is also a non-resident research associate at the School of Politics, Security, and International Affairs at the University of Central Florida (UCF). Previously, Doreen was a nuclear security policy fellow at the American Academy of Arts and Sciences and a Stanton nuclear security fellow at the Massachusetts Institute of Technology. Her research examines pro-, non-, and counter-proliferation, as well as nuclear norms contestation and public opinion on nuclear issues. She holds a PhD in security studies from UCF, an MA in international relations from New York University, and a BA in international studies from Manhattan College.

Abstract

Apart from North Korea, no state has conducted explosive nuclear tests in the 21st century, reflecting the emergence of a strong international norm against such testing. This norm developed under scientific, public, and strategic pressure, leading to the Partial Test Ban Treaty in 1963 and later to the Comprehensive Nuclear-Test-Ban Treaty (CTBT) in 1996. Although the treaty has not yet entered into force, its global monitoring system has made secret testing nearly impossible, and major nuclear powers have maintained voluntary moratoriums. After the Cold War, computer-based simulations replaced physical tests, further reinforcing the ban.

However, recent global developments suggest that the norm against nuclear testing is increasingly being challenged by nuclear powers. Russia and China have been accused by the United States of conducting low-yield nuclear tests: Russia's primary objective appears to be intimidating the West, while China's motivation is driven by technical considerations. North Korea has conducted physical tests to verify and enhance the reliability of its nuclear arsenal, but also to demonstrate its progress. Concerns have also emerged over the possibility of the United States resuming testing, especially since the CTBT has not yet been ratified.

Yet, open-source evidence suggesting that Russia, China, or the United States are seriously considering a return to explosive testing remains limited. Most declarations have been conditional threats or made by *former* officials. Today, nuclear tests and the threat of testing serve diverse strategic purposes. Once primarily focused on technological development and arsenal technical reliability, they have now become instruments of geopolitical pressure and power demonstration.

The international community should remain committed to preventing further explosive nuclear tests. The P5 framework provides a valuable platform for addressing these issues. Non-nuclear weapon states can also take various measures to reinforce the norm against testing, such as isolating norm violators, advocating for strengthening the CTBT's International Monitoring System (IMS), and globally supporting the CTBTO.

Résumé

À l'exception de la Corée du Nord, aucun État n'a mené d'essais nucléaires au XXIe siècle, rendant compte de l'émergence d'une norme internationale forte contre de tels essais. Cette norme s'est développée sous la pression scientifique, publique et stratégique, conduisant à la mise en place du Traité d'interdiction partielle des essais en 1963, puis du Traité d'interdiction complète des essais nucléaires (TICE) en 1996. Bien que ce dernier n'ait pas encore été ratifié, son système de surveillance mondial a rendu les essais secrets quasiment impossibles, et les principales puissances nucléaires ont maintenu des moratoires volontaires. Après la guerre froide, les simulations informatiques ont remplacé les essais physiques, renforçant davantage l'interdiction.

Pourtant, les évolutions géopolitiques récentes suggèrent que la norme contre les essais nucléaires est de plus en plus remise en question. La Russie et la Chine ont été accusées de mener des essais nucléaires de faible puissance : l'objectif principal de la Russie semble être d'intimider l'Occident, tandis que la motivation de la Chine est liée à des considérations plus techniques. La Corée du Nord a mené quelques essais physiques, principalement pour vérifier et améliorer la fiabilité de son arsenal nucléaire, mais également pour démontrer ses progrès. Des préoccupations sont également apparues quant à la possibilité que les États-Unis reprennent les essais, notamment parce qu'ils n'ont pas encore ratifié le TICE.

Cependant, les preuves ouvertes suggérant que la Russie, la Chine ou les États-Unis envisagent sérieusement de reprendre les essais explosifs restent limitées. La plupart des déclarations ont été des menaces conditionnelles, ou faites par d'anciens responsables. Aujourd'hui, les essais nucléaires et la menace d'en faire servent des objectifs stratégiques divers. Alors qu'ils servaient le développement technologique et la fiabilité technique de l'arsenal, ils sont désormais devenus des instruments de pression géopolitique et de démonstration de puissance.

La communauté internationale doit rester engagée pour prévenir de nouveaux essais nucléaires. Le cadre des P5 offre une plateforme pertinente pour aborder ces questions. Les États non dotés d'armes nucléaires peuvent également prendre diverses mesures pour renforcer la norme contre les essais, telles que l'application de sanctions et l'isolement accru des violateurs de la norme. De plus, ils doivent plaider pour le renforcement du Système international de surveillance (IMS) du TICE, et plus largement le bon fonctionnement du secrétariat du traité.

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Introduction

Since the Comprehensive Nuclear-Test-Ban Treaty (CTBT) opened for signature in 1996, merely three countries have tested nuclear weapons: India, Pakistan, and North Korea, all of which remain outside the treaty's legal framework.[1] Only North Korea has conducted nuclear tests in the 21st century, with its most recent test occurring in 2017. All other states, including those with advanced nuclear arsenals, have refrained from explosive testing, largely adhering instead to national moratoria and alternative warhead certification measures such as subcritical and computer-simulated tests. Thus, even in the absence of the CTBT's entry into force, an international *norm* against nuclear explosive testing has emerged, marking a stark contrast to the testing campaigns during the Cold War.[2]

However, international developments suggest that the norm faces increasing contestation from some of the nuclear powers. In its most extreme case of violation, North Korea tested nuclear weapons six times from 2006 to 2017, with its largest one, claimed to be a hydrogen bomb, on September 2, 2017. Also, Russia, China, and the United States are all upgrading their nuclear test sites, either for subcritical or explosive tests. Current and former officials in Moscow and Washington have raised the possibility of resuming explosive nuclear tests.[3]

The outlook for the norm against nuclear testing appears increasingly precarious. This paper reviews recent violations and tests those against the implementation of the norm. To what extent do current violations challenge the norm, are there visible patterns in these violations, and what can be done to strengthen it? The paper finds that (1) the norm against nuclear testing persists despite challenges, (2) that tests and threats of testing serve different strategic purposes beyond scientific weapons development, (3) and that threats of testing have evolved from a technical development

1. The author would like to thank Héloïse Fayet, Joseph Rodgers, and numerous other reviewers for their valuable feedback and support during the preparation of this paper. Special thanks to Caroline Covey for providing terrific research support and the Institut français des relations internationales for the wonderful opportunity to write this paper. Any remaining errors or omissions are the author's own.

2. M. Krepon, *Winning and Losing the Nuclear Peace: The Rise, Demise, and Revival of Arms Control*, Stanford, Stanford University Press, 2021; D. Horschig and H. Williams, "House of Cards? Nuclear Norms in an Era of Strategic Competition", Center for Strategic and International Studies, July 18, 2024.

3. R. O'Brien, "The Return of Peace Through Strength: Making the Case for Trump's Foreign Policy", *Foreign Affairs,* June 18, 2024; P. Sonne and D. E. Sanger, "On Russian Nuclear Threat, Putin Lets Others Rattle the Saber", *The New York Times*, October 7, 2023, available at: www.nytimes.com.

tool to a strategic instrument of influence and deterrence in global power dynamics. Understanding the scope of contestation of the norm is crucial to inform policymakers on steps to enforce it. This paper adds some clarity in a time when references to testing in the nuclear community are increasing.

Nuclear testing in this brief encompasses all explosive testing, including underground tests. While there is no collectively agreed-upon definition, the shared norm against nuclear testing enjoys a tacit and consensus understanding where actors agree on the general meaning (the so-called "zero-yield" standard).[4] Threats of testing refer to the specific statements or actions by a state indicating its intent to conduct a nuclear test, often as a means of coercion, signaling, or deterrence.

4. Technically speaking, subcritical tests do produce a nuclear 'yield' and the recent interpretations of this standard prohibit "all nuclear explosions that produce a self-sustaining, supercritical fission chain reaction of any kind". See "Scope of the Comprehensive Nuclear Test-Ban Treaty", U.S. Department of State, 2017.

Empirical evidence on the nuclear testing norm

The United States detonated the first nuclear device at the Trinity site in New Mexico in July 1945. That test ushered in the nuclear age, followed by the bombings of Hiroshima and Nagasaki. In the years thereafter, the United States, Soviet Union, China, France, and the United Kingdom collectively conducted hundreds of atmospheric, underwater, and underground tests, often with little regard for the long-term health and environmental consequences.

The norm against nuclear testing emerged through a mix of scientific advocacy, public pressure, and shifting strategic priorities among nuclear-armed states. In the 1950s, scientists and activists sounded the alarm about radioactive fallout, pointing to health risks and environmental damage. The 1954 Castle Bravo test, which contaminated Pacific islanders and a Japanese fishing crew, sparked outrage and fueled global protests.[5] The growing strength of anti-nuclear movements, particularly in Europe and Japan, began to shape public discourse. This public and domestic opposition pushed governments to take action, leading to the 1963 Partial Test Ban Treaty (PTBT), which prohibited tests in the atmosphere, outer space, and underwater. While the PTBT had significant limitations, most notably the absence of key states such as China and France, and the continued practice of underground testing, it marked a critical moment in norm-building. It acknowledged that nuclear testing posed unacceptable transboundary risks and established a legal framework for restraining such behavior. Moreover, it represented one of the first times when adversaries during the Cold War cooperated to reduce nuclear dangers. Underground testing continued, but growing evidence of its dangers, along with rising anti-nuclear sentiment, made the practice harder to defend. More than just an environmental issue, stopping nuclear tests also served as a way to slow technical advances in nuclear weapons development, limiting the ability of nuclear states to refine new designs and capabilities.

The real transformation came in the post-Cold War era. With the Soviet Union's collapse and the end of great power confrontation, new opportunities emerged to push for a comprehensive end to nuclear testing. The 1990s witnessed a confluence of disarmament momentum, scientific advocacy, and civil society mobilization aimed at achieving a global ban.

5. A. L. Brown, "No Promised Land: The Shared Legacy of the Castle Bravo Nuclear Test", Arms Control Association, 2014, available at : www.armscontrol.org.

Efforts to curb nuclear testing were further reinforced through institutions and monitoring systems. Momentum built for a far-reaching ban, leading to the 1996 Comprehensive Nuclear-Test-Ban Treaty (CTBT). Even though the treaty has not entered into force, the CTBT Organization (CTBTO) has kept its mission alive, and widespread support for the treaty remains (as of 2024, there are 185 signatories and 178 ratifications). Its International Monitoring System (IMS), which uses seismic, hydroacoustic, infrasound, and radionuclide sensors, makes it almost impossible to test in secret. That level of scrutiny has discouraged countries from breaking the norm. Major nuclear powers like the United States, China, and Russia have also maintained voluntary test moratoriums, further solidifying the expectation that full-scale nuclear testing belongs in the past.

The end of the Cold War made testing seem unnecessary, as countries stabilized their arsenals and turned to computer simulations to refine their weapons. Nonproliferation and disarmament efforts, including commitments under the NPT, reinforced the idea that testing undermines global security. Crucially, the test ban remains one of the key conditions for preventing a renewed arms race, as resuming testing could prompt rival states to do the same, escalating tensions and reversing decades of restraint. Over time, these pressures worked together to turn nuclear testing from a routine practice into a nearly universal taboo.[6] One that has proven to be remarkably robust.

To assess the current state of this norm against nuclear testing that has developed over time, this brief assesses empirical evidence of recent violations of the nuclear norm against testing. The data[7] suggests that in the 21st century, there have been six tests and no fewer than 11 threats of testing. This section examines key actors recently implicated in norm violations.

Russia: Threats as a strategic tool

The United States brought noncompliance charges in several State Department reports about Russian low-yield nuclear tests. In reports in 2018, 2019, and 2020, Washington accused Russia of "a failure to adhere to the U.S. 'zero-yield' standard, which would prohibit supercritical test (see Table 1)."[8] While Russia has criticized recent U.S. rhetoric about resuming

6. For more detailed discussions of the evolution of the norm against nuclear testing and countries' testing history, see M. Krepon, *Winning and Losing the Nuclear Peace, op. cit.*; W. Potter, *Nuclear Politics and the Non-aligned Movement: Principles vs Pragmatism*, Abingdon, Routledge, 2017.

7. The data categorizes nuclear tests, unconditional and conditional (if *they* will, *we* will) threats of testing, the (conditional) option to test, recommendations to test, responses to threats of testing, allegations, and evidence of preparation for tests.

8. "Executive Summary of the 2020 Adherence to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments (Compliance Report)", United States Department of State, December 2020.

nuclear testing, it does not find U.S. subcritical experiments in violation of the moratorium on nuclear tests.[9] More recent U.S. reports referred to these previous versions. Since then, there has been no definite evidence in support of actual tests happening. But open-source satellite imagery suggests that Moscow and Beijing have been expanding their nuclear test sites.[10] They have built new roads, storage facilities, and tunnels.

In addition, Russia revoked its ratification of the CTBT in 2023, citing Washington's hesitation to ratify the treaty. Moscow has also been repeatedly leveraging nuclear intimidation and rhetoric to deter Western intervention and support for Ukraine.[11] For example, in December 2024, Deputy Foreign Minister Sergei Ryabkov said Moscow is considering steps to resume nuclear testing in the interest of ensuring its security.[12] Additionally, Andrei Sinitsyn, head of Russia's nuclear test site at Novaya Zemlya, confirmed in 2024 that "the test site is ready for resumption of full-scale testing activities. It is ready in its entirety. Laboratory and testing facilities are ready. The personnel are ready. If the order comes, we can start testing at any moment."[13] As the data shows, some of these threats have been veiled or conditional on actions of the United States, while a handful have been more direct. The Kremlin's nuclear signaling is seemingly most severe when Russian battlefield advances in Ukraine are slowing.

As a result, Russia manipulates nuclear risk from a point of weakness. When Russia is performing fairly well on the battlefield, it is issuing fewer nuclear signals. This pattern suggests that nuclear rhetoric is mostly a tactical tool in Russia's approach to the war in Ukraine, leveraged primarily when its military position is weak, rather than a genuine indication of intent to escalate to nuclear testing. While live testing can also help refine Russia's new systems under battlefield conditions, such as its hypersonic glide vehicles (e.g., Avangard) and tactical nuclear weapons, a test is likely foremost for demonstrative reasons to intimidate the West. Russia's computational capabilities and physical experiments conducted by the All-Russian Scientific Research Institute for Experimental Physics (VNIIEF) allow it to maintain its arsenal without full-scale nuclear explosions.

9. "Russia Says U.S. Subcritical Experiment Does Not Violate Nuclear Test Ban Treaty", Reuters, May 21, 2024, available at: www.reuters.com.
10. E. Cheung, B. Lendon and I. Watson, "Exclusive: Satellite Images Show Increased Activity at Nuclear Test Sites in Russia, China and US", CNN, September 22, 2023.
11. H. Williams *et al.*, "Deter and Divide: Russia's Nuclear Rhetoric & Escalation Risks in Ukraine", CSIS, February 11, 2025.
12. J. King, "Russia Considering New Nuclear Tests, Moscow Warns", *Newsweek,* December 27, 2024.
13. A. Osborn, "Russian Nuclear Test Chief Says Moscow Is Ready to Resume Testing 'at Any Moment'", Reuters, September 17, 2024, available at: www.reuters.com.

Table 1: Nuclear Testing Data for Russia

Who	When	What	Type
Ambassador to the UN Vitaliy Churkin	June 2, 2009	In response to the May 2009 DPRK nuclear test, Russia sees the need for a strong UNSC response, but warns against unreasonable sanctions against the DPRK.	Response
Scientific Head of All-Russian Scientific Research Institute of Experimental Physics Vyacheslav Solovyov	February 8, 2023	Claims the Novaya Zemlya nuclear test site is ready to resume testing "if need be and given the corresponding political will".	Conditional option
President Vladimir Putin	February 21, 2023	Announces the suspension of New START and says that Russia should be ready to resume nuclear weapons testing if the U.S. does so.	Conditional threat
Russian President Vladimir Putin	October 5, 2023	President Putin makes a speech claiming a successful Burevestnik missile and suggests Russia may resume nuclear testing – "What we can do is act just as the United States does".	Conditional threat
President of National Research Centre Kurchatov Institute Mikhail Kovalchuck	October 2023	Said the West's position towards Russia requires the resumption of nuclear testing to exhibit Russia's determined defense of itself.	Threat
Deputy Foreign Minister Sergei Ryabkov	October 10, 2023	Accuses the US of preparing for nuclear tests at the Nevada nuclear test site, but says again that they will not resume testing unless the US does.	Conditional threat
President Vladimir Putin	November 2, 2023	Russia is revoking the CTBT for parity purposes with the US, and says they will not resume testing unless Washington does.	Conditional threat
President Vladimir Putin	February 29, 2024	In a speech to the Duma, Putin claims "certain actors in Washington" are considering full-scale nuclear testing.	Allegation
Head of Rossiyskaya Andrei Sinitsyn	September 27, 2004	Sinitsyn stated that his testing site was ready to resume nuclear tests "at any moment" if Moscow gave the order,	Conditional threat
Deputy Foreign Minister Sergei Ryabkov	December 27, 2024	Russia is considering taking steps toward nuclear testing, considering incoming Trump's prior attitude towards the CTBT and the possible resumption of nuclear testing.	Conditional threat

CNN	2023	Satellite imagery from the James Martin Center for Nonproliferation Studies at the Middlebury Institute of International Studies suggests increased activity at the Novaya Zemlya nuclear test site.	Physical evidence
State Department Memo – Adherence to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments	April 15, 2020	The US State Department claimed that China and Russia may have covertly conducted low-yield underground nuclear tests based on circumstantial evidence. Chinese Foreign Ministry's Zhao Lijian and Russian Deputy Foreign Minister Sergei Ryabkov deny the claims.	Allegation

China: A real technical need?

China has signed the CTBT and maintains a nuclear testing moratorium but has not ratified the treaty because the United States has not done so either. Beijing has suggested that it wants to ensure that its nuclear deterrent remains credible, especially as the United States advances missile defense and conventional strike capabilities. The refusal to ratify the treaty raises questions about China's long-term commitment to a permanent test ban. The United States has accused China of possible preparations to operate its Lop Nur site (see Table 2).[14] Despite reports about China preparing its test site, there has been little unclassified evidence on whether Beijing seriously intends to conduct explosive testing, or whether it is shortening its preparation time to test if needed.

Publicly, China has supported the norm against testing, responding with objections to North Korea's 2009 and 2017 nuclear tests, demanding that Pyongyang denuclearize, and asking the country to avoid such provocations. This was not only because China feared instability in the Northeast but because the effects of the test were felt in China. The tests triggered seismic activity in Chinese border towns and cities, leading to school and office evacuations and raising concerns about radiation in the region.[15] In response to the DPRK's 2009 test, China sought a United Nations Security Council Resolution (UNSCR) that would avoid the risk of military conflict. China's decision not to remain silent is noteworthy. However, Beijing's intentions regarding nuclear testing remain as opaque as its plans for shifting its nuclear posture. Unlike Russia, China has not used nuclear testing threats as a signaling tool. While both countries

14. "Executive Summary (Compliance Report)", U.S. Department of State, *op. cit.*
15. "North Korea Nuclear Test Site Mantapsan Mountain Collapse Makes It Unusable for Kim Jong Un, Scientists Say", *CBS News,* April 26, 2018.

generally follow a different approach to deterrence and nuclear signaling, it may suggest that China's potential motivation for testing may be driven by technical advancements.

Under the patronage of the China Academy of Engineering Physics, China conducted 45 nuclear tests between 1964 and 1996, with early tests focused on rapidly developing its deterrent, including hydrogen bomb capabilities by 1967. The Cox Report (1999) alleged that China obtained U.S. nuclear weapons design information, which may have reduced its need for extensive live testing.[16] If China resumed testing, it could gain technical advantages by validating new warhead designs, improving reliability for multiple independently targetable reentry vehicles (MIRVs), and advancing hypersonic nuclear capabilities, all of which remain priorities in its military modernization.[17]

Table 2: Nuclear Testing Data for China

Who	When	What	Type
Ministry of Foreign Affairs of PRC	May 25, 2009	In response to DPRK May 2009 test, the PRC demands that the DPRK fulfill its denuclearization promise and is resolutely opposed to the provocations.	Response
PLA Public Statement	April 11, 2017	In a warning against DPRK nuclear threats that could jeopardize the security of northeast China, they threaten a military attack against DPRK nuclear facilities.	Response
CNN	2023	Satellite imagery from the James Martin Center for Nonproliferation Studies at the Middlebury Institute of International Studies suggests increased activity at the Lop Nur Nuclear test site.	Physical evidence
State Department Memo – Adherence to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments	April 15, 2020	The US State Department claimed that China and Russia may have covertly conducted low-yield underground nuclear tests based on circumstantial evidence. Chinese Foreign Ministry's Zhao Lijian and Russian Deputy Foreign Minister Sergei Ryabkov deny the claims.	Allegation

16. "U.S. National Security And Military/Commercial Concerns With The People's Republic Of China", Select Committee United States House Of Representatives Volume, available at : www.congress.gov.
17. H. M. Kristensen, M. Korda, E. Johns and M. Knight, "Chinese Nuclear Weapons, 2024", *Bulletin of the Atomic Scientists*, Vol. 80, No. 1, January 2024, pp. 49-72.

United States: Between norms and hawks

Like China, the United States has yet to ratify the CTBT. The country has not done so out of concerns over the treaty's verifiability and potential impact on maintaining a safe, reliable nuclear deterrent. Washington does, however, observe a moratorium on nuclear explosive testing and has traditionally strongly supported the norm against nuclear testing post-Cold War. Most recently, former Acting Assistant Secretary of Defense for Space Policy Vipin Narang reaffirmed that the United States "will uphold the global norm against nuclear explosive testing and support the entry into force of the [CTBT]."[18] However, since the 1990s, U.S. legislators have debated CTBT ratification. The Senate rejected ratification in 1999, and despite periodic attempts to revive the issue, opposition, especially among Republicans, has remained strong, with critics arguing that simulation programs may be insufficient without the option to test and that other nuclear states might not fully comply with the treaty.

Currently, Washington ensures technical operability of its nuclear warheads through its Stockpile Stewardship Program (SSP), the conduct of subcritical tests to ensure the effectiveness of nuclear warheads without a self-sustained nuclear chain reaction. When satellite images of the Nevada National Security Sites (formerly the Nevada Test site), revealed increased activity, the National Nuclear Security Administration (NNSA) explained that it was making infrastructure improvements "to inform plans for modernizing the nuclear weapons stockpile" and to build two measurement devices as part of SSP.[19] In a transparency effort, the NNSA invited Robert Floyd, Executive Secretary of the CTBTO, and non-governmental experts in 2023 to demonstrate how it abides by its pledge not to conduct nuclear explosive tests.[20] This is also in line with U.S. policy of being prepared to conduct a nuclear test within 6 to 10 months for a simple test, with waivers and simplified processes, 24 to 36 months for a fully instrumented test to address stockpile needs with the existing stockpile, and 60 months for a test to develop a new capability.[21] Adversaries have amplified disinformation, creating a narrative that risks being weaponized to justify renewed testing, with them arguing that if the United States questions its own deterrent, it might feel compelled to "test first" rather than respond to another state's resumption of testing.

18. "Nuclear Threats and the Role of Allies: A Conversation with Acting Assistant Secretary Vipin Narang", CSIS, August 1, 2024, available at: www.csis.org.
19. E. Cheung, B. Lendon and I. Watson, "Exclusive: Satellite Images Show Increased Activity at Nuclear Test Sites in Russia, China and US", *op. cit.*
20. "NNSA Demonstrates Transparency During Arms Control and Nonproliferation Experts' Visit to Nevada", U.S. Department of Energy, December 1, 2023, available at: www.energy.gov.
21. "Stockpile Stewardship and Management Plan: Report to Congress", National Nuclear Security Administration, 2017, available at: www.energy.gov.

There have been indeed some concerns over considerations in Washington to return to testing (see Table 4). President Trump's former National Security Advisor, Robert O'Brien, argued in 2024 that a return to testing is needed for "reliability and safety."[22] He argued this would hold deterrence value *vis-à-vis* China and Russia and that it could show resolve during a crisis. Similarly, Christian Whiton, a former State Department adviser in the George W. Bush and first Trump administrations, highlighted the necessity of testing newer weapons designs like the W93 and B61-13.[23] In May 2020, Trump national security officials reportedly discussed conducting a U.S. nuclear test explosion as a show of force to intimidate China and Russia during negotiations.[24] They justify the calls to prepare for a return to underground nuclear testing by the need to affirm the credibility of the U.S. nuclear arsenal and to signal resolve to adversaries.[25] However, in lead-up to and at the onset of the second Trump administration, there has been no official mention or threat of a return to testing. On the contrary, U.S. President Donald Trump has spoken about *denuclearization* and the administration's nominee to head the NNSA, Brandon Williams, stated in his confirmation hearing that he "would not advise testing" and thinks the United States "should rely on the scientific information."[26]

From a technical standpoint, the argument that testing is necessary for reliability purposes is not particularly compelling for the United States. The country has invested billions in infrastructure, including supercomputing, to assess its nuclear weapons without explosive testing and now does so more effectively than ever.[27] Thus, if Washington would consider a return to testing, the motivation would likely not be the verification of its technical capability, but likely to signal resolve and strength to U.S. adversaries, and a possible leverage in future negotiations.

22. R. O'Brien, "The Return of Peace Through Strength: Making the Case for Trump's Foreign Policy", *op. cit.*
23. W. J. Broad, "Trump Advisers Call for U.S. Nuclear Weapons Testing if He Is Elected", *The New York Times,* July 5, 2024, available at: www.nytimes.com.
24. J. Hudson and P. Sonne, "Trump Administration Discussed Conducting First U.S. Nuclear Test in Decades", *The Washington Post*, May 23, 2020.
25. R. Peters, "America Must Prepare to Test Nuclear Weapons", The Heritage Foundation, January 16, 2025, available at: www.heritage.org.
26. "Remarks By President Trump at the World Economic Forum", The White House, January 23, 2025, available at: www.whitehouse.gov; W. Broad, "Nuclear Testing Not Advised, Trump's Nominee Says in Senate Hearing," *The New York Times*, April 8, 2025, available at: www.nytimes.com.
27. J. Lewis, "Why America Stands to Lose If It Resumes Nuclear Testing", *Foreign Affairs,* July 30, 2024.

Table 4: Nuclear Testing Data for the United States

Who	When	What	Type
President Barack Obama	June 16, 2009	Response to May 2009 DPRK nuclear test. Calls for the denuclearization of the Korean Peninsula and recognizes the threat the DPRK poses to world security.	Response
President Barack Obama	February 12, 2013	President Obama discusses how the DPRK's third nuclear test is a provocation, and its programs threaten US national security, which requires steps to defend allies and the self.	Response
Joint Press Conference with President Barack Obama and President Park Geun-hye of Republic of Korea	April 25, 2014	Discussing North Korean testing and the threats it poses to international security, with an emphasis on the consequences to DPRK.	Response
Secretary of State John Kerry	September 9, 2016	Condemnation of DPRK's September 9 nuclear test. Promises measures necessary for defense commitments to allies and the American people.	Response
President Donald Trump	September 3, 2017	In response to DPRK 2017 nuclear test, Trump says appeasement will not work and the DPRK is hostile and dangerous to the US.	Response
(Sec Def James Mattis), Office of the Secretary of Defense Nuclear Posture Review	February 5, 2018	Direct quote: "The United States will not resume nuclear explosive testing unless necessary to ensure the safety and effectiveness of the U.S. nuclear arsenal."	Conditional option
US DOD Nuclear Matters Handbook	2020	The President retains the right to authorize a test "if an urgent issue with a weapon were to arise that required a nuclear test".	Conditional option
CNN	2023	Satellite imagery from the James Martin Center for Nonproliferation Studies at the Middlebury Institute of International	Physical evidence

		Studies suggests increased activity at the Nevada National Security Site.	
Anonymous senior Trump administration official	May 15, 2020	The Trump administration is considering resuming testing as a tool to get Russia and China to come back to trilateral negotiations.	Threat
Former Assistant Secretary of State Stephen Rademaker	June 18, 2020	Discusses 2021 NDAA amendment by Senator Cotton (R., Ark), which sets aside $10 million to carry out projects related to shortening the time required to execute a nuclear test. Discusses why it is important to "preserve the ability to test" for weapons reliability.	Recommendation
Ambassador Bonnie Denise Jenkins, Under Secretary for Arms Control and International Security	August 29, 2023	Reaffirm commitments to ratify the CTBT, claims the US has no intention to test a NW. Cites concerns over Russia's nuclear rhetoric and statement of resuming nuclear testing.	Response
Former National Security Advisor Robert C O'Brien	July 2024	O'Brien urges Trump to conduct nuclear testing if he wins the election for "reliability and safety in the real world" and to maintain superiority over Russia and China.	Recommendation
Former State Department advisor (George W. Bush, Trump) Christian Whiton	July 2024	Claims the W93 and the B61-13 need to be tested, and new warhead designs must be tested to keep up with Chinese/Russian hypersonics.	Recommendation
U.S. Mission to International Organizations in Geneva	October 22, 2024	Cites concerns over Russia's revocation of the CTBT and PRC's lack of moratorium on the production of fissile material.	Response

North Korea: Engineering deterrence

North Korea, not a signatory to the CTBT and whose decision to withdraw from the NPT in 2003 has not been recognized as lawful, stands out as the only country to have repeatedly disregarded any non-testing norm. North Korea initially threatened nuclear testing in 2003 and followed through with a physical test of an estimated yield of 0.48 kiloton in 2006 (see Table 3).[28] The regime stated that the test was "entirely attributable to the U.S. nuclear threat, sanctions, and pressure."[29] The country followed with five more tests over the next few years until the latest, most powerful one in 2017, reportedly a hydrogen bomb. Internationally, the tests were met with a mixture of verbal condemnation and multiple resolutions imposing sanctions. UNSCR 1718, 2094, 2270, and 2375 imposed financial sanctions, travel bans, and enhanced cargo inspections in 2006, 2013, 2016, and 2017, respectively.[30] India said they were concerned about the risks it poses to its national security; Israel stated that only a firm international response would deter other nations from doing the same; and the five permanent members (P5) of the UNSC pledged in 2016 to ratify the CTBT and reaffirm moratoria on NW tests.[31]

The repetition and variety of capabilities involved in North Korea's nuclear testing suggest that its motivation lay in the need to verify and enhance the reliability of its nuclear arsenal. Given the technical complexities of developing functional nuclear weapons, repeated testing allowed Pyongyang to refine warhead designs, improve yield efficiency, and ensure that its weapons work as the regime intended. The DPRK tested various warheads with increasing yields.[32] Additionally, North Korea uses the nuclear warhead and missile tests to demonstrate its progress to both domestic and international audiences, signaling the regime's deterrence posture and strategic leverage. North Korea's progression from early, lower-yield detonations to more sophisticated thermonuclear claims suggests a trajectory of technical refinement and operational confidence-building. Furthermore, statements from North Korean leadership frequently emphasize the necessity of a reliable nuclear deterrent against perceived external threats, reinforcing the view that capability assurance is a central motivation behind Pyongyang's tests.

28. L.-F. Zhao, X. Xiao-Bi, W. Wei-Min and Y. Zhen-Xing, "Regional Seismic Characteristics of the 9 October 2006 North Korean Nuclear Test", *Bulletin of the Seismological Society of America*, Vol. 98, No. 6, 2008, pp. 2571-2589.
29. P. Kerr, "North Korean Test Provokes Widespread Condemnation", Arms Control Association, November 2006, available at: www.armscontrol.org.
30. All these resolutions are available on this website: www.securitycouncilreport.org.
31. "Joint Statement on the Comprehensive Nuclear-Test-Ban Treaty by the Nuclear Nonproliferation Treaty Nuclear-Weapon States", U.S. Department of State, September 15, 2016, available at: 2009-2017.state.gov.
32. "Punggye-ri Nuclear Test Facility", The Nuclear Threat Initiative, June 7, 2023, available at: www.nti.org.

There are concerns of additional nuclear tests. The IAEA reported in 2022 that the nuclear test site was reopened after North Korea announced in 2018 as destroyed. Shortly after, international suspicion grew that the country has been readying for a seventh test of its suspected tactical nuclear weapons or other warhead designs.[33] North Korea would send a signal of determination to continue its nuclear program and to establish itself as nuclear weapons state.

Table 3: Nuclear Testing Data for North Korea

Who	When	What	Type
Ministry of Foreign Affairs of the DPRK	October 16, 2003	If the US does not change its negotiating position, the DPRK will "take a measure to open its nuclear deterrent to the public as a physical force", suggesting testing.	Threat
Ministry of Foreign Affairs of the DPRK	October 3, 2006	Said North Korea would conduct a nuclear test in the future but also notes that they will adhere to no first use.	Threat
Ministry of Foreign Affairs of the DPRK	October 9, 2006	The DPRK announces its test of a nuclear weapon.	Test
Ministry of Foreign Affairs of the DPRK	October 11, 2006	Official statement concerning the October 9 test: the test was "entirely attributable to the U.S. nuclear threat, sanctions, and pressure" and "If the U.S. increases pressure upon the DPRK, persistently doing harm to it, it will continue to take physical countermeasures, considering it as a declaration of a war."	Justification
Ministry of Foreign Affairs of the DPRK	May 25, 2009	The DPRK announces its test of a nuclear weapon.	Test

[33] Johnson J, "South Korea's Yoon says preparations for seventh North Korean nuke test complete", *The Japan Times*, October 25, 2022, available at : www.japantimes.com.

Ministry of Foreign Affairs of the DPRK	January 24, 2013	DPRK claimed it would "conduct a nuclear test", but no specific date.	Threat
Korean Central News Agency	February 12, 2013	The DPRK announces its test of a nuclear weapon. Also claimed the country would continue testing and building its arsenal.	Test
Korean Central News Agency	January 6, 2016	The DPRK announces its test of a smaller hydrogen bomb.	Test
Ministry of Foreign Affairs of the DPRK	September 9, 2016	The DPRK announces its test of a nuclear warhead designed to be mounted on a Hwasong ballistic missile. Says this will protect the DPRK from "US-led hostile forces" and will bolster their nuclear force.	Test
Vice Foreign Minister Han Song-ryol	April 18, 2017	Han claims the DPRK will test missiles weekly, monthly, yearly, and threatens a preemptive nuclear attack should the US plan a military attack. Mike Pence says "all options are on the table" when dealing with the DPRK.	Threat
Ministry of Foreign Affairs of the DPRK	September 3, 2017	The DPRK announces its test of a hydrogen bomb to be delivered on an ICBM.	Test
International Atomic Energy Agency	September 26, 2022	IAEA chief Rafael Grossi noted that North Korea's nuclear test site was reopened.	Allegation

Patterns of compliance and erosion in nuclear testing norms

The review of recent questionings or violations of the norm against nuclear testing reveals three findings.

First, while concerns about the breakdown of the norm against nuclear testing are warranted, empirical evidence suggests these threats, references, and pressure on it may not be as severe as often perceived. The recent surge in statements and discussions about resuming explosive testing has highlighted the risk of it happening. However, open-source evidence that Russia, China, or the United States are seriously considering a return to explosive testing is limited. Several statements were either made as conditional, rather than direct threats, or were merely conditional options a state has. Yet other statements did not come from current officials and are only policy recommendations. The threats of testing that were made are seemingly strategic rather than imminent. In addition, the international response to actual explosive testing has been fairly strong post-Cold War. Lastly, other nuclear possessors (India, Pakistan, Israel) have not mentioned a desire to test. Nuclear weapons states, France and the United Kingdom in particular, have upheld their commitments to cease nuclear testing.[34] France has put large efforts into its simulation program and dismantled all of its explosive testing facilities. The United Kingdom is collaborating with France and the United States to ensure the reliability of its Trident warheads. Most non-nuclear weapons states have ratified the CTBT, and many have tirelessly advocated for the treaty, supported the United Nations' resolutions, and condemned potential testing through diplomatic and multilateral efforts.

Second, tests and current threats of testing serve profoundly different strategic purposes, such as reinforcing deterrence postures, ensuring technical capabilities, or scoping international resolve against nuclear proliferation. The only country to blatantly disregard the norm against nuclear testing is North Korea. The country's tests served technical and

34. See for example, "Conference on Disarmament High Level Week: UK Statement", UK Government, February, 28, 2022, available at: www.gov.uk, "Statement by the United Kingdom, 2015 Conference on facilitating the entry into force of the comprehensive nuclear-test ban treaty", September 29, 2015, available at: www.ctbto.org; and "Déclaration de M. Jean-Yves Le Drian, ministre de l'Europe et des Affaires étrangères, sur le traité d'interdiction complete des essais nucléaires", Paris, September 23, 2021, available at: www.vie-publique.fr.

strategic purposes. The country examined the resolve of the international community by gauging the response to verbal threats before proceeding with actual tests that then ensured that its nuclear capabilities worked as intended. Some of these threats helped shape the psychological and strategic environment leading up to a test, allowing North Korea to control the narrative and prepare both domestic and international audiences for the inevitable fallout. The threats and subsequent tests also reinforced deterrence by demonstrating that North Korea was not merely bluffing but willing and able to advance its nuclear program despite external pressure.

Third, threats of testing are increasingly used to exert influence and deterrence in global power dynamics. Given the different strategic purposes mentioned in the previous finding and tables, it appears that threats and recommendations of testing or of resuming testing, rather than tests themselves, by some nuclear weapons states and possessors are increasingly becoming strategic tools shaped by geopolitical conditions rather than purely technical needs, as evidenced through Russian and U.S. statements. For Russia, the threat of nuclear testing is seemingly another tool to rattle the nuclear saber. Moscow uses testing threats as a flexible coercive tool, responding to shifts in its military position. Meanwhile, in Washington, political debates on testing are rooted less in reliability concerns, given advanced stockpile stewardship capabilities, and more in signaling strength to adversaries, with the underlying motive to be in a strong position for nuclear discussions with Russia and China.

Recommendations to strengthen the norm

Recent breaches of the norm against nuclear testing cannot be ignored, and the international community should remain committed to preventing further explosive tests. Despite the discussed cases, others, including Iran, India, and Pakistan, may have an incentive to consider testing, preparing for such, or threats of testing. If Iran crosses the nuclear threshold, it will likely want to test that capability. Pakistan may need to test to produce hydrogen bombs. India may also need to test to produce hydrogen bombs, given the uncertainty of the effectiveness of its claimed hydrogen test.[35] While the moment for renewed testing may not have arrived, various actors can take proactive steps to reinforce the norm.

For example, **the United States** benefits from responding to isolated breaches of the nuclear testing norm with measured assessments rather than disproportionate reactions. Instead of escalating rhetoric, Washington can evaluate direct violations and implicit threats based on their actual impact. Isolating actors like Russia and the DPRK who use nuclear coercion, including threats of testing, to intimidate others and gain geopolitical leverage, helps counter their strategies. Those actors have aimed to gain diplomatic leverage by threatening or hinting at nuclear tests to engage diplomatically, sometimes leading to concessions (e.g., sanctions relief or security guarantees), domestic legitimacy by demonstrating nuclear capabilities to nationalistic pride and regime stability, and alliance disruption by attempting to create divisions among U.S. allies, making it harder to form a unified response. The United States gains little technical advantage from nuclear testing, making reciprocal action counterproductive. Linking U.S. testing decisions to Russian actions risks legitimizing their rhetoric and escalating tensions unnecessarily. The United States can prioritize stability, as the limited benefits of an even earlier preparation for testing do not outweigh the risks of fueling unnecessary escalation.

The **P5** is one of the few forums where the adversarial great powers continue to engage. In 2022, the five major nuclear weapons states restated the Reagan-Gorbachev maxim "a nuclear war cannot be won and must never be fought." While such joint statements are no concrete action in themselves, they do reaffirm nuclear powers' commitment to restraint, signal stability to allies and adversaries, and reinforce the global norm

35. P. Sachin, "Pokhran II Not Fully Successful: Scientist", *The Times of India*, August 26, 2009.

against nuclear war. Given the repeated threats of nuclear use, a similar declaration may be less feasible today. However, a general joint statement on nuclear testing, separated from the issue of CTBT's ratification, could still be achievable, compartmentalized from broader nuclear threats and political tensions. Russia, China, and the United States are fueling each other's fears. But there is at least one common interest for all to refrain from testing: the high financial costs. As U.S. President Trump stated in January 2025, "tremendous amounts of money are being spent on nuclear, and the destructive capability."[36] For the United States, a single underground test would start somewhere around $132 million, according to a 2003 study by Sandia National Laboratories.[37] An independent study with visible outreach that lays out those costs could inform P5 or bilateral negotiations, or even public opinion and ill-informed advisors who advocate for nuclear testing without knowing the cost. It could be used as arguments in negotiations rather than appealing to appropriate state behavior.

The **P5** meetings may also represent an opportunity to address the underlying strategic purposes and motivations for a return to testing. In 2023, the head of the NNSA proposed technical talks with Beijing and Moscow to strengthen the global nuclear testing moratorium. The proposed discussions aimed to establish confidence-building measures at their former test sites, ensuring that subcritical nuclear experiments did not constitute nuclear test explosions. Even though this U.S. initiative was not met with interest by Russia and China, such renewed talks could help to address suspicions and mistrust among the actors and mitigate their motivations to test.

There are numerous actions **non-nuclear weapon states** (NNWS) can take to strengthen the norm, such as isolating norm violators and building stronger counterproliferation checks into export controls to ensure that they are not involuntarily aiding states interested in proliferation. Testing plays a critical role in this process, as it is often necessary for states to validate and improve their warhead designs, making it a key step in moving from theoretical capability to operational nuclear weapons. Ideally, NNWS would respond collectively to statements and threats from nuclear states on testing, given that many have firsthand experience with its effects.[38] The Ukraine war demonstrated how international pressure had some influence on Russia to adopt a more conciliatory tone on nuclear

36. "Remarks By President Trump at the World Economic Forum", *op. cit.*
37. A. Maloney, "Requiring Technical Necessity for Explosive Nuclear Testing", Federation of American Scientists, October 25, 2024, available at: www.fas.org.
38. M. Gordeyeva, "'Let Us Be A Lesson', Say Kazakhs Wary of Return to Nuclear Testing", Reuters, November 30, 2023, available at: www.reuters.com.

rhetoric.[39] Strong and unified opposition to threats of nuclear testing could have a similar impact.

Joint actions reinforcing the nuclear norm could be impactful, but economic interests and diplomatic ties often limit such responses. Instead, **NNWS** could call for recapitalization and securing of the budget of the CTBT's International Monitoring System (IMS) that could increase transparency in national verification efforts. Albeit imperfect because of challenges in identifying low-yield or evasive tests, the lack of on-site inspections due to the CTBT's non-entry into force, and gaps in global sensor coverage, IMS is important to verify compliance with the CTBT by detecting nuclear explosions. Adding more seismic stations to monitor for underground tests can help in tackling disinformation if actors try to hide tests and help to hold them accountable. The IMS also supports scientists in studying other natural events, including climate change, and as such is a useful investment and collaborative international effort.

Further, **NWS** committed to the test ban standard can engage key **NNWS** by increasing technical cooperation, such as sharing data and expertise to enhance national verification capabilities and reinforcing the role of the CTBTO as a hub for capacity-building. Additionally, they can work with NNWS to establish regional initiatives that amplify diplomatic pressure on potential norm violators, leveraging multilateral forums to ensure sustained political and financial support for the IMS and broader nonproliferation efforts.

39. H. Williams *et al.*, "Deter and Divide: Russia's Nuclear Rhetoric & Escalation Risks in Ukraine", *op. cit.*

Conclusion

The findings of this paper reveal that while concerns over the erosion of the nuclear testing norm are valid, empirical evidence suggests that violations remain limited. The research highlights how some actors use nuclear testing and threats of testing as strategic tools. These insights clarify the evolving role of nuclear testing in global security dynamics and underline the need for measured responses. Moving forward, reinforcing the norm against nuclear testing will require diplomatic engagement among major nuclear powers, particularly through confidence-building measures, collective P5 commitments, and sustained pressure from non-nuclear states.

If nuclear countries return to testing, it will likely have devastating consequences for not only the norm against nuclear testing, but also those against nuclear proliferation and use. Nuclear norms are deeply intertwined.[40] Explosive testing would violate moratoriums and signal to nuclear-ambitious states and non-nuclear states that some states are playing by their own rules. It would be a blatant disregard for international norms and increase the mistrust between the members of the NPT. And it would carry risks to human health and the environment. Underground testing may not have the same fallout as above-ground testing, but it would encourage other actors to test, and they may not stay underground or have the necessary safety measures. These second and third-order effects are likely to further intensify the nuclear crisis the international community is already in.

40. D. Horschig and H. Williams, "House of Cards?", *op. cit.*

27 rue de la Procession 75740 Paris Cedex 15 – France

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