



Wilton Park



Image: Wilton Park

Report

Irreversibility in Nuclear Disarmament

Wednesday 16th – Friday 18th March 2022 | WP2019

In association with: UK Foreign, Commonwealth and Development Office and the
Royal Norwegian Ministry of Foreign Affairs



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Introduction: The origin, objectives, and parameters of IND

1. The principle of irreversibility in nuclear disarmament (IND) is widely considered to be essential when implementing nuclear disarmament measures. At present, however, there is no common definition or unified understanding of the principle of irreversibility. States parties interpret and use the principle in different ways and there is no clear framework which explains how this principle is or could be applied in practice.
2. In the context of the Non-Proliferation Treaty (NPT), IND was first highlighted in the Final Document of the 2000 Review Conference. One of the 13 'practical steps' towards the implementation of the Article VI, the 'principle of irreversibility [is] to apply to nuclear disarmament, nuclear and other related arms control and reduction measures.'¹ This was further reaffirmed at the 2010 Review Conference where all parties committed to applying the principles of irreversibility, verifiability, and transparency in their implementation of the treaty obligations.²
3. Following the 2010 RevCon, several researchers sought to interrogate the parameters of IND,³ but interest readily declined, likely in part due to the worsening of the security environment and waning hopes for significant progress towards disarmament.
4. This Wilton Park meeting convened government and non-governmental experts to renew a conversation on IND, aiming to better understand and identify requirements for IND and to develop more detailed thinking about how states can apply the principle in relation to the implementation of their NPT obligations. The following report summarises the dialogue of that meeting and offers recommendations as we advance towards the 10th NPT RevCon.

¹ 2000 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, 'Final Document', 2000, <<https://unoda-web.s3-accelerate.amazonaws.com/wp-content/uploads/assets/WMD/Nuclear/pdf/finaldocs/2000%20-%20NY%20-%20NPT%20Review%20Conference%20-%20Final%20Document%20Parts%20I%20and%20II.pdf>>, p.14

² 2010 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, 'Final Document', 2010, [https://www.un.org/ga/search/view_doc.asp?symbol=NPT/CONF.2010/50%20\(VOL.I\)](https://www.un.org/ga/search/view_doc.asp?symbol=NPT/CONF.2010/50%20(VOL.I)) p.20

³ Ian Anthony, 'Irreversibility in Nuclear Disarmament Political, Societal, Legal and Military-Technical Aspects', Stockholm International Peace Research Institute, September 2011, < [irreversibility_ian.indd \(admin.ch\)](#) > David Cliff, Hassan Elbahtimy and Andreas Persbo, 'Irreversibility in Nuclear Disarmament Practical steps against nuclear rearmament', Verification Research, Training and Information Centre, September 2011, <[davidcli64256hassanelbahtimvandandreaspersbo4ece48257c33b.pdf](https://www.nonproliferation.eu/davidcli64256hassanelbahtimvandandreaspersbo4ece48257c33b.pdf) (nonproliferation.eu)>

The political, legal, and technical aspects of IND

Political

5. Participants discussed the idea that the international community must first create a set of political conditions to create an environment for disarmament, and that such normative change may be considered a prerequisite for IND. The gradual devaluation and ultimately delegitimation of nuclear weapons would allow states to feel more comfortable with irreversibly giving up their capabilities. Some highlighted the difficulty of achieving normative change in a time of a worsening security environment and considered potential alternatives. Overall, most participants agreed that normative change is not a silver bullet solution to the challenges of IND. States should, however, strive to achieve it, otherwise the cost of verification may become unbearable. This makes it necessary to create *sustainable confidence*, which in turn may involve creating a global network aiming to ensure 'undiminished security for all', where all members of the international security cooperate to ensure that rearmament is unnecessary. IND must be embedded in such a framework and make rearmament unattractive for, among others, political reasons. It should not, however, be imposed or dictated. Participants largely agreed that on the international stage, this process would be best facilitated via the United Nations General Assembly (UNGA).
6. One participant stressed the value of a macro-level notion of irreversibility, which focuses on analysing how significant events in the security realm can affect identities, memories, political cultures, and future decisions about the desirability of irreversibility. This framework is particularly relevant in the wake of Russia's invasion of Ukraine, which reignited mainstream conversations about the potential hazards of disarmament.

Legal

7. While NPT State Parties have used the concept of IND for over two decades, one participant argued that it does not constitute a legal principle as defined by International Court of Justice (ICJ), since it thus far lacks the necessary clarity for tribunals to rely on. As one participant observed, the legal community generally regards IND as a political, rather than legal, commitment and statement of intent.
8. However, a legal basis to support states' political commitments and reinforce political engagement will be required eventually. It might be useful to regard the legal basis conducive to IND as already set out in various documents such as the NPT and the Final Document of the Tenth Special Session of the General Assembly in 1978.
9. Withdrawal clauses, as evidenced in other arms control and disarmament treaties, could be a useful tool in any legal framework seeking to consolidate irreversibility. One might argue that withdrawal clauses make entering treaties more acceptable to states as they help ensure a legitimate way to reinstate whatever was given up for the treaty should the strategic environment change. However, foregoing withdrawal clauses in disarmament treaties could be instrumental to IND, as it builds irreversibility into the agreement. As it removes the lawful way to exit the treaty, it leaves state parties with the sole option of exiting via a violation – something that is universally seen as less legitimate, meaning that states will have to bear more consequences for such a decision. To ensure that IND is a clear and indisputable obligation, parties to disarmament agreements may want to forgo including withdrawal clauses in them. This was, for example, the case in the disarmament of Iraq in the 1990s, where United Nations Special Commission did not allow for deviations from the process.⁴

⁴ Ian Anthony, 'Irreversibility in Nuclear Disarmament Political, Societal, Legal and Military-Technical Aspects', p. 26

Technical

10. Several previous arms control treaties include language on ensuring irreversible damage to weaponry, and some offer very specific guidance. For example, the Protocol on Elimination of the Intermediate-Range Nuclear Forces (INF) Treaty outlines exact procedures for the elimination of missile systems elements, which involve techniques such as burning, crushing, or flattening.⁵
11. Participants discussed the *long-term* irreversibility of physical dismantlement and its feasibility. In the process of disarmament, the technical steps are fairly clear, but in a nuclear weapons-free world, the picture becomes complicated by the need to manage the possibility of states restarting the scientific and industrial processes for weapons production. One participant stressed that verification and transparency are inherent to successfully maintaining irreversibility.
12. It should also be noted that irreversible dismantlement methods are costly and labour-intensive. For example, the US only dismantles on average about 300 warheads per year.⁶ To expedite the dismantlement process, states would likely have to invest in additional infrastructure.
13. One participant noted that there is a degree of overlap between technical and political aspects of IND. Politics will influence technology acquisition and reversal, as exemplified by Germany's phasing out of nuclear energy. Further, the crushing and cutting of the weapons had political implications as it presented an evocative symbolic picture.

Past and current examples of IND

Ukraine

14. In the 1990s, Ukraine decided to renounce thousands of former Soviet nuclear weapons left on their territory. There are several political, legal, and technical factors that contributed to this decision and helped make it irreversible. At the time, the legal mechanisms to define a legitimate nuclear possessor were already in place: Ukraine would not be able to join the NPT, and thereby the international community, had it decided to retain nuclear weapons. Further, Ukraine's extensive nuclear energy infrastructure meant that the country required technical assistance from the IAEA. The disarmament process itself was a cooperative endeavour led by a power condominium who provided technical assistance partially informed by the clauses in START I (Strategic Arms Reduction Treaty).
15. The buy-in and trust in international regimes was crucial in Ukraine's case and is an important lesson for irreversibility. Even Russia's invasion of Ukraine does not raise concerns about a possible rearmament.

⁵ Treaty Between The United States Of America And The Union Of Soviet Socialist Republics On The Elimination Of Their Intermediate-Range And Shorter-Range Missiles (INF Treaty), 8 December 1987, <<https://2009-2017.state.gov/t/avc/trty/102360.htm#elimination>>

⁶ U.S. Department of State Bureau of Arms Control, Verification and Compliance, 'Transparency in the U.S. Nuclear Weapons Stockpile' Fact Sheet, 5 October 2021, <[Transparency in the U.S. Nuclear Weapons Stockpile - United States Department of State](#)>

South Africa

16. In 1989, South Africa officially ended its nuclear programme, and joined the NPT as a NNWS. As one participant noted, this case study might be the clearest proof that denuclearisation is foremost a political process, as South Africa's level of engagement and cooperation with the IAEA showed that the country made a strategic decision to disarm. South Africa's organisational transformation allowed it to shift its perception of nuclear weapons and made it more open to joining the nuclear non-proliferation architecture.
17. Although full technical verification was not possible at the time, even partial inspections were sufficient to confirm that all key elements of the programme were eliminated. This highlights that verification must be pragmatic: while there will always be gaps and inconsistencies, a 'technically coherent picture' is enough to be meaningful. This example could inform a principle for future verification methodology for IND, which includes searching for any discrepancies in a proactive manner.

North Korea

18. Having withdrawn in 2003, North Korea is no longer a party to the NPT. Since then, the country has acquired nuclear weapons and grown its warhead and delivery vehicle arsenal. Efforts to compel North Korea to disarm have thus far been unsuccessful, and Pyongyang has not shown any political signs of a willingness to denuclearise. The country's relationship with China proves to be an obstacle in applying incentives to disarm.
19. Several statements mention the word 'irreversible' in relation to North Korea's denuclearisation – notably, the US originally called its proposal the complete, verifiable, and irreversible dismantlement (CVID) of the nuclear programme. In 2007, during the Six Party Talks, the parties devised a 'disablement' plan where North Korea agreed to take defined steps to disable three facilities at the Yongbyon complex. According to the US representative Christopher Hill, the plan aimed 'to make it difficult to restart a nuclear programme.'⁷ Following the collapse of the talks in 2009, North Korea stated it would restore its nuclear facilities. While the disablement efforts were ultimately halted, experts assess that the plan slowed down the restoration of North Korea's capabilities.⁸
20. As the case of North Korea demonstrates, retaining a degree of hedging capability is likely to be necessary in the early stages of the disarmament process, as states may not initially feel ready to irreversibly give up all of their nuclear activities. It also underscores the need for political will to accompany technical measures as a requirement for achieving IND. Future efforts at denuclearisation of North Korea will have to focus on maintaining political engagement and improving transparency and trust among negotiating parties.

⁷ David Cliff, Hassan Elbahtimy and Andreas Persbo, 'Irreversibility in Nuclear Disarmament Practical steps against nuclear rearmament', p. 67

⁸ Ibid., p.72

Irreversible steps towards disarmament

Fissile material

21. The Trilateral Initiative, a 1996-2002 effort to examine the IAEA's verification system for weapon-origin and other fissile material, can inform current and future thinking on IND. As part of the Initiative, the Joint Working Group was established to consider the financial, technical, and legal aspects of the endeavour. The Initiative was successful in developing verification processes that allowed to maintain secrecy. In parallel, the parties agreed on a legal framework – the Model Verification Agreement.
22. Nevertheless, irreversibility in the context of fissile material remained an unsolved issue after the Initiative's conclusion. The outstanding questions include the very objective and whether it should be to provide assurances that the material is removed from any military-adjacent purposes, or whether physical transformation, such as down-blending of material, would be enough. Further, it is unclear whether verification could stop after achieving an agreed degree of irreversibility, or whether it would have to be perpetual, like IAEA safeguards. There also are challenges to ensuring continued compliance that necessitate sustained verification of correctness and completeness of many elements of disarmament, such as the modification of critical nuclear facilities to non-nuclear uses.

Arms control and nuclear reductions

23. The United States and Russia have always framed nuclear arms control agreements as acting in fulfilment of their disarmament commitments. There is, however, a fundamental tension between the objectives of arms control and disarmament based on different visions of security. Arms control is a tool for managing and sustaining deterrence, and while it may in places overlap with disarmament, the end states are different.
24. The past practice of arms control can serve as a bank of ideas to tie together the questions of irreversibility, verification, and transparency. Among others, states have experience in overseeing irreversible destruction of delivery vehicles, monitoring missile production, and bilateral dispute resolution processes. All these could be useful in informing rearmament prevention.
25. The scale of arms control, however, is much smaller than that of disarmament, which makes its applicability limited. Elimination of fissile material and delivery vehicles is not sufficient to achieve disarmament. The disarmament process needs to consider all elements of nuclear arsenals, such as R&D and command and control architecture. There are also thorny technical issues to overcome. For example, it might be difficult to determine whether certain activities, which might exhibit the same characteristics and use the same infrastructure are nuclear weapons-related. Similarly, while it is impossible to ban research on all nuclear-adjacent issues, it will prove challenging to ensure that this research does not turn into clandestine nuclear rearmament. To make sense of this complexity, we may need new analytical models and principles.

Irreversibility as a disincentive?

26. The notion of irreversibility is increasingly built into nuclear disarmament rhetoric. States signal their commitment to disarmament by taking steps towards it in an irreversible manner. However, at present, the concept is still largely fluid and does not negate the possibility of restarting a programme, but rather the positive decision to forego it in a verifiable way for the foreseeable future.

27. Some participants expressed a concern that irreversibility might in fact act as a disincentive for disarmament. In an unstable security environment, states may be reluctant to engage in irreversible steps towards nuclear disarmament when that means foregoing the ability to change course should their security situation change dramatically.
28. The desire to retain some capabilities is linked to the concept of hedging. Since it is impossible to uninvent the bomb, states may want to preserve the ability to rearm. This may be especially true in the absence of a credible breakout prevention mechanism for major powers. In some historical cases of disarmament, states have shown a degree of reluctance to lose their capabilities completely.
29. Preservation of some materials and technologies could further be justified by their non-nuclear weapons uses. For example, nuclear-related materials and technologies can be useful for other defence and civilian purposes, and dual-use delivery vehicles might be retained for conventional warfare. Finally, certain skills and infrastructure may be of use in disarmament verification mechanisms.
30. On the other hand, there is some scepticism about the feasibility of reversible disarmament. The idea that a form of virtual deterrence, based on the ability to rebuild nuclear arsenal, may be stabilising, is debatable. In peacetime, it might be difficult to ensure that nuclear-related skills are preserved without any actual programmes. Questions also remain about the potential unfair advantage that NWS might retain in such a system, as well as about how this might translate to security alliances dynamics.
31. Many participants expressed the belief that to get to irreversible disarmament, states need not just an improved security environment, but also a change of mindset. If delegitimisation of nuclear weapons cannot be achieved, states may need to learn to manage latent nuclear power at least for the first decades following disarmament.

Maintaining a disarmed world

Possible 'end states' in a disarmed world

32. It is useful to think about IND in relative, rather than binary, terms. Another way, irreversibility can be considered as a scale or spectrum. From this perspective, IND can serve as a tool for managing the risks of rearmament, with varying degrees of 'end-states' presenting varying levels of risk. For example, only eliminating the current warhead stockpile may prove to be easily reversible without addressing all the other elements of nuclear programmes.
33. One participant offered five potential degrees of 'locking in' arms reductions:
 - Dismantlement of warheads, including the removal of the fissile materials from the physics package.
 - Destruction of all warhead pits.
 - A verifiable commitment by states to only engage in peaceful uses of nuclear technology.
 - Elimination of enrichment and reprocessing facilities to halt the production of highly enriched uranium (HEU) and plutonium.
 - Complete abandonment of nuclear infrastructure, including that for peaceful use.

Civil nuclear industry

34. As noted in point 5 above, the highest degree of irreversibility may include abandonment of *all* nuclear infrastructure, to ensure that any potential rearmament is exceedingly costly and easy to discover. In the absence of such measures, we must consider options for preserving capabilities for producing nuclear power while still ensuring irreversibility of disarmament.
35. Fissile material is inherently dual-use, thus posing considerable challenges in a disarmed world that still uses civil nuclear power. Participants recognised that the IAEA Safeguards in their current form are necessary for now, but might not be sufficient at a global zero. While their basic approach of monitoring declared nuclear-related activities and detecting undeclared ones is sound, disarmed states with decades of nuclear experience might pose unique challenges, and thus will need a different set of restrictions.
36. A maximalist approach to ensuring irreversibility would see the abandonment of nuclear fission altogether. This would involve elimination of fissile material from nuclear weapons, as well as halting production. As one participant noted, transition to fusion energy is not proliferation-resistant, but it offers fewer risks. A less drastic scenario could still allow for multilateral reprocessing but would eliminate sovereignty and ban any single state from producing fissile material. This solution would require reducing and down-blending stocks.
37. Future challenges to consider include the potential for next generation reactors using different material for fuels, as well as the unique problems posed by naval reactors. In a disarmed world, nuclear energy is likely to spread to more countries, adding more pressure onto the safeguards system. Finally, the vulnerabilities inherent in excessive reliance on nuclear power are becoming increasingly apparent. Rising temperatures and extreme weather events caused by climate change have already shown adverse effects on nuclear plants' operation. Recently, Russia's seizure of the Chernobyl nuclear power plant and the attack on the Zaporizhzhia plant in Ukraine raised concerns about the spread of radioactive material. To mitigate some of these risks, states may wish to turn towards greater reliance on renewables.

Nuclear latency

38. Nuclear weapons cannot be uninvented, as the technologies, material, infrastructure, and knowledge will exist for many generations to come. This raises concerns about the potential misuse of civilian nuclear power programmes for military purposes to achieve strategic surprise. Existing case studies, such as Japan or South Korea, both with significant latent capability, paint a worrisome picture of nuclear latency, which will certainly continue to exist as nuclear forces are reduced. This creates potential for high level of crisis instability.
39. From the perspective of irreversibility, nuclear latency could be viewed as possessing some but not all technology, resources, and know how necessary for nuclear weapon without full operational readiness. There are no clear silver bullet solutions to achieving this, but the focus should be on increasing the time, cost and effort involved in reconstituting weapons through political and technical measures. Potential steps may include international fuel storage arrangements and strengthening IAEA safeguards. As one participant noted, however, there are limits to technical elimination of latency. Monitoring individuals with sensitive knowledge might prove necessary. This may include creating incentives for nuclear scientists to redirect their work, as well as normative measures such as practitioners' declaration.

40. Currently, there is no agreed way to verify disarmament at low numbers to zero. There are significant tensions derived from secrecy around nuclear weapons. The Fissile Material Cut-off Treaty (FMCT) especially would pose challenges at low numbers. Potential steps to alleviate these tensions might include increasingly consolidated fissile material storage, and new verification provisions for the Comprehensive Test Ban Treaty (CTBT). At low numbers, other weapons of mass destruction (WMD) and their delivery vehicles will prove significant – the existing regimes to control them are suitable at present but might need to look different in a nuclear weapons-free world.

Conclusion and recommendations

In the context of Russia's invasion of Ukraine, the security environment appears far from conducive to nuclear disarmament. Exploring forward-looking concepts like irreversibility may therefore seem premature or possibly even futile. However, there is clear utility in doing the preparatory work in anticipation of a more favourable strategic moment. As the 1990s demonstrate, political conditions can change suddenly and prove favourable to more transformative disarmament measures. Many of the challenges, questions, and lines of enquiry noted above suggest the international community has some way to go to fully capitalise on such a moment were it to occur. In short, much work remains to be done to seize on the opportunity of irreversibility in nuclear disarmament.

The following suggestions, made over the course of the conference, could serve as a starting point to further develop this agenda and strengthen long-term efforts to sustain nuclear disarmament.

- All State Parties should reaffirm the principle of irreversibility at the 2022 NPT Review Conference and pose it as a topic of discussion for the next review cycle.
- Discussions of IND should be incorporated into existing initiatives such as the International Partnership for Nuclear Disarmament Verification (IPNDV) and the Creating an Environment for Nuclear Disarmament (CEND) initiative. For discussions on IND and risk, a track 1.5 dialogue is particularly suitable as it can bring together different sectors and industries.
- Governments and other funders should strive to dedicate resources to facilitate extensive research into IND. Some of the themes pertaining to IND that warrant particular attention include:
 - **An examination of the 'building blocks' of IND and the interconnectedness of its political, legal, and technical aspects.** Irreversibility is a continued process, and the notion of an end-state is difficult to envision in a fluid political and security environment. There is a need to develop thinking on how the three aspects can be operationalised and reinforce each other to safeguard the irreversibility of disarmament in times of crisis and change. These discussions would benefit from the involvement of legal and scientific experts.
 - **The variety of perspectives on IND.** To wholly understand and develop the concept, it is imperative to scope the full range of perspectives on irreversibility. This effort should be inclusive of various groups such as the Non-Aligned Movement and nuclear powers who are not part to the NPT as well as civil society.
 - **Sociological and normative aspects of IND** should be examined to establish what kind of normative change, if any, will be necessary to ensure an irreversibly disarmed world. This should include thinking about how events such as the Russian invasion of Ukraine affect the collective memory and future decisions about disarmament.

- **Potential verification measures to ensure the irreversibility of disarmament processes**, both for the short-and medium-term steps and in a long-term nuclear-free world. Although the principle of irreversibility is distinct from that of verification the two cannot be separated in the long term.
- **Case studies of past examples of irreversibility in disarmament** should be identified and studied to explore how the understanding of the concept translated into practices. This could include previous processes, especially in global prohibition regimes such as the Chemical Weapons Convention (CWC).
- **The relationship between irreversibility and risk**. Irreversibility is not binary; rather, it exists on a spectrum. Different degrees of irreversibility might entail different risks. Further, risk perceptions might differ among countries. Potential approaches to these questions could draw from economics and the insurance industry.
- **The relationship between irreversibility and Article IV of the NPT**. There is a need to consider the management of dual-use technologies in a disarmed world and the tensions in the NPT between peaceful uses and irreversibility.

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