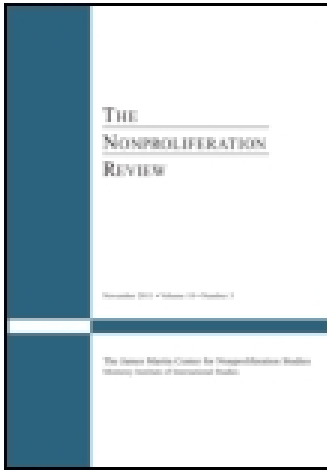


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CONFRONTING THE “PERPETUAL MENACE TO HUMAN SECURITY”

Openness as a Tool to Enable Nuclear Disarmament

Zia Mian and **Alexander Glaser**

Nuclear weapon states historically have attached great secrecy to their nuclear weapon and fissile material production programs and stockpiles, despite warnings that this would fuel fears, handicap informed debate and decision making, and drive arms races. As evidenced by the “Action Plan on Nuclear Disarmament” agreed upon at the 2010 Treaty on the Non-Proliferation of Nuclear Weapons (NPT) Review Conference, however, the international community now sees greater transparency about nuclear weapon and fissile material stocks as necessary for enabling and monitoring progress toward nuclear disarmament. To support this effort, the International Panel on Fissile Materials has proposed a step-by-step program for weapon states to declare their inventories, production histories, and disposition of nuclear warheads and fissile materials, and to set up joint projects to develop methods for verifying these declarations. This openness initiative is described here, and could be adopted at the 2015 NPT Review Conference, laying a basis for negotiating verifiable deep reductions in nuclear arsenals and their eventual elimination.

KEYWORDS: Fissile material; highly enriched uranium; plutonium; verification; nonproliferation; disarmament

In a July 1944 letter to President Franklin D. Roosevelt, Danish physicist Niels Bohr warned of the dangers of nuclear weapons and the need for controlling the fissile materials that are their key ingredients, urging that “unless ... some agreement about the control of the use of the new active materials can be obtained in due time, any temporary advantage, however great, may be outweighed by a perpetual menace to human security.”¹

Bohr’s warning came at a time when the United States was still struggling to design its first nuclear weapons and produce sufficient highly enriched uranium (HEU) and separated plutonium for weapon use. These fissile materials—which Bohr described as “active materials”—are the key component of nuclear weapons because they are able to sustain the fission chain reaction that powers a nuclear explosion. A year later, in July 1945, the United States carried out the first ever nuclear weapon test.

Today, almost seventy years later, there are an estimated 17,000 nuclear weapons globally, with the United States and Russia together holding more than 16,000 of these weapons and the other seven nuclear weapon states holding a combined total of about

1,000 weapons.² The global stockpile of fissile material is estimated to be about 2,000 metric tons, consisting of HEU and separated plutonium mostly held by the nine nuclear weapon states.³ There is great uncertainty in these estimates because of the secrecy surrounding nuclear weapon and fissile material production histories and current stockpiles in most of the weapon states.

The failure to reach an international agreement concerning the control of fissile materials—which will be critical to achieving nuclear disarmament, halting the proliferation of nuclear weapons, and ensuring that terrorists do not acquire nuclear weapons—contributed to the founding in January 2006 of the International Panel on Fissile Materials (IPFM). The IPFM is an independent group of arms control and nonproliferation experts from eighteen states, including nuclear weapon and non-nuclear weapon states, that works to analyze the technical basis for practical and achievable policy initiatives to secure, reduce, and eliminate stockpiles of military and civilian HEU and plutonium.⁴

This report presents key ideas from the IPFM's *Global Fissile Material Report 2013: Increasing Transparency of Nuclear Warhead and Fissile Material Stocks as a Step toward Disarmament*. It discusses the issue of nuclear secrecy and the need for increased transparency by the nuclear weapon states about national stockpiles of nuclear weapons and fissile materials. It lays out briefly the proposals by IPFM for how nuclear weapon states could address this lack of openness through a series of increasingly detailed public declarations of their nuclear warheads and inventories, the production and disposition of HEU and separated plutonium, and suggests new cooperative projects to enable verification of these declarations. These openness initiatives, if adopted, would provide the essential background information required for the negotiation and verification of deep reductions in nuclear arsenals and for the eventual elimination of nuclear weapons.

Shifting the Boundaries Between Nuclear Secrecy and Nuclear Transparency

The commitment to nuclear secrecy is as old as nuclear weapons. The White House press release announcing the atomic bombing of Hiroshima in August 1945 explained that secrecy was now necessary for security, declaring that:

It has never been the habit of the scientists of this country or the policy of the Government to withhold from the world scientific knowledge. Normally, therefore, everything about the work with atomic energy would be made public.

But under present circumstances it is not intended to divulge the technical processes of production or all the military applications, pending further examination of possible methods of protecting us and the rest of the world from the danger of sudden destruction.⁵

Others saw in nuclear secrecy a danger rather than a path to security. With the Cold War superpower nuclear arms race picking up pace, driven in part by mutual fears and lack of information about the capabilities of the other side, Niels Bohr wrote to the United Nations in June 1950, recalling his 1944 memo to President Roosevelt and urging greater openness as a path to building trust and confidence and so stemming the arms race:

It has not been possible to obtain consent as regards control of atomic energy armaments. Under the circumstances it would appear that most careful consideration should be given to the consequences which might ensue from ... immediate measures towards openness on a mutual basis. Such measures should in some suitable manner grant access to information, of any kind desired, about conditions and developments in the various countries and would thereby allow the partners to form proper judgment of the actual situation confronting them. Every initiative from any side towards the removal of obstacles for free mutual information and intercourse would be of the greatest importance in breaking the present deadlock and encouraging others to take steps in the same direction.⁶

A similar judgment was reached in a January 1953 report by the Panel of Consultants on Disarmament appointed by Secretary of State Dean Acheson. It was chaired by J. Robert Oppenheimer, who led the scientific work to design and build the US atomic bomb during World War II. The Panel recommended that "the United States Government should adopt a policy of candor toward the American people—and at least equally toward its own elected representatives and responsible officials—in presenting the meaning of the arms race."⁷ The candor was viewed as necessary to allow an informed and democratic process of policy making on nuclear issues and, in this way, help to restrain the superpower arms race. The Oppenheimer report argued:

We believe, then, that the United States government should tell the story of the atomic danger, and in particular we believe that it should explain the rate and impact of atomic production, that it should emphasize the growing capability of the Soviet Union, and that it should direct attention to the fact that beyond a certain point we cannot ward off the Soviet threat merely by "keeping ahead of the Russians." We believe that official disclosure and recognition of these realities is the basic condition for a sound national attitude toward the problems of the atomic arms race. ... It is bad enough to be in a very dangerous world; it is still worse to be unaware of the danger.⁸

As Cold War dangers have faded, the search for military and political advantage through buildups of nuclear arsenals has given way to recognition of the need for stability and to collective security and the goal of a nuclear-weapon-free world. In 2009, a special heads of state summit session of the UN Security Council, chaired by President Barack Obama, approved Resolution 1887 "to seek a safer world for all and to create the conditions for a world without nuclear weapons."⁹

With this shift in perspective, Bohr's insight about the central importance of transparency and openness for nuclear disarmament has become increasingly evident in international efforts. There is growing recognition among states, nonproliferation and disarmament treaty parties, and international organizations in particular, of the need for concrete transparency measures by the nuclear weapon states as a necessary part of the process of achieving nuclear disarmament.¹⁰ It is well understood that this openness need not include making public detailed information about the engineering and design of nuclear weapons. What is needed is reliable, official information about the number of nuclear warheads and stockpiles of fissile materials and the history of their production so that the international community can verify progress toward nuclear disarmament.

TABLE 1

Estimated warhead fissile material stockpiles for the nuclear weapon states.

State	Nuclear warheads (historic peak)	Nuclear warheads (current)	Military plutonium (current)	Highly enriched uranium (current)
United States	31,255 (declared)	c. 7,700 (including retired)	83 metric tons (MT) (declared)	575 MT (declared)
Russia	c. 40,000 (high uncertainty)	c. 10,000 (including retired)	128 +/- 25 MT	646 +/- 120 MT
United Kingdom	c. 520	fewer than 225 (declared)	3.2 MT (declared)	c. 20 MT (declared)
France	c. 540	fewer than 300 (declared)	6 +/- 1.2 MT	20 +/- 5 MT
China	c. 240	c. 240	1.8 +/- 0.4 MT	16 +/- 4 MT
Israel	(unknown)	100–200	0.9 +/- 0.3 MT	0.3 MT (highly uncertain)
India	80–100	80–100	0.5 +/- 0.2 MT	2.4 +/- 0.8 MT
Pakistan	100–200	100–120	0.2 +/- 0.1 MT	3 +/- 1 MT
North Korea	fewer than eight	fewer than five	0.03 MT	(unknown)

The fact that there is no official figure for the total number of nuclear weapons in the world nor for the amount of fissile materials is a result of policy decisions by the nuclear weapon states often made decades ago. These decisions are in part a result of the institutional interests, culture, and habits of nuclear weapon complexes, which use nuclear secrecy as a way to reduce oversight, protect budgets, and exercise power over policy making.¹¹ It is noteworthy, however, that the United States has disclosed the number of its nuclear weapons (through 2009) and provided detailed declarations, with updates, of its fissile material stockpiles, while the United Kingdom has made less detailed declarations of its arsenal and fissile material production.¹² Given inadequate information, independent analysts have been left to make estimates, both of the size of nuclear weapon arsenals and of the fissile materials holdings.¹³

Over the past seventy years, vast amounts of fissile material have been produced to manufacture nuclear warheads for these weapon programs (see Table 1).¹⁴ One legacy of the Cold War is that the United States and Russia together account for almost all of the global production of military plutonium and HEU for military purposes.

Generally undertaken with great secrecy and urgency, and a single-minded focus on producing nuclear weapons, it is not surprising that fissile material production was

characterized by poor material accounting, as well as chronic environmental contamination and neglect of worker safety.¹⁵ There are today large uncertainties in the estimates of national plutonium and HEU inventories. On average, a modern thermonuclear warhead contains only about 15-20 kilograms (kg) of HEU and 3-4 kg of plutonium. The combined uncertainties in the estimates of global fissile material stocks are therefore equivalent to thousands of nuclear warheads.

With the end of the Cold War, Russia and the United States have begun to reduce their nuclear arsenals; similarly, the United Kingdom and France have reduced their arsenals by about half, and others will have to follow to achieve the goal of a nuclear-weapon-free world. As nuclear arsenals are reduced and nuclear weapons dismantled, large quantities of fissile materials are becoming excess for weapons and other military purposes. Most of this fissile material has not been placed under International Atomic Energy Agency (IAEA) safeguards to provide assurances that it is not secretly returned to weapon use; by contrast, non-weapon states in the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) are required to place all fissile materials under IAEA safeguards.

In 2009, UN High Representative for Disarmament Affairs Sergio Duarte explained how transparency was linked to and underpinned the disarmament goals of the NPT:

Transparency is not a dispensable option for ensuring accountability under the treaty, both with respect to non-proliferation and disarmament commitments, as well as to peaceful uses. If there is little or no transparency, how are the States parties supposed to assess progress in achieving the goals of the treaty, especially with respect to disarmament? Basic facts about weapon production, stockpiles, and holdings of fissile material are absolutely essential in the establishment of a "base line" from which to assess progress in disarmament. Without such facts, how is the whole "confidence-building" function of transparency to be achieved? If states are to rely exclusively upon discretionary reporting on progress in disarmament, on what grounds can a stricter standard be applied to assess compliance in non-proliferation?¹⁶

This view has gained ground and support among states. NPT non-weapon states and the larger international community have encouraged and supported increased transparency by the nuclear weapon states. In some cases, non-weapon states have made specific proposals for transparency measures that could contribute to the disarmament process.¹⁷

The NPT weapon states have also started to recognize the imperative of greater openness. The five NPT weapon states—China, France, Russia, the United Kingdom, and the United States—have met in London (2009), Paris (2011), Washington, DC (2012), and Geneva (2013) to discuss, among other issues, those of "confidence-building, transparency, and verification experiences."¹⁸ For some of these states, this initiative has come about because of the demands of international politics and the need to present an image of compliance with NPT disarmament obligations. Domestic pressure from civil society-based peace movements also has led to greater openness about nuclear weapons and fissile material holdings as part of national policy debates.

In sum, the value of nuclear openness or transparency to the goal of disarmament is that it serves to provide a means of establishing public confidence in judgments about the nuclear capabilities of states and lays a basis for informed debate and participation in decisions on these capabilities by citizens, national policy makers, and the international

community. Agreement on transparency arrangements between states can serve to enhance mutual confidence. As part of a system to verify compliance with bilateral or multilateral arms control or disarmament treaty obligations, transparency arrangements become a basis for collective international security and order.

Proposals for Increasing Transparency

The “Action Plan on Nuclear Disarmament” agreed upon at the 2010 NPT Review Conference affirmed “the need for the nuclear-weapon states to reduce and eliminate all types of their nuclear weapons.”¹⁹ It also was agreed that “nuclear disarmament and achieving the peace and security of a world without nuclear weapons will require openness and cooperation, and ... enhanced confidence through increased transparency and effective verification.”²⁰

Item 19 of the Action Plan contained the commitment: “All States agree on the importance of supporting cooperation among Governments, the United Nations, other international and regional organizations and civil society aimed at increasing confidence, improving transparency and developing efficient verification capabilities related to nuclear disarmament.”

Under the terms of the Action Plan, the NPT nuclear weapon states agreed to these measures and to provide regular reports on progress on such steps.²¹ The nuclear weapon states are expected to report to the NPT Preparatory Committee in 2014 on their progress, with the 2015 Review Conference charged to “take stock and consider the next steps” toward nuclear disarmament.²²

To support this process, IPFM has proposed a specific set of transparency and related measures that nuclear weapon states could adopt by 2015 for later implementation. These are summarized below.

As a first step, the nuclear weapon states could make baseline declarations of the total numbers of nuclear warheads in their possession as of a specific recent date with a commitment to release subsequent annual updates.

Since nuclear weapon states may have developed different terms to describe the status of their nuclear warheads, they could develop a shared terminology to describe nuclear warheads and warhead components, and their deployment, storage, and stages of dismantlement. This would make their declarations comparable and consistent over time. One option to provide a basic level of transparency of their strategic nuclear arsenals would be for the United Kingdom, France, and China (and the non-NPT nuclear weapon possessors) to adopt the reporting structure agreed upon by Russia and the United States in their 2011 New Strategic Arms Reduction Treaty.

Future arms control agreements could begin to place limits on tactical weapons, non-deployed weapons, and the *total* number of nuclear weapons in national arsenals. Such agreements would require fundamentally new verification approaches to establish confidence in the completeness of declarations that weapon states make for their historic and current nuclear warhead inventories. Because fissile materials are the key ingredients of nuclear weapons, transparency measures to enable such verification could usefully

include declarations about nuclear weapon states’ fissile material stocks, as well as the history of production and evolution of the fissile material stockpile.

As part of their baseline declarations, by 2015, NPT nuclear weapon states could therefore also make public:

- Total holdings of plutonium and of HEU as of a specific, recent date;
- HEU and plutonium in other states and any foreign-owned material in country;
- The portions of their HEU and plutonium stockpiles available for IAEA safeguards.

All nuclear weapon states historically have attached great importance to maintaining secrecy about their warhead stockpiles. This secrecy began to lift—for some states—following the end of the Cold War. The United States has been the most transparent among the nuclear weapon states in making public information about its nuclear warhead stockpile and its production and stockpiles both of HEU and plutonium.²³

One assessment of the challenges of producing the US fissile material declarations has highlighted the problem of incomplete or missing records and the importance of organizing and archiving all the information needed to construct the declarations.²⁴ It also makes clear the value of binding commitments to transparency and reporting for overcoming political and institutional barriers to making declarations.

There is a precedent for regular declarations by some weapon states of one part of their respective national fissile material stockpiles. Nine states (Belgium, China, France, Germany, Japan, the Russian Federation, Switzerland, the United Kingdom, and the United States) have made annual declarations of civilian plutonium holdings since 1997. These declarations are known as the “Guidelines for the Management of Plutonium” and published each year by the IAEA as INFCIRC/549. The United Kingdom, Germany, and France declare civilian HEU as part of their INFCIRC/549 declarations, but the other states do not. The Guidelines could be broadened to include HEU and the weapon states making these declarations could include information on fissile material in weapon programs.²⁵

The 2010 NPT Review Conference Final Document encourages the nuclear weapon states “to declare, as appropriate, to the International Atomic Energy Agency (IAEA) all fissile material designated by each of them as not required for military purposes and to place such material as soon as practicable under IAEA or other relevant international verification and arrangements for the disposition of such material for peaceful purposes.” To this end, the NPT weapon states could declare and place under IAEA safeguards:

- all plutonium and HEU in civilian use;
- all plutonium and HEU recovered from excess weapons or its nuclear weapon complex and declared excess for weapon purposes; and
- all plutonium and HEU going to waste disposal sites.

Given the goal of further reductions and eventual elimination of nuclear weapons, the NPT weapon states should agree to begin to prepare information about their warhead and fissile material stockpiles for later disclosure in the context of deep cuts agreements.

At the 2015 NPT Review Conference, the weapon states could commit to greater openness about their nuclear forces and lay the basis for future exchanges of information similar to those undertaken biannually by the United States and Russia on:

- the locations of deployed delivery vehicles and the number of deployed warheads at each operational base;
- the assignment of a unique identification number to each missile, aircraft, and missile launcher, whether deployed or not.

The weapon states could also agree to prepare national records that would allow them to declare:

- total nuclear warhead stockpiles by year and numbers of warheads built, retired, and dismantled each year; and
- plans for future warhead production, life-extension, deployment, and disassembly for the next five years.

Along with preparing warhead and delivery system records, the weapon states could take similar steps regarding their fissile material production and lay the basis for declaring:

- shut down fissile material production facilities, the state of shutdown, and their decommissioning or conversion plans; and
- HEU and plutonium production and related waste production and disposal records.

Finally, by the 2015 NPT Review Conference, the weapon states could agree to pursue new cooperative projects, with IAEA participation where possible, to develop and demonstrate approaches that could allow verification of all these declarations. Russia and the United States are currently conducting inspections at strategic nuclear weapon deployment sites and related facilities. It will be particularly important to develop approaches for verifying warhead dismantlement. This would provide confidence that warheads have been destroyed as part of arms control agreements and assurance that the fissile material contained in the warheads was recovered and accounted for.

Verification of declarations of historical fissile material production would require access to former fissile material production sites, operating records, and waste materials. To make this possible, weapon states should, as soon as possible:

- catalog and preserve operating records and waste materials.

Assessing the completeness and accuracy of weapon state fissile material declarations will require independently reconstructing the operating history of production facilities. States could work together to develop the appropriate technical methods of “nuclear archaeology” to do so. Cooperative projects could aim to develop the tools for nuclear-forensic analysis of samples from structural or waste materials from:

- dedicated plutonium production reactors;
- high-level waste from military reprocessing plants;
- gaseous diffusion, electromagnetic, and centrifuge uranium enrichment facilities that were used for HEU production; and

- depleted uranium stored at enrichment facilities.

Since former production facilities are mostly shut down, priority for nuclear archaeology projects should be given to facilities being prepared for decommissioning and for waste materials scheduled for elimination or processing for long term storage that may erase critical information. To help establish the potential contribution of nuclear archaeology to achieving verifiable nuclear disarmament, nuclear weapon states might cooperate with the IAEA in an international study to clarify the capabilities and limits of nuclear archaeology, for instance, by designating one production site each as a test bed.

The experience of US-Russian cooperation in developing approaches and tools for nuclear warhead verification and for nuclear archaeology demonstrates the success of research and development efforts in the areas of cooperatively monitoring nuclear warheads and their dismantlement and in reconstructing plutonium production histories in some kinds of production reactors.²⁶ Successful development of nuclear weapon and fissile material verification procedures and technologies will likely require more such collaborative research and development efforts and may be carried out on a bilateral or multilateral basis between weapon states as well as non-nuclear weapon states. In particular, weapon states will need to rethink what information needs to be treated as secret since secrecy is a fundamental obstacle to comprehensive verification of nuclear disarmament.

Toward More Openness

Seventy years ago, Niels Bohr proposed that openness and cooperation were required to control the danger of nuclear weapons and fissile materials. Today, this realization has become a central feature of international nuclear politics. There are a growing number of detailed openness proposals from states and civil society groups involving public declarations by the weapon states of their nuclear weapon and fissile materials holdings, production histories, and plans.

Accurate, up-to-date, and complete declarations of nuclear weapon and fissile material stocks are urgently needed to establish and help confirm progress toward nuclear disarmament. International and domestic demands for greater openness by nuclear weapon states through increased transparency can play an important role in achieving this goal. Cooperation in verification activities among nuclear weapon states and with non-weapon states would be an important trust- and confidence-building measure that would create institutional arrangements to support the nuclear disarmament process.

NOTES

1. Niels Bohr, “Memorandum to President Roosevelt,” July 3, 1944, in Niels Bohr, *Collected Works, Volume 11: The Political Arena (1934–1961)*, Finn Aaserud, ed., (Amsterdam: Elsevier, 2005), pp. 101–08.
2. International Panel on Fissile Materials, *Global Fissile Material Report 2013: Increasing Transparency of Nuclear Warhead and Fissile Material Stocks as a Step toward Disarmament*, October 2013, <www.ipfmlibrary.org/gfmr13.pdf>.
3. Ibid.

4. The Panel's twenty-nine members include nuclear experts from Brazil, Canada, China, France, Germany, India, Iran, Japan, South Korea, Mexico, the Netherlands, Norway, Pakistan, Russia, South Africa, Sweden, the United Kingdom, and the United States. IPFM research and reports are shared with international organizations, national governments, and nongovernmental groups. Key documents are available at <www.fissilematerials.org> and <www.fissilematerials.org/blog>.
5. White House Press Release on Hiroshima, Statement by the President of the United States, August 6, 1945, Harry S. Truman Library and Museum, <www.trumanlibrary.org/whistlestop/study_collections/bomb/large/documents/pdfs/59.pdf>.
6. Niels Bohr, "Open letter to the United Nations," June 9, 1950, in Bohr, *Collected Works, Volume 11*, pp. 173–86.
7. *Report by the Panel of Consultants of the Department of State to the Secretary of State*, January 1953, in *Foreign Relations of the United States, 1952–1954: Volume II, Part 2, National Security Affairs*, US Government Printing Office, Washington, DC, 1983 <history.state.gov/historicaldocuments/frus1952-54v02p2/d67>.
8. *Ibid.*
9. United Nations Security Council Resolution S/RES/1887, 2009, states that the Security Council resolves "to seek a safer world for all and to create the conditions for a world without nuclear weapons, in accordance with the goals of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), in a way that promotes international stability, and based on the principle of undiminished security for all."
10. Randy Rydell, "Nuclear Weapon State Transparency, the Nuclear Non-Proliferation Treaty and the United Nations," in International Panel on Fissile Materials, *Global Fissile Material Report 2013*, pp. 39–49.
11. See e.g., Stephen I. Schwartz, ed., *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons Since 1940*, (Washington DC: Brookings Institution Press, 1998). See also, Hans Born, Bates Gill, Heiner Hånggi, eds., *Governing the Bomb: Civilian Control and Democratic Accountability of Nuclear Weapons*, (Oxford: Oxford University Press, 2010).
12. For details, see Peter Dessaules, "Challenges of Producing National Fissile Material Declarations," in International Panel on Fissile Materials, *Global Fissile Material Report 2013*, pp. 59–70.
13. For estimates of nuclear warheads, see Hans Kristensen and Robert S Norris, "Nuclear Warhead Stockpiles and Transparency," in International Panel on Fissile Materials, *Global Fissile Material Report 2013*, p. 9.
14. Figures for stockpile estimates of fissile material are rounded. For details, see International Panel on Fissile Materials, *Global Fissile Material Report 2013*, p. 8–26.
15. See, for example, Schwartz, *Atomic Audit*, pp. 353–43; Arjun Makhijani, Howard Hu, and Katherine Yih, eds., *Nuclear Wastelands: A Global Guide to Nuclear Weapons Production and its Health and Environmental Effects*, (Cambridge: MIT Press, 1995).
16. Duarte, "Perspectives for an Increase in Accountability and Transparency through International Mechanisms for Nonproliferation," cited in Rydell, "Nuclear Weapon State Transparency," p. 41.
17. The ten-nation Non-Proliferation and Disarmament Initiative (NPDI) has sought to "promote transparency in nuclear disarmament reporting," and in 2012, the NPDI states presented a model reporting form that weapon states could consider to develop "a draft standard nuclear disarmament reporting form." See "Transparency of nuclear weapons: the Non-Proliferation and Disarmament Initiative," Working paper submitted by Australia, Canada, Chile, Germany, Japan, Mexico, the Netherlands, Poland, Turkey and the United Arab Emirates, 2012 NPT Prepcom, NPT/CONF.2015/PC.I/WP.12, 20 April 2012, <www.un.org/ga/search/view_doc.asp?symbol=NPT/CONF.2015/PC.I/WP.12>.
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19. For the "Action Plan on Nuclear Disarmament," see "2010 NPT Review Conference Final Document, Vol. 1," New York, 2010, pp. 19–21, <www.un.org/en/conf/npt/2010>.
20. *Ibid.*
21. *Ibid.*, p. 24, Action 20: "States parties should submit regular reports, within the framework of the strengthened review process for the Treaty, on the implementation of the present action plan... ." Action 21: "As a confidence-building measure, all the nuclear-weapon States are encouraged to agree

as soon as possible on a standard reporting form and to determine appropriate reporting intervals for the purpose of voluntarily providing standard information... ."

22. Ibid., p. 21, Action 5: "The nuclear-weapon States commit to accelerate concrete progress on the steps leading to nuclear disarmament ... [and] are called upon to report ... to the Preparatory Committee at 2014."
23. The United States has released detailed declarations, with updates, of its fissile material stockpiles: the plutonium declaration covering the period 1944–94 was released in 1996, and updated in 2012 to cover the period up to 2009; the HEU declaration for the period 1944–96 was completed in 2001, publicly released in 2006, and updated in 2006 to cover the period up to 2004. See Dessales, "Challenges of Producing National Fissile Material Declarations," pp. 59–70.
24. Ibid.
25. Fred McGoldrick, "The International Plutonium Guidelines," in International Panel on Fissile Materials, *Global Fissile Material Report 2013*, pp. 71–81.
26. James Fuller, "Nuclear Archaeology and Warhead Verification Collaborations," in International Panel on Fissile Materials, *Global Fissile Material Report 2013*, pp. 82–89.