Verification Scope of FMCT

Sangcheol Hyung*, Junghyun Lee
Korea Institute of Nuclear Nonproliferation and Control, 573 Expo-Ro, Yuseong-Gu, Daejeon, Korea
**Corresponding author: wakendragon@kinac.re.kr*

1. Introduction

The Fissile Material Cutoff Treaty (FMCT) is a proposed international treaty to prohibit the further production of fissile material for nuclear weapons or other explosive devices. In a speech in Prague in April 2009, President Obama announced that he will pursue an effectively verifiable FMCT, which is a shift from the Bush administration position on verification. Verification aspects will be central to the FMCT. However, the treaty has not been negotiated and its terms, especially on the verification scope of FMCT, remain to be defined. [1]

In this paper, we'd like to briefly technical analysis about the proscribed material in the FMCT in order to estimate the range of application of the FMCT.

2. Proscribed Material

2.1 Fissile material

U.S. proposal for fissile material production cut-off is almost same as the materials regarded by the IAEA for safeguards purposes as direct-use nuclear materials– nuclear material that could be converted into nuclear explosive components without transmutation or further enrichment– are as follows : [2]

- HEU, i.e. uranium enriched to 20% or more in the isotope U-235;
- plutonium containing less than 80% of the isotope Pu-238;
- uranium-233.

According to a proposal by Russia, proscribed fissile material would be limited to weapons-grade uranium (with more than 90% U-235) and plutonium (with more than 90% Pu-239).

HEU The fissile uranium in nuclear weapons usually contains 85% or more of U-235 known as weapons-grade, though for a crude, inefficient weapon 20% is sufficient (called weapons-usable); some argue that even less is sufficient. So, it is necessary to regulate HEU.

Plutonium Weapons-grade plutonium is defined as being predominantly Pu-239 with less than 7% Pu-240. The terms "weapons-grade plutonium" was defined mainly in the aspect of the cost.[3] In 1962, US actually tested an about 20kt-nuclear device made from plutonium with a Pu-240 content of >19%.

Table I: Critical Mass of Uranium [kg]

Enrichment (% U-235)	No reflector	U-238 reflector	Beryllium reflector
93.5	48.0/44.5	18.4/17.2	14.1/13.5
90.0	53.8/48.4	20.8/18.7	15.5/14.0
80.0	68/54.4	26.5/21.2	19.3/15.4
60.0	120/72.0	45/27.0	32/19.2
40.0	250/100	100/40	70/28
20.0	800/160	370/74	245/49

Table II: Plutonium Grade

	Isotope (%)				
	Pu238	Pu239	Pu240	Pu241	pu242
Super-Grade	-	98.0	2.0	-	-
Weapon-Grade	0.12	93.8	5.8	0.35	0.022
Reactor-Grade	1.3	60.3	24.3	9.1	5.0
MOX-Grade	1.9	40.4	32.1	17.8	7.8
FBR Blanket	-	96.0	40,0	-	-

Table III: Critical Mass for Plutonium
[Total kg/Pu-239 content kg]

Isotopic atomic composition		No reflector	Natural U reflector (10cm)
Pu-239	Pu-240		
100%	0%	10.5/10.5	4.4/4.4
90%	10%	11.5/10.3	4.8/4.3
80%	20%	12.6/10.0	5.4/4.3
60%	40%	15.4/9.2	7.0/4.2
40%	60%	20.0/8.0	9.2/3.7
20%	80%	28.4/5.7	13.0/2.6
0%	100%	40.0/0.0	20.0/0.0

U-233 U-233 is produced through irradiation of thorium, cannot be used for explosive purposes without being separated from thorium and fission products by reprocessing. So the form of U-233 defined as fissile material for the purposes of the FMCT would be separated U-233.[4]

Np, Am The IAEA has identified neptunium and americium as alternate nuclear materials having potential proliferation significance. Of these, neptunium is the most significant, in terms of quantities potentially available in spent fuel and its suitability for explosive use. The IAEA's designation of americium as an alternate nuclear material was contentious at the time, due to major technical problems confronting explosive use of this material, but proliferation potential of americium should be considered.

2.2 Stocks

A fundamental question is whether the FMCT will apply only to material produced after EIF, or will also apply to material pre-dating the treaty. Many argue that the treaty should apply to pre-existing material.

The benefit of the FMCT would be undermined if some parties take advantage of substantial pre-existing fissile material stocks to expand their nuclear arsenals. But there is nothing in the negotiating mandate to say that the treaty should be retroactive – a ban on production can only be forward-looking, applying to production that could occur after EIF. Furthermore, the nuclear-weapon states (NWS) have emphasized that they will not accept the retroactive application of this treaty – it is unrealistic to press for this.

2.3 Civil use

The FMCT would not proscribe production of fissile material per se, only production for nuclear weapons or nuclear explosives. Reprocessing for civil use would not be proscribed. Nor would production of HEU for civil use or for non-explosive military use (e.g. naval propulsion) – though consideration could be given to proscribing high enrichment (on the basis that existing HEU stocks should be sufficient for foreseeable needs) and separation of weapons grade plutonium.

3. Conclusions

The FMCT has the potential to deliver substantial security benefits, furthering the twin goals of nuclear disarmament and nuclear non-proliferation. By capping the amount of fissile material available for weapons use, the FMCT would be an essential step towards irreversible nuclear disarmament.

This paper has argued for the range of application of the FMCT. Developing the details of verification for the FMCT will require careful technical analysis. And, it will also be necessary to address institutional aspects: which will be the verification agency, what decision-making organs will be required, and so on.

REFERENCES

[1] John Carlson, PROPOSED FISSILE MATERIAL CUT-OFF TREATY: VERIFICATION ISSUES, p. 3, 2010.
[2] IAEA, IAEA SAFEGUARDS GLOSSRY, 2001
[3] Wikipedia, http://en.wikipedia.org/wiki/Enriched_uranium
[4] 한국원자력통제기술원, 핵무기 FAQ, p. 111, 2009
[5]형상철, KINAC 핵정보분석지 No.46, *FMCT 주요쟁점사항*, pp.1~9, 2010