Verifiable Declarations of Fissile Material Stocks: Challenges and Solutions

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UNIDIR RESOURCES

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The issue of existing stocks of fissile materials is among the most contentious questions that have emerged from the discussions of a treaty that would limit production of fissile materials for nuclear weapons, an FM(C)T. There has been consistent and growing support for the treaty that in addition to limiting future production, includes already produced materials into its scope.[1] The issue is likely to remain controversial, especially since it cannot be separated from other steps toward nuclear disarmament and the broader context of international security. It is important, however, to recognize that aside from the general political question on whether an effective arrangement that bans production of fissile materials should also cover existing stocks, there are a number of practical and technical issues that would have to be addressed for this coverage to become possible. One of these issues is declarations of the current fissile material holdings.

It has been widely recognized that declarations of the amounts of weapon-usable fissile materials held by the States would be an important confidence-building measure (CBM) and could represent a significant step toward reductions and the eventual elimination of nuclear weapons. This issue has been repeatedly raised during the Nuclear Non-proliferation Treaty (NPT) review process as part of an effort to increase transparency in nuclear disarmament.[2] In expressing their views on the future fissile material ban treaty, a number of States advocated measures that would increase transparency of existing stocks.[3] A number of important technical studies supported the idea of declarations and explored various implementation options.[4] In a very important step, the United States took the initiative in releasing detailed information about past production of military fissile materials and its

1 United Nations, *Report of the Group of Governmental Experts to Make Recommendations on Possible Aspects That Could Contribute to but Not Negotiate a Treaty Banning the Production of Fissile Material for Nuclear Weapons or Other Nuclear Explosive Devices*, A/70/81, 7 May 2015, Para 6, 7.

2 Preparatory Committee for the 2015 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, "Transparency of Nuclear Weapons: The Non-Proliferation and Disarmament Initiative", 20 April 2012. .

3 United Nations, *Treaty Banning the Production of Fissile Material for Nuclear Weapons or Other Nuclear Explosive Devices. Report of the Secretary-General*, 16 July 2013, http://www.unog.ch/80256EDD006B8954/(httpAssets)/3FA91170E91A8E83C1257CAF00303C49/$file/A-68-154.pdf.

4 International Panel on Fissile Materials, *Global Fissile Material Report 2009: A Path to Nuclear Disarmament*. Fourth Annual Report of the International Panel on Fissile Materials, 2009, http://ipfmlibrary.org/gfmr09.pdf; Nuclear Threat Initiative, "Innovating Verification: New Tools & New Actors to Reduce Nuclear Risks. Verifying Baseline Declarations of Nuclear Warheads and Materials", *Cultivating Confidence Verification Series*, July 2014, http://www.nti.org/media/pdfs/WG1_Verifying_Baseline_Declarations_FINAL.pdf.

current stocks. The United Kingdom has also published an account of fissile materials in its military program.

Despite the significant progress that has been made in the past twenty years, a number of political and technical issues remain unresolved and the international community has yet to develop an approach toward declarations of existing stocks of fissile materials that would make a meaningful contribution to nuclear disarmament and that would be accepted by all States that have fissile materials in their possession. One of the most difficult issues that would have to be addressed is making sure that the declarations can be verified for correctness and completeness. Given that significant amounts of fissile materials remain in active inventories, some of which are in nuclear weapons, verifiability of declarations presents a serious challenge to the future fissile materials treaty.

This paper presents an overview of the issues associated with declarations of existing stocks of fissile materials in the context of a future FM(C)T with a focus on the challenge of verification. Even though it is far from certain that the treaty will include provisions related to existing stocks, this paper assumes that it will and considers some potential approaches to verification of initial declarations that may be incorporated in the treaty.

The role of initial declarations in an FM(C)T

Initial declarations are essential elements of virtually any arms control and disarmament agreement. Since declarations provide a baseline for limitations and reductions, they play an important role in the treaty's implementation. This means that the treaty should include a mechanism for verification of initial declarations, which would allow to detect and deter actions that would constitute material violation of the treaty obligations.

There are several different roles initial declarations of existing fissile material stocks can play in the future FM(C)T. First, it has been suggested that even if the treaty does not include any provisions regarding existing stocks, declarations could be a valuable confidence-building measure and could provide a broad measure of progress toward nuclear disarmament. In this case the treaty would not have to include a verification mechanism, since declarations would have no bearing on the central obligation of the treaty, which is to stop production of fissile material for weapons. It is likely that verification activities designed to monitor the ban on production would help increase confidence in initial declarations, for example by granting access to facilities involved in production in the past, but unless the treaty includes specific provisions that address existing stocks and past production, declarations will remain essentially unverifiable.

Another role that declarations may play in the FM(C)T context also applies to the case when the treaty does not directly address the already existing stockpiles. Discussions thus far of the verification provisions of the future treaty have demonstrated that there is some support for the idea that specific verification objectives, such as quantity of diverted material to be detected or timeliness of detection, may depend on the size of the fissile material stock in the inspected State.[5] According to this argument, diversion of several kilograms of fissile material would have different consequences in States with tens of tons or tens of kilograms of material in their inventory. It is also assumed that the verification objectives will become universal as States reduce their fissile material holdings. Although it is far from

5 For example, the U.S.–Russia–IAEA Trilateral Initiative considered using one percent of the inventory as a significant quantity of a material. "Verifying Baseline Declarations", op. cit., 61.

certain that this approach will receive support at the negotiations, it should be noted that its implementation would require parties to formally declare the amount of fissile materials in their arsenals.[6] As these declarations will have legal consequences for the monitoring provisions to be applied in a State, they would have to be open to verification.

Finally, in the most ambitious proposals, in addition to a ban on production the future treaty would include an obligation to eliminate all existing stocks of weapon-usable fissile materials or to place all these materials under safeguards comparable to the International Atomic Energy Agency (IAEA) safeguards accepted by non-nuclear weapon members of the NPT. Strictly speaking, it is possible to design elimination arrangements that would not require initial declarations of stocks. Declarations, however, would significantly enhance the integrity of this process and probably are critical for its success. In this case, it would be essential for the treaty to include a mechanism for verifying declared amounts of fissile materials as well as measures specifically designed to provide access to information about past production.

As mentioned earlier, a number of States have indicated their opposition to extending the scope of the future treaty to existing stocks and expressed serious doubts about the feasibility of designing a system that would provide effective verification of initial declarations. At the same time, the technical work in this area suggests that there are no fundamental reasons why this system cannot be created.

Current status of declarations

The information about global stocks of fissile materials that is available today is incomplete and extremely fragmented. It has been estimated that as of the end of 2014 the global inventory of weapon-usable materials included 13703125 tons of highly-enriched uranium and 506310 tons of separated plutonium.[7] The large absolute uncertainty of these estimates reflects the lack of accurate information about the largest fissile material stock, held by the Russian Federation. The accuracy of estimates, however, is rather low for almost all States that possess nuclear weapons.

In NPT non-nuclear weapon States, all fissile materials are subject to IAEA safeguards, so the Agency has full access to the information about quantities of the material and the material handling facilities. However, the IAEA is not allowed to disclose this information or share with other Member States.[8] The only information that is released publicly by the IAEA is the total amount of material under safeguards by the type of material and the type of agreement.[9] The Agency does not provide country-specific information.

A number of States provide information about some of their fissile material stocks on a voluntary basis. In 1998, nine States—Belgium, China, France, Germany, Japan, the Russian Federation, Switzerland, the United States, and the United Kingdom—agreed to abide by voluntary plutonium management guidelines, which include submitting annual reports on

6 See, for example, the discussion in "GGE Report", op. cit., para 44–45.

7 International Panel on Fissile Materials, *Global Fissile Material Report 2015*, 2015, http://ipfmlibrary.org/ipfm15.pdf; International Panel on Fissile Materials, "Fissile Material Stocks", 2016, http://fissilematerials.org/.

8 The model safeguard agreement specifies that "the Agency shall not publish or communicate to any State, organization or person any information obtained by it in connection with the implementation of the [Comprehensive Safeguards] Agreement." "The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons [INFCIRC/153 (Corrected)]" (International Atomic Energy Agency, 1972), Para. 5.

9 IAEA, *IAEA Annual Report 2014*, 2015, 127, https://www.iaea.org/sites/default/files/gc59-7_en.pdf.

the amount of civilian plutonium that they possess.[10] These reports include information on the amount of separated plutonium owned by the State or stored on its territory as well as an estimate of the amount of plutonium in the irradiated fuel of nuclear reactors. The scope of these declarations vary from country to country. Non-nuclear weapon States report all their plutonium. Of the nuclear weapon States, France and the United Kingdom include information about the material that is placed under IAEA/Euratom safeguards. The United States reports as civilian the military-origin plutonium that was declared excess to military needs. The Russian Federation and China report the plutonium that was separated from irradiated fuel of civilian power reactors.[11] Three of the INFCIRC/549 States— France, Germany, and the United Kingdom—also include information about their civilian stocks of highly enriched uranium (HEU) that are covered by the IAEA/Euratom safeguards.

In addition to its INFCIRC/549 report submitted to the IAEA, Japan publishes an underlying annual national report on the status of plutonium management.[12] The national report provides a more detailed account of the amounts of plutonium and facilities that handle it than the report submitted to the IAEA. The United Kingdom also publishes an annual national plutonium report, which is identical to the one it submits to the IAEA.

Only two nuclear weapon States released information about their military fissile materials stocks. The Unites States has published detailed accounts of its plutonium and HEU production and use, and has issued a number of updates.[13] The United Kingdom also published a report on its military HEU material balance as well as some information about its military plutonium stock.[14] No other State that possesses nuclear weapons released information about fissile materials produced by its military program.

Table 1 lists estimates of the amount of fissile materials in NPT nuclear weapon States and States that are not NPT members produced by the International Panel on Fissile Materials.[15]

10 IAEA, "INFCIRC/549. Communication Received from Certain Member States Concerning Their Policies Regarding the Management of Plutonium", 16 March 1998, https://www.iaea.org/sites/default/files/infcirc549.pdf.

11 "2014 Civilian Plutonium (and HEU) Reports Submitted to IAEA", *IPFM Blog*, 12 October 2015, http://fissilematerials.org/blog/2015/10/2014_civilian_plutonium_a.html.

12 Japan Atomic Energy Commission, "Current Situation of Plutonium Management in Japan, accessed 19 July 2014, http://www.aec.go.jp/jicst/NC/iinkai/teirei/plutonium_management.htm.

13 US Department of Energy, "Plutonium: The First 50 Years. United States Plutonium Production, Acquisition, and Utilization from 1944 through 1994", February 1996; Department of Energy, "The United States Plutonium Balance, 1944–2009. An Update of Plutonium: The First 50 Years, DOE/DP-0137, February 1996", June 2012, http://fissilematerials.org/library/doe12.pdf; "Highly Enriched Uranium: Striking a Balance. A Historical Report on the United States Highly Enriched Uranium Production, Acquisition, and Utilization Activities from 1945 Through September 30, 1996" (U.S. Department of Energy, January 2001), http://fissilematerials.org/library/doe01.pdf; "Transparency in the U.S. Highly Enriched Uranium Inventory," *Whitehouse.gov*, March 31, 2016, https://www.whitehouse.gov/the-press-office/2016/03/31/fact-sheet-transparency-us-highly-enriched-uranium-inventory.

14 UK Ministry of Defence, "Historical Accounting for UK Defence Highly Enriched Uranium. A Report by the Ministry of Defence on the Role of Historical Accounting for Highly Enriched Uranium for the United Kingdom's Defence Nuclear Programmes", March 2006, http://fissilematerials.org/library/mod06.pdf; "The United Kingdom's Defence Nuclear Weapons Programme," n.d., www.ipfmlibrary.org/mod00b.pdf.

15 *Global Fissile Material Report 2015*, op. cit.

Table 1. Estimated national stocks of fissile materials

	HEU, tons	Non-civilian Pu, tons	Civilian Pu, tons
Russian Federation	679	128	52.8
United States	599	87.6	0
France	30.6	6	61.9
United Kingdom	21.2	3.2	104.2
China	18	1.8	0.025
India	3.2	5.7	0.4
Pakistan	3.1	0.19	0
Israel	0.3	0.86	–
North Korea	0	0.03	–
Others	15	–	52.8
TOTAL	1370	234	272

Numbers for the United States and the United Kingdom are based on their official reports. Most numbers for civilian plutonium are based on INFCIRC/549 declarations submitted to IAEA and reflect the status as of December 31, 2014. Other numbers are non-governmental estimates, often with large uncertainties.

The challenge of verifying fissile material declarations

At the most basic level, a declaration of the existing stocks should include two numbers disclosing the total amount of plutonium and HEU in a State's inventory.[16] A simple declaration, however, would not accurately reflect the status of the fissile material inventory and therefore would have only a limited practical value, especially from the point of view of its verifiability. To increase confidence in the information provided in the declaration, a State would have to disclose details of the material balance process that was used to obtain the reported amount of fissile material, such as the records of material production and removals from the inventory.

To understand the challenge of verifying initial declarations it is instructive to consider the IAEA practice of establishing comprehensive safeguards in States that had substantial pre-existing stocks of fissile materials, such as the former Soviet Union States. In the case of South Africa, the State had a significant history of fissile material production. At the beginning of this process a State submits an initial nuclear material inventory report, which contains a detailed physical inventory listing for each material balance area within its facilities that handle fissile materials.[17] This report provides a starting point for a cooperative verification programme that establishes correctness and completeness of the listing. During this process, the IAEA carries out physical inventory verification at all declared facilities that handle fissile materials and, when necessary, examines historical operating records of

16 *Global Fissile Material Report 2009*, op. cit., 35. It is normally assumed that the amounts of plutonium and highly enriched uranium would be reported separately. Should the FM(C)T include other isotopes, such as neptunium or americium, in its scope, amounts of these materials would be reported separately as well.

17 IAEA, *Guidance for States Implementing Comprehensive Safeguards Agreements and Additional Protocols*, 2014, 21, http://www-pub.iaea.org/MTCD/Publications/PDF/SVS-21_web.pdf.

all active and decommissioned production facilities.[18] The verification process is expected to discover discrepancies between the initially submitted physical inventory listing and the actual verified physical inventory. It is also expected to identify some material unaccounted for (MUF or inventory difference), which is the difference between the measured inventory and the amount of material held according to material accounting records. Inventory differences do not necessarily indicate an actual loss (or gain) of material. They would, however, require an investigation if the verification procedure is expected to provide assurances of non-diversion of material.

Accounts of their fissile material inventories published by the United States and the United Kingdom provide an illustration of the potential magnitude of the challenge of closing the material balance on a State-wide scale in a programme with a long history of fissile material production. In its most recent plutonium account, the United States reported a difference of 2.4 tons of plutonium out of the total measured inventory of 95.4 tons.[19] In another example, the United Kingdom reported the audited stock of HEU of 21.86 tons, while the material balance amount was 21.64 tons – an apparent gain of 0.22 tons of material.[20] As can be expected, most inventory differences occurred at the early stages of nuclear programs.[21]

In general, for the purposes of an assessment of prospects of verifying fissile materials declarations that may be submitted by States with nuclear weapons, it is useful to distinguish between two different challenges. First, verification would have to involve taking a detailed physical inventory of the entire fissile material stock to provide a basis for a conclusion about correctness of the declaration. Second, verification would have to examine material balance records to ensure both correctness and completeness of the declared data.

The most difficult problem with taking physical inventory in a State that maintains an active arsenal of nuclear weapons is that it would require having full or selective access to materials in nuclear warheads, including those in operationally deployed weapons. It is highly unlikely that any State would grant this kind of access to any verification body. Indeed, in the current practice even such information as the average fissile material content in active nuclear weapons is considered sensitive from both the national security and nuclear proliferation points of view.

Another problem related to physical inventory is the difficulty of carrying out accurate measurements of fissile material content in some forms, especially the material in waste or abandoned material. Some of this material can be considered disposed of for the purposes of national accounting, even if its recovery is within the capability of the host State. For example, the standard for termination of domestic safeguards accepted in the United States assumes that the removed material is protected from subnational theft and diversion, which is different from the IAEA standard that requires that the material should be "practically

18 Adolf von Baeckmann, Garry Dillon, and Demetrius Perricos, "Nuclear Verification in South Africa", *IAEA Bulletin*, no. 1 (1995), 42–48; Olli Heinonen, "Verifying the Dismantlement of South Africa's Nuclear Weapons Program", in *Nuclear Weapons Materials Gone Missing. What Does History Teach?*, ed. Henry Sokolski (The Nonproliferation Policy Education Center, 2014), 89–95, http://belfercenter.hks.harvard.edu/files/Verifying%20the%20Dismantlement%20-%20Heinonen%20Chapter%208.pdf.

19 This means that the measured inventory was 2.4 tons less than the amount reflected in the records. "The United States Plutonium Balance, 1944–2009", op. cit., 4.

20 "Historical Accounting for UK Defence Highly Enriched Uranium", op. cit.

21 According to the U.S. plutonium report, "68% of the inventory difference occurred during the period prior to the late 1960s". "Plutonium: The First 50 Years", op. cit., 53.

irrecoverable".[22] Indeed, the U.S. standard includes provisions for returning once terminated material to the active inventory.[23]

One example of material that has been removed from the inventory but may be considered recoverable is the material that is left at nuclear test sites. In Kazakhstan, significant amounts of plutonium (and HEU) were left behind at the Semipalatinsk test site by the extensive underground nuclear test programme carried out there by the Soviet Union. Although the cost of recovery of this material would be quite substantial, the plutonium was apparently considered to be vulnerable to recovery by subnational groups. To prevent diversion, the United States in close cooperation with Kazakhstan and the Russian Federation launched a dedicated program, completed in 2012, to secure this material in place to reduce its attractiveness. This material has never been declared to the IAEA and apparently has not been included in any national inventory.[24]

Verification of material balance records would also present a very difficult problem. Most nuclear weapon programmes are at more than fifty years old, so it is possible that some operating records are no longer available. Many fissile material production facilities have been modified, converted, decommissioned, or demolished making verification of production records extremely difficult. To some extent the fissile material production history can be reconstructed with the help of nuclear archaeology. Nuclear forensic analysis can provide valuable help with verifying the amount of material produced at a facility. This effort, however, would require physical access to the production sites and materials as well as significant degree of cooperation from the host State.[25]

Verifying removal of material from accountable inventory may prove even more challenging. For example, according to the U.S. reports, most of the plutonium removed from the inventory was discarded as waste. In the case of HEU, a large quantity of material was used in naval reactor fuel. Nuclear tests also consumed very large amounts of U.S. plutonium and HEU. Unlike production, removals in most cases leave no physical evidence that can be independently examined and therefore can be extremely difficult to verify.

Potential approaches to verification

The difficulty of getting access to fissile material inventories and material balance records suggests that full validation of initial declarations would be an extremely complex undertaking that would require full cooperation of the host State. In countries with large fissile material stocks and with substantial history of production verification can take decades and may never be fully completed.

The most common approach to addressing the verification challenges calls for gradual introduction of transparency, in which would States would begin by releasing limited information about their fissile material inventories, such as the aggregate amounts of materials, and then would increase the amount of disclosed information and grant access to

22 IAEA, *IAEA Safeguards Glossary*, 2002, para 2.12.

23 US Department of Energy, "Nuclear Materials Control and Accountability. DOE Standard DOE-STD-1194-2011", June 2011, 39, http://www.energy.gov/sites/prod/files/2013/09/f2/DOE-STD-1194-2011_CN2.pdf.

24 See Eben Harrell and David E. Hoffman, "Plutonium Mountain: Inside the 17-Year Mission to Secure a Legacy of Soviet Nuclear Testing", Project on Managing the Atom, Belfer Center for Science and International Affairs, Harvard Kennedy School, 15 August 2103, http://belfercenter.ksg.harvard.edu/files/Plutonium%20Mountain-Web.pdf.

25 "Nuclear Archaeology", in *Global Fissile Material Report 2009*, op. cit., 52–62.

key facilities and historical records in a manner that would build confidence in correctness and completeness of the released data. It is also important that this process would allow the international community to develop understanding of past production activities and to build the technical and institutional capacity that would support effective verification of the data.[26] In the end, it is generally understood that a conclusion about correctness and completeness of declarations would have to be based on the record of openness and cooperation demonstrated by the inspected State as well as on the analysis of technical data.

The gradual approach to verification is probably the only practical way to deal with the issue. However, it may not be fully compatible with the requirements of a legally binding treaty that includes obligations regarding existing stocks. This treaty would presumably have to include specific reporting and verification provisions that would be applied at the time it enters into force.

There are probably a number of ways to address this issue. First of all, initial declarations of fissile material inventories could be a valuable element of the treaty even if the treaty does not provide a mechanism to verify them. The absence of verification provisions does not mean the absence of verification. The history of arms control and disarmament has examples of treaties that did not include verification provisions, relying instead on national technical means for verification. Although inventories of fissile materials cannot be easily verified by national technical means, the value of this approach should not be underestimated. As the analysis conducted by independent experts demonstrates, in most cases the size of national fissile material stocks can be estimated based on publicly available data, so even simple declarations of aggregate amounts of material can be checked for consistency.[27] Information available to national governments would probably significantly improve accuracy of these estimates. Detailed reports on the status of inventories, similar to the ones released by the United States and the United Kingdom would further increase confidence in the provided data. As long as the limitations of this approach are well understood, it could meet some requirements of the treaty.

It is also possible to develop other approaches to verification of initial declarations of fissile material inventories, including ones that could provide a greater degree of confidence in the accuracy of declarations and that could support the goals of verified reduction and elimination of military fissile material stocks. These proposals must address the verification challenges outlined earlier in this paper, namely the lack of access to fissile materials in active inventories and the difficulty of accurate verification of the historical material balance records.

One possible arrangement of this kind, which may be called “deferred verification,” would take advantage of the fact that fissile material inventories and the facilities that handle them can be separated into two distinct segments. The first segment would include material in active inventory as well as all the facilities that handle the material. Deployed nuclear warheads and warheads in active arsenal and reserve would also be assigned there. By design, the amount of fissile material in this segment would be known with very high accuracy. This amount would be reported as one part of the initial declaration of the inventory. The segment, however, would not be available for any verification or monitoring

26 “Declarations of Fissile Material Stocks and Production”, ibid., 32–41; “Verifying Baseline Declarations”, op. cit.

27 International Panel on Fissile Materials, *Global Fissile Material Report 2010: Balancing the Books: Production and Stocks*, 2010, http://ipfmlibrary.org/gfmr10.pdf.

activity, such as an independent physical inventory. The subsequent discussion will refer to it as a "closed segment."

The second, "open", segment would include the rest of the nuclear complex and, importantly, all current and former production facilities as well as all sites that may have waste containing fissile materials or abandoned material. As discussed earlier, the quantity of the material in the open segment could only be known with limited accuracy; it will be included in the initial declaration with the understanding that this number may be updated and corrected in the course of verification activities. And as the name implies, the key characteristic of the open segment is that it would be open for verification.[28]

If a State is concerned that a declaration of the amount of material in the closed segment might disclose sensitive information about its active nuclear arsenal it could add any amount of additional material there to mask that information. Indeed, as long as the overall quantity of material in the closed segment is known with high accuracy, the exact amount it contains is not particularly important. Once the amount of material in the closed segment is declared, however, it would be necessary to design arrangements that would ensure that no new material is added there. Removals, on the other hand, would be allowed. Any fissile material that becomes excess for military purposes could be removed from the closed segment as long as it is done in a verified manner, so the amount of material remaining in the closed segment is always known with high accuracy.

Verification of the initial declarations would be done in different ways for the open and closed segments of the nuclear complex, although in each case it would probably take a considerable period of time.

For the closed segment, the definitive check of the accuracy of the initial declaration would be deferred until the time when all material is removed from that part of the nuclear complex or when it is made available for a complete physical inventory. Since any removals from the closed segment would be independently verified, it should be possible to close the material balance for the entire segment with very high accuracy and guarantee that all material is accounted for.

Providing a similar guarantee for the open segment would be a more difficult task because of the uncertainties described earlier. Verification activities in this part of the nuclear complex would probably follow the gradual approach outlined above. Initial declaration of the amount of material would be followed by a release of a more detailed account of the structure of the inventory and uses of that material, the history of production and removals. Access to former and current production facilities as well as to the material storage and disposition sites would gradually increase confidence in the absence of undeclared materials outside of the closed segment, even if the accurate verification of the initial declaration would be technically impossible.

The deferred verification approach is probably one of the many ways to deal with the inherently difficult issue of initial declarations. It has yet to demonstrate that it could serve as a basis for a practical verification mechanism. It does suggest, however, that such problems

28 Activities associated with production and use of fissile materials for military non-weapon purposes, such as naval fuel, would have to be assigned to the open segment. These activities would be generally open for verification, although specific verification procedures may be different from those applied to civilian material. See Pavel Podvig, "Fissile Material (Cut-Off) Treaty: Elements of the Emerging Consensus", UNIDIR, 2016, http://www.unidir.org/files/publications/pdfs/fissile-material-cut-off-treaty-elements-of-the-emerging-consensus-en-650.pdf.

as the lack of access to materials in active inventories and the uncertainty associated with past production may not present an insurmountable obstacle on the way toward building effective arrangements for verifying initial declarations of fissile material inventories.

In conclusion, it should be noted that although development of effective verification measures presents a considerable challenge, getting political support for comprehensive declarations of fissile material inventories would probably be a more difficult task. It is possible that this issue will not be resolved during the FM(C)T negotiations and the treaty will not cover existing stocks of fissile materials. It is nevertheless important to understand that the international community will eventually have to address this issue and establish a system that would account for all produced fissile materials and ensure that they are managed safely and securely. The FM(C)T negotiations process could make an important contribution toward this goal.

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Verifiable Declarations of Fissile Material Stocks: Challenges and Solutions

If the future treaty that bans production of fissile materials for weapons is to require declarations of the existing fissile material stocks, it would have to include provisions to allow effective verification of these declarations as well as measures that would deal with the materials in active nuclear arsenals. These requirements may present a significant challenge for the future fissile material control agreement. This paper examines some practical challenges of including declarations of fissile material stocks in the treaty as well as solutions that could help address these challenges.