CD/1906

Conference on Disarmament

14 March 2011

Original: English

Note verbale dated 9 March 2011 from the Permanent Mission of Australia to the Conference on Disarmament addressed to the Secretary-General of the Conference transmitting the Chair's report of the Australia-Japan experts side event on FMCT definitions, held at the Palais des Nations in Geneva on 14-16 February 2011

The Australian Permanent Mission to the Conference on Disarmament presents its compliments to the Secretary-General of the Conference on Disarmament, and has the honour to transmit the attached report, entitled "Australia-Japan Experts Side Event on FMCT Definitions, Palais des Nations, Geneva, 14-16 February 2011, Report of the Chair, Ambassador Peter Woolcott of Australia".

The Australia-Japan Experts Side Event on FMCT Definitions addressed the issue of possible definitions in a future treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices. This is an issue of relevance to the Conference's agenda item 1 "Cessation of the nuclear arms and nuclear disarmament" and its agenda item 2 "Prevention of nuclear war, including all related matters".

The Australian Permanent Mission would be grateful if this report could be issued as an official document of the Conference on Disarmament and distributed to all member States to the Conference, as well as to observer States participating in the Conference.

Australia-Japan Experts Side Event on FMCT Definitions
Palais des Nations, Geneva, 14-16 February 2011
Report of the Chair, Ambassador Peter Woolcott of Australia

I. Introduction

About the event

1. On 14-16 February 2011, Australia and Japan co-hosted a three-day "Experts Side Event on FMCT Definitions" in the Palais des Nations, Geneva. The event was chaired by Mr. Peter Woolcott, Ambassador and Permanent Representative of Australia to the Conference on Disarmament, assisted by Mr. Bruno Pellaud (Doctor), of Switzerland as Vice-Chair and Rapporteur.

2. Representatives of around forty five (45) member States of the Conference on Disarmament (CD) and around ten (10) observer States attended the event, as did representatives of the United Nations Office for Disarmament Affairs (UNODA), the International Atomic Energy Agency (IAEA) and the United Nations Institute for Disarmament Research (UNIDIR).

3. The topic of this event was possible definitions to be included in a treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices, commonly known as the Fissile Material Cut-Off Treaty (FMCT).

4. The purpose of this event was first to build confidence about FMCT and momentum towards FMCT negotiations in the CD on the basis of CD/1299 of 24 March 1995 and the mandate contained therein. Its purpose more broadly was to inform and support the work of the CD and to build confidence among its member and observer states.

5. This event did not represent a negotiation, nor a pre-negotiation, but an opportunity to exchange views. During this event, no agreements were sought and no decisions were taken. Views expressed during this event were without prejudice to national negotiating positions when FMCT negotiations in the CD begin.

6. The event consisted of four sessions, an introductory session on 14 February, and three discussion sessions 14-16 February. On 14 February, Mr Kevin Alldred of the IAEA's Nuclear Fuel Cycle and Waste Technology Division opened the event with a presentation on the nuclear fuel cycle.

7. The first of the event's three discussion sessions was also held on 14 February. It considered the question of how the term "fissile material" might be defined in an FMCT. On 15 February, the second discussion session considered the question of how the term "production" might be defined in an FMCT. On 16 February, the third discussion session considered the question of whether there were any other definitions which might be relevant for an FMCT.

About this report

8. This report represents the Chair's personal summary of the three discussion sessions held during the event. It is not an exhaustive treatment of the topic of FMCT definitions and it draws no conclusions about the merits of options put forward. The purpose of this report is not to predetermine the conduct of future FMCT negotiations in the CD, but to inform and support the work of the CD and to stimulate further substantive exchanges in the CD on issues related to an FMCT.

II. What do "fissile material" and "production" mean?

9. The first two discussion sessions provided the opportunity for participants to exchange views on the definitions of "fissile material" and "production" which would fall under an FMCT, i.e. a treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices. Because of the relationship between the definitions of "fissile material" and "production", the sessions are reported together in this section.

10. The first part of this section addresses the concrete options for definitions of "fissile material" and "production" which were raised during the discussion. The second part addresses issues which arose during the discussion.

Overview of definitions of "fissile material" and "production"

11. In introducing the sessions on "fissile material" and "production", the Vice-Chair offered a number of options for consideration and to stimulate discussion.

12. On fissile material, the Vice-Chair noted that the relevant isotopes were uranium-233 (U-233), uranium-235 (U-235), plutonium-239 (Pu-239), neptunium-237 (Np-237) and odd-number isotopes of americium (Am).

13. Options for the definition of "fissile material" as offered by the Vice-Chair can be summarised as in the following table:

Options for the definition of "fissile material" as offered by Vice-Chair

Fissile material option[1]	*Isotopic quality included in the definition*	*Relationship to IAEA definitions and categories*[2]
1. "Nuclear material plus"	All uranium and all plutonium mixtures – except if more than 80% Pu-238. Neptunium and americium included.	Nuclear material, including source material and special fissionable material, plus neptunium and americium.
2. CD/1895	(a) HEU, i.e. uranium enriched to 20% or more in the isotope U-235; (b) Separated (unirradiated) plutonium containing less than 80% of the isotope Pu-238; (c) Separated U-233; (d) (Possibly) separated neptunium; (e) (Possibly) separated americium.	Unirradiated direct use material, plus (possibly) separated neptunium and americium.
3. "Isotopic-A"	Same as "Nuclear material plus"	Unirradiated and irradiated

1 Option 1 is an all-inclusive definition. The plutonium component of option 2 reflects the fact that plutonium contained in spent nuclear fuel requires a further step of separation through reprocessing before it can be used for a nuclear explosive device – and hence a possible choke point on which to focus verification activities. Option 6 was put forward by the Ambassador of the Russian Federation to the CD, Mr. Leonid Skotnikov in 1996. The revised option 5 (an option for discussion developed by the Vice Chair) would tighten the constraint on the quality of materials.

2 Annex I of this report contains a summary of relevant IAEA definitions and categories, as distributed by the Chair during the event. References to IAEA definitions and categories are included as a guide and do not presuppose possible legal or institutional arrangements (including for verification) under an FMCT.

Fissile material option[1]	Isotopic quality included in the definition	Relationship to IAEA definitions and categories[2]
	option – excluding uranium enriched below 20% in the isotope U-235, recycled plutonium (whether irradiated or not) and americium. Neptunium is included.	direct use material (except unirradiated and irradiated plutonium in and from MOX spent fuel). Plus neptunium.
4. "Isotopic-B"	Same as "Isotopic A" – excluding uranium enriched between 20% and 40% in U-235, and high burn-up plutonium mixtures with more than 30% (Pu-238, Pu-240 and Pu-242), whether irradiated or not. Neptunium is included.	Unirradiated and irradiated direct use material (except plutonium in and from MOX spent fuel and high-burn-up plutonium, both unirradiated and irradiated). Plus neptunium.
5. "Skotnikov-B"	HEU above 60% enrichment in the isotope U-235 and plutonium with more than 60% Pu-239.	Potential weapons usable material
6. "Skotnikov-A"	HEU above 90% enrichment in the isotope U-235 and plutonium with more than 90% Pu-239.	Weapons usable material

14. In the interests of providing a range of options for the definition of production and stimulating discussion, the Vice-Chair outlined a number of possible starting points for the production of both uranium and plutonium. For uranium production, these starting points included uranium in yellowcake form, uranium enriched above the natural level (0.7%), uranium enriched above 5%, or uranium enriched at 20% or above. For plutonium production, these starting points included irradiation of uranium, handling of irradiated fuel, or reprocessing of irradiated fuel (i.e. separation of plutonium from irradiated fuel).

15. Options for the definition "production" as offered by the Vice-Chair can be summarised as in the following table:

Options for the definition "production" as offered by Vice-Chair

Production option[3]	Production thresholds
1. "Fuel cycle"	Production covering the whole fuel cycle, from ore extraction and conversion to spent fuel handling and disposal. Starting with yellowcake production for uranium, and starting with the effective production of plutonium in an operating reactor through irradiation of nuclear fuel or other nuclear materials.

[3] Option 1 is an all-inclusive definition. Option 2 refers to a low production starting point. For uranium, this would be any enrichment. For plutonium, this would be the presence of spent fuel containing fissile materials in unseparated form. Moving the starting point to the beginning of irradiation of uranium in fresh fuel (as in option 1) could also be considered, involving more verification during facility operation. Option 3 concentrates on the key weapons-relevant fissile material production facilities – i.e. spent fuel reprocessing and enrichment facilities. Under this option, there would be no verification of plutonium in irradiated fuel. Thus, for plutonium, production would begin with what the IAEA calls "separated direct use materials" or "unirradiated direct use material". Option 4 would decrease the verification scope by removing from the definition of production all activities related to LEU used in the civilian nuclear fuel cycle, i.e. at less than 5%.

Production option[3]	*Production thresholds*
2. "Low start"	For uranium, production starting with enrichment activities above the natural level (0.7%) of U-235. For plutonium, U-233 and neptunium, production starting with the removal from any reactor of any kind of spent fuel or other irradiated nuclear material.
3. "Separation"	For uranium, production starting with enrichment activities above the natural level (0.7%) of U-235. For plutonium, U-233 and neptunium, production starting with reprocessing (i.e. separation from any kind of spent fuel or other irradiated nuclear material).
4. "Separation+"	For uranium, production starting with enrichment activities above 5% of U-235. For plutonium, U-233 and neptunium, production starting with reprocessing.

16. In the subsequent discussions, participants offered or spoke to four broad options for the definition for "fissile material" and "production" subject to an FMCT. These options, which are not exhaustive, can be summarised as in the following table:

Definitions for "fissile material" and "production" as raised by participants

Definition	*"Fissile material"*	*"Production" (where specified)*
1. "Skotnikov-A"	High enriched uranium (HEU) above 90% enrichment and plutonium with more than 90% Pu-239.	U-235 production = enrichment ≥ 90%.
2. CD/1771	Plutonium with more than 70% Pu-239; HEU containing more than 40% of U-235; as well as U-233 and neptunium.	U-235 production = enrichment ≥ 40%; Pu production = irradiation only where Pu-239 content is ≥ 70%, otherwise separation.
3.	"Unirradiated direct use material"	U-235 production = enrichment ≥ 20%; Pu production = reprocessing; U-233 production = reprocessing.
4.	"Special fissionable material, plus neptunium"	U-235 production = enrichment > 0.7%; Pu production = irradiation; U-233 production = irradiation; Np-237 production = irradiation.

17. Of those participants offering or speaking to particular options, most spoke to definitions 3 and 4 in the table directly above. The differences between these two definitions – essentially unirradiated direct use material and special fissionable material – raised issues which may feature prominently in FMCT negotiations in the CD and which are set out in more detail below.

18. Some proponents of definition 3 in the table directly above offered variations on that definition. These variations can be summarised as in the following table. The primary variations were whether the fissile material subject to an FMCT might include neptunium and americium and whether production subject to an FMCT might include enrichment of plutonium-239 by isotopic separation.

Variations on the definition "unirradiated direct use material" as raised by participants

Variation	*"Fissile material" by isotopic quality*	*Production*
CD/1777	(a) Plutonium except plutonium whose isotopic composition includes 80 percent or greater plutonium-238. (b) Uranium containing a 20 percent or greater enrichment in the isotopes uranium-233 or uranium-235, separately or in combination; or (c) Any material that contains the material defined in (a) or (b) above.	(a) separating any fissile material from fission products in irradiated nuclear material; (b) enriching plutonium-239 in plutonium by any isotopic separation process; (c) enriching uranium-233 or uranium-235 in uranium to an enrichment of 20 percent or greater in those isotopes, separately or in combination, by any isotopic separation process.
CD/1895	(a) HEU, i.e. uranium enriched to 20% or more in the isotope U-235; (b) Separated (unirradiated) plutonium containing less than 80% of the isotope Pu-238; (c) Separated Uranium-233; (d) (Possibly) separated neptunium; (e) (Possibly) separated americium.	U-235 production = enrichment ≥ 20%; Pu production = reprocessing; U-233 production = reprocessing; Np-237 production = reprocessing; Am-241 production = reprocessing.
Variation 3	(a) Plutonium-239, uranium enriched to 20% or greater in the isotopes uranium-233 or uranium-235, separately or in combination; (b) Any material containing the material defined in (a) above, except plutonium containing 80% or greater in the isotope plutonium-238.	(a) separating any fissile material from fission products in irradiated nuclear material; (b) enriching plutonium in plutonium-239 by an isotopic separation process; (c) enriching uranium-233 or uranium-235 to an enrichment of 20% or greater in those isotopes, separately or in combination, by an isotopic separation process.
Variation 4 (see annex II of this report)	Neptunium-237, plutonium-239; plutonium mixtures, uranium-233; uranium enriched in the isotopes 235 with the following exceptions: (a) uranium enriched in the isotopes 235 with concentrations	The enrichment of uranium in U-235; the separation of plutonium and/or Np-237 from irradiated uranium; the separation of U-233 from irradiated thorium and the conversion of fissile material into weapon usable form.

Variation	"Fissile material" by isotopic quality	Production
	less than 20%; (b) plutonium mixtures with Pu-238 concentrations equal or more than 80%"; (c) fissile materials mixed with fission products (irradiated).	

Issues arising from the discussions of the definitions of "fissile material" and "production"

19. The discussions on the definitions of "fissile material" and "production" revealed a number of issues – including some differences – which can be expected to influence FMCT negotiations in the CD.

Approaches to definitions

20. The Vice-Chair suggested that a consistent set of characteristics might allow effective assessment of options for FMCT definitions. Such a set could include:

- Verifiability – making verification technically and organisationally possible;
- Confidentiality – minimising proliferation risks associated with inspection and verification activities; and
- Costs – which could be important at the end of the negotiating process.

21. The Vice-Chair's remarks elicited a range of comments. Some considered this set too narrow, suggesting in particular the characteristic of non-discrimination among states under an FMCT. Some questioned whether costs could be used as an evaluating factor in a preliminary technical context; that costs could only be derived from a broad perspective including FMCT definitions, objectives, scope and especially verification.

22. Noting the linkages between definitions and other issues in an FMCT (including objectives, verification and scope), some emphasised the importance of developing a "dialable" range of options for definitions, particularly for the definitions of "fissile material" and "production". "Dialability" of options would assist when the broader considerations of treaty objective, scope, verification and costs were being addressed in negotiations.

23. There was also debate about whether new definitions of "fissile material" and "production" needed to be created or whether IAEA definitions and categories were sufficient. Some argued that a set of "scientific" definitions for an FMCT based on specific materials and activities was appropriate. Some argued that the IAEA definitions and categories represented a good starting point, possibly with some amendments to take neptunium and americium into account.

24. Some expressed concern about the possible negative impact on the IAEA safeguards system, if broader or different definitions were used in an FMCT than those in use by the IAEA. Their arguments were that broader or different definitions might make the IAEA definitions and categories and (with them) the IAEA safeguards system look deficient, and that different verification standards might be applied to more or less to the same set of issues.

25. There was relevance in this discussion to a subsequent exchange on neptunium. Some participants advocated the inclusion of neptunium in the definition of “fissile material” subject to an FMCT. While acknowledging that significant quantities could probably only be produced at large reprocessing facilities, they noted the value of neptunium as a fissile material (it has only one long-lived isotope) and argued that the omission of neptunium from an FMCT could create interest in its production for nuclear weapons purposes.

26. Some participants raised the possible implications of neptunium’s inclusion, when it was not included in the definition of “nuclear material” in the IAEA safeguards agreements for the purposes of safeguards verification. The Vice-Chair noted that in practice, neptunium had been monitored and accounted for since the late 1990s in the verification of large reprocessing facilities, but it was not yet subject to the full accountancy and control provisions of IAEA safeguards agreements. The inclusion of irradiated neptunium in an FMCT could encourage the IAEA Board of Governors to re-examine this issue.

“Special fissionable material plus neptunium” and “unirradiated direct use material”

27. “Special fissionable material plus neptunium” and “unirradiated direct use material” (including or excluding neptunium and americium) are not the only options for the definition of “fissile material” and (implicitly) the definition of “production” in an FMCT. But they were the two options which featured most prominently in the discussions during the experts side event. The discussions on these two options touched on issues which may influence FMCT negotiations in the CD.

28. Proponents of the “special fissionable material plus neptunium” option expressed concerns about the implication of a narrower definition for both “fissile material” and “production”, i.e. definitions which did not include lower levels of uranium enrichment nor plutonium production through irradiation. Their concerns addressed such issues as the effect on the NPT regime through the possible creation of legal loopholes towards break-out capability.

29. Proponents of the “unirradiated direct use material” option expressed the view that definitions should focus on material and activities which presented a risk to the object and purpose of an FMCT. Under this line of argument, narrower definitions could be chosen which were reinforced by verification activities on the “choke points” of fissile material production for nuclear explosive purposes. These “choke points” were uranium enrichment at a level where weapons-usability came into focus, as well as reprocessing, the process by which plutonium became weapons-usable in a physical sense. Given the very large quantities of spent fuel in some countries, inclusion of irradiated plutonium would make verification very expensive without increasing treaty effectiveness. This was not only a question of financial costs for individual states, but also a question of the resources required of any institution charged with verifying an FMCT.

30. While these differences emerged, it is worth noting that a proponent of the definition “special fissionable material plus neptunium” suggested that under that definition, different levels of verification could be considered, depending on the strategic sensitivity of the fissile material – e.g. there could be a lower level of verification for irradiated plutonium in spent fuel and for low enriched uranium, and a higher level of verification for separated plutonium and for high enriched uranium.

31. Similarly, a proponent of the “unirradiated direct use material” definition suggested that under that definition, verification of enrichment facilities declared to be producing less than 20% could be aimed at confirming this fact, while “full ‘IAEA like’ verification” would apply to those declared to be producing more than 20%.

32. So despite the differences between “special fissionable material plus neptunium” and “unirradiated direct use material”, some observed that the gap between the two definitions might be narrower than first appeared, when possible verification activities underpinning those options were considered.

Low burn-up of fuel as an anomalous form of production

33. Some suggested that if the definition of plutonium production in an FMCT included irradiation, the situation of low burn-up fuel might need to be considered as an anomalous form of production. Irradiation of nuclear fuel under standard operation of a reactor produced reactor-grade – not weapons-grade – plutonium. However, if fuel was removed from a reactor early (for example, after an accident), the contained plutonium would be considered weapons-grade.

34. The Vice-Chair suggested that the problem was not negligible, given the significant quantities of plutonium in spent fuel pools from power reactors around the world. The IAEA did not measure in detail the plutonium content of spent fuel, but inspectors could recognise the presence of low burn-up fuel. From a physical perspective, the issue could be resolved by reprocessing such spent fuel together with normal reactor-grade spent fuel. Diversion scenarios were possible and the issue might warrant further consideration, though verification might come at a significant cost.

III. Are there other definitions?

35. The third discussion session provided the opportunity for participants to raise other definitions which might be relevant for the future FMCT.

Stocks

36. The Vice-Chair asked how stocks might be defined, if states decided to include existing stocks of fissile material in the scope of an FMCT. Despite much debate on the question of existing stocks, there could be greater consideration of what this might mean in practical, physical terms.

37. The Vice-Chair suggested three possible aggregations of fissile materials which could serve as a basis for discussion on the associated aspects of verification, if states decided to include existing stocks of fissile material in the scope of an FMCT:

(a) Stored weapon components (pits), at weapons stores;

(b) Stocks stored in bulk form (weapon mixtures) at fabrication plants or weapons stores;

(c) Materials in bulk form (pre-weapon powders) stored separately in other less sensitive facilities.[4]

[4] The Vice-Chair considered that the first option was close to the proposal in CD/1888, i.e. fissile material not contained in a nuclear weapon or in any other nuclear explosive device. In that case, the weapon would first be dismantled (the so-called physics package) and the part containing fissile material (the so-called pit) separated from the other components (chemical explosive, neutron source and electronics). The international verification of such stocks in the form of pits had been extensively investigated between 1996 and 2002 in the frame of the “Trilateral Initiative” between Russia, United States and the IAEA, an initiative which was abandoned in part because of the sensitivities related to verification. This option would also include pre-stocks of pits which had not yet been incorporated in a device. The second option implied the grinding down of the pits, a process that would eliminate

38. The Vice-Chair suggested that one could devise other options, depending on the definition of fissile material otherwise chosen: for example, by including all civilian stocks of enriched uranium and separated plutonium. He noted that the technical and confidentiality issues in verification might be complex.

39. The Vice-Chair's comments elicited a range of responses which considered the issue from the perspective of definitions, but also from the perspective of verification and scope. Some questioned whether stocks, if included in the scope of an FMCT, should or could be defined technically, as opposed to politically or legally. Some noted the relationship and distinction between "technical categories" of stocks (such as those suggested by the Vice-Chair) and "political definitions" (such as "excess materials declared, but unverified" and "excess materials declared and verified").

40. Some sought to frame a definition of stocks around the three categories: (a) separated direct use materials, (b) all direct use materials and (c) all fissionable materials. Some also noted that a distinction between stocks for civilian purposes and stocks for nuclear weapons purposes was a key consideration, if stocks were included in the scope of an FMCT.

41. Looking to questions of scope and verification, some noted a preference for a broad definition of stocks. An approach which verifiably caught stocks in the broadest possible way could fulfil both disarmament and nuclear security aims. Some noted that the sheer technical complexity of stocks verification – there would be hundreds of types of pits and several tens of thousands of pits.

Effectively verifiable

42. Noting the reference in CD/1299 to an "effectively verifiable treaty", the Vice-Chair asked whether this could be taken to mean that an FMCT must be conceived in terms of scope and technical definitions so as to make effective verification *a priori* possible.

43. Some participants argued that the term "effectively verifiable" would not be defined in an FMCT, with one noting in particular that FMCT negotiations would need to be undertaken with a credible assurance that compliance would result. Some considered that "effectively verifiable" was an important criterion and that a discussion on it was a valid exercise. It could serve as a guide to how to approach future FMCT negotiations in the CD. Effectively verifiable could be considered to mean providing an acceptable level of confidence that non-compliance could be detected in time for others to attempt to halt or reverse the non-compliance or else compensate for the non-compliance. Some noted that an FMCT should be cast first in terms of desired definitions and scope and then in terms of achievable verification.

Production facility

44. Participants discussed whether and how "production facility" should be defined in an FMCT. The Vice-Chair suggested that the definition of "production facility" would essentially be determined by the chosen definition of "fissile material" and "production", with each possible combination of "fissile material" / "production" definitions leading to its own list of relevant facilities. For example, in the case of "unirradiated direct use material",

information about the physical shape of pits, but maintain the chemical composition of the powders. The third option would include stocks of basic fissile materials (HEU and plutonium) stored separately – either before pit assembly or after dismantlement – in readily accessible non-military facilities, since the only remaining sensitive information would be isotopic composition.

the coverage would include all enrichment and reprocessing facilities, whether military or civilian, whether or not they contained the corresponding fissile material. Nuclear power plants and their associated fresh fuel facilities and spent fuel stores would not be included. But in general terms, relevant facilities were those in which fissile material was present or could be produced, whatever the chosen definitions.

45. The Chair suggested that the negotiations would need to consider how to treat small-scale facilities under an FMCT (for example, laboratory scale experiments). While it followed from the broad purpose of an FMCT under CD/1299 that large reprocessing or enrichment facilities producing large volumes of material would be a key consideration during FMCT negotiations, the issue of laboratory-scale experimental facilities warranted consideration.

46. To this point, some further noted that if production was defined only as an activity, then not only would all large-scale commercial enrichment and reprocessing plants be covered but also small laboratory-scale experiments.

47. Some noted that in addition to the definition of relevant production facilities, the operational status of those facilities was also an important consideration for an FMCT, as were concepts of facility dismantlement and irreversibility.

Nuclear explosive device

48. Noting the reference in CD/1299 to a treaty banning the production of fissile material for nuclear weapons or other *nuclear explosive devices*, some suggested that "nuclear explosive device" might need to be defined in an FMCT. Some questioned the necessity of defining the term and recalled the difficulty in defining such a term during the CTBT negotiations.[5] In the context of this discussion, there was also debate on whether an FMCT needed to refer specifically to "peaceful nuclear explosions" or whether the concept had already effectively been invalidated.

Irradiated / unirradiated

49. Some noted that if "fissile material" were defined in an FMCT as "unirradiated direct use material", the terms "irradiated" and "unirradiated" might also need to be defined. If the "unirradiated direct use material" definition applied, certain forms of nuclear material would become subject to an FMCT when moving from the irradiated form to the unirradiated form, and conversely, unirradiated nuclear material might no longer be subject to an FMCT once irradiated.

50. The IAEA categorised "irradiated" in the context of "substantial" amounts of fission products, but without clear definition of "substantial". For safeguards accountancy purposes, nuclear material was considered "irradiated" immediately upon insertion in a reactor core. For physical protection purposes, a large radiation dose metric was used for some security level categories (INFCIRC/225/Rev.4 and Rev.5).

51. However, if a definition for "fissile material" broader that "unirradiated direct use material" applied – i.e. one which included both irradiated and unirradiated nuclear material, such as "special fissionable material" – this issue might not be relevant.

[5] Although the term is not found in the text of the CTBT, the glossary on the website of the CTBTO Preparatory Commission (http://www.ctbto.org/glossary/, accessed 9 March 2011) defines "nuclear explosive device" as "any nuclear weapon or other explosive device capable of releasing nuclear energy, irrespective of the purpose for which it could be used. The term includes such a weapon or device in unassembled and partly assembled forms, but does not include the means of transport or delivery of such a weapon or device if separable from and not an indivisible part of it."

IV. Concluding remarks and acknowledgements

52. The discussions on FMCT definitions during this event were rich, but were by no means exhaustive. Importantly, they underlined linkages between particular definitions, and also between definitions and other core elements of an FMCT, including verification and scope.

53. As a result of this opportunity for learning and sustained discussion on FMCT definitions among CD member and observer States, the Chair hopes that this event will encourage reflection on options raised. The Chair also hopes that this event will encourage reflection on other possible options which were not raised, as well as on broader technical and political considerations which will frame future FMCT negotiations in the CD.

54. The Chair thanks the CD member and observer States which participated in this event and particularly thanked the experts who travelled to Geneva for this event – in some cases from quite distant capitals.

55. The Chair thanks Mr Kevin Alldred for his very informative and helpful presentation on the nuclear fuel cycle and was grateful to the IAEA for facilitating Mr. Alldred’s participation.

56. The Chair offers a special thanks to Mr Bruno Pellaud (Doctor) for his assistance, participation and contributions as Vice-Chair and Rapporteur of this event, and expresses his gratitude to Switzerland, and in particular to Mr. Jürg Lauber, Ambassador and Permanent Representative of Switzerland to the Conference on Disarmament, for facilitating Mr. Pellaud’s participation.

57. Finally, the Chair, thanks Japan, and in particular Mr. Akio Suda, Ambassador and Permanent Representative of Japan to the Conference on Disarmament, for co-hosting the event. Australia and Japan will co-host a second experts’ side event on the FMCT in the near future.

Annex I

A Summary of Relevant IAEA Definitions and Categories[1]

Nuclear material

Any source material or special fissionable material as defined in Article XX of the IAEA Statute. Essentially, uranium, plutonium or thorium.

Special fissionable material

- Plutonium-239
- Uranium-233
- Enriched uranium (i.e. including any enrichment in the isotope uranium-235 from slightly above natural uranium up to weapons-grade) – this category essentially includes all forms of light-water reactor fuel
- Any combination or mixture of the above.

This definition does not include neptunium-237 nor americium-241. However, the IAEA has reported (GOV/1998/61) that if available in sufficient quantities in separated form, neptunium and, with considerably greater difficulty, americium could be used to manufacture nuclear explosive devices.

Source material

- Natural uranium (i.e. uranium containing the mixture of isotopes found in nature)
- Depleted uranium
- Thorium
- Any combination or mixture of the above in the form of metal, alloy, chemical compound or concentrate (e.g. uranium ore concentrates, i.e. "yellowcake").

Direct-use material

Nuclear material that can be used for the manufacture of nuclear explosive devices, without transmutation (e.g. through irradiation) or further enrichment. Includes:

- plutonium containing less than 80% plutonium-238
- high enriched uranium (HEU) – i.e. uranium-235 enriched to 20% or above
- uranium-233
- any combination of the above in chemical compounds, oxide mixtures (i.e. MOX fuel), plutonium in spent fuel.

[1] This summary was distributed during the experts side event by the Chair. It is based on Article XX of the IAEA Statute and the IAEA Safeguards Glossary 2001 edition.

It does not include:

- source material

- neptunium-237 and americium-241 (However, the IAEA has reported [GOV/1998/61] that if available in sufficient quantities in separated form, neptunium and, with considerably greater difficulty, americium could be used to manufacture nuclear explosive devices).

Irradiated direct-use material

Direct use material in a mix with substantial amounts of fission products. The term irradiated applies from the moment the material begins irradiation in a reactor.

Examples of material covered by this definition include:

- Plutonium contained in nuclear fuel in an operating reactor or in spent fuel,
- HEU contained in nuclear fuel in an operating reactor or in spent fuel,
- Uranium-233 in nuclear fuel in an operating reactor or in spent fuel,
- Plutonium, HEU or uranium-233 contained in irradiated targets.

Unirradiated direct use material

Direct use material which does not contain substantial amounts of fission products, which therefore would require less time and effort (compared to irradiated direct use material) to convert to components of nuclear explosive devices.

Examples of material covered by this definition include:

- Direct use material in fresh fuel or fresh targets,
- Separated plutonium,
- Recycled plutonium, whether completely separated or contained in a mixture of other fissile materials produced through the irradiation of nuclear material,
- MOX (mixed oxide) fuel,
- Weapons material.

Indirect use material

All nuclear material except direct use material. It includes depleted, natural and low enriched uranium, and thorium, all of which must be further processed in order to produce direct use material.

Annex II

Non Paper by the Hungarian Atomic Energy Authority[1]
Recommendations for FMCT Definitions

I. What does "fissile material" mean?

Proposed definition:

"Neptunium-237, plutonium-239; plutonium mixtures, uranium- 233; uranium enriched in the isotopes 235 with the following exceptions:

- uranium enriched in the isotopes 235 with concentrations less than 20 wt%;
- plutonium mixtures with Pu-238 concentrations equal or more than 80 wt%";
- fissile materials mixed with fission products (irradiated)."

Reasoning:

1. Since FMCT is meant to be a treaty banning the production of fissile material for use in nuclear weapons or other nuclear explosive devices, the definition provides that the FMCT focus on fissile materials that can directly be used to build nuclear explosive devices in general. It should be noted that fissile materials that are most appropriate to build nuclear weapons have more stringent requirements than what is included in the proposed definition. This broader approach would however greatly contribute to non-proliferation by limiting the amount of direct use materials that can be accessible to non-state actors for building improvised nuclear explosive devices. In this way FMCT would also be in line with internationally accepted nuclear security concepts of the physical protection of these materials.

2. FMCT should contribute to the fulfillment the Article VI of Non-proliferation Treaty (NPT) and therefore harmonization between FMCT and NPT with the corresponding safeguards agreements should be sought. This definition would also serve this harmonization as explained below by putting "special fissile materials" into focus with the following exceptions:

(a) International safeguards recognize that three materials can be produced in large quantities to manufacture nuclear weapons: (i) high-enriched uranium containing 90 wt% U-235, (ii) weapon grade plutonium (Pu-239 above 90 wt%), and (iii) U-233. It is also recognized however that above a certain enrichment of uranium in U-235 it is feasible to produce a nuclear explosive device and that below that enrichment, production of such a device is practically not feasible. This recognition resulted in the current safeguards structure in which uranium enriched above 20 wt% U-235 is considered weapons-usable material.

(b) The mixture of plutonium isotopes theoretically can also be used to build nuclear explosive devices with the exception of plutonium with two high Pu-238 content for which 80 wt% threshold was established.

[1] A version of this non-paper was distributed during the experts side event by the Hungarian Atomic Energy Authority. The non-paper is reproduced and attributed in this report at the request of the Permanent Mission of Hungary.

(c) If these fissile materials are mixed with fission products (irradiated) they cannot practically be used to build nuclear explosive devices, only after reprocessing.

3. Neptunium-237 has also been considered to be suitable for building nuclear weapons and other nuclear explosive devices. The inclusion of this material into the proposed definition is recommended, because its omission could promote the interest of nations for its production.

4. Banning and verifying the production of fissile materials as defined above is believed to strengthen the international non-proliferation regime by reducing discrimination between States as well as enhancing nuclear security.

II. What does "production" mean?

Proposed definition:

"The enrichment of uranium in U-235; the separation of plutonium and/or Np-237 from irradiated uranium; the separation of U-233 from irradiated thorium and the conversion of fissile material into weapon usable form".

Reasoning

1. Uranium enriched in the U-235 with concentrations not less than 20 wt% (HEU) can only be produced by an enrichment process of uranium in U-235. Enrichment facilities would be required to declare that either no production of HEU takes place or no HEU produced is diverted to the fabrication of nuclear explosive devices.

2. Plutonium can be produced by separation from irradiated uranium (mostly in the form of irradiated/spent reactor fuel). Separation may be carried out in large plants operating at commercial levels (reprocessing facilities), in smaller plants, or at laboratory bench level. It should also be noted that the separation of plutonium from fresh MOX fuel does not require the large facilities associated with commercial scale operation.

3. U-233 has been produced by irradiating thorium with neutrons and by separation of uranium from irradiated thorium targets or thorium-containing spent-nuclear fuel. The production results in the generation of nearly pure, weapons-usable product.

4. Significant quantities of Np-237 are also found in spent nuclear fuel which can also be separated. For instance a 1,000 megawatt-electric pressurized-water reactor (PWR) may produce about 25 tonnes of spent fuel containing about 10-12 kilograms of neptunium-237 annually. The same spent fuel contains about 250 kilograms of plutonium.

5. The end products of enrichment and separation (reprocessing) are usually passed on to the conversion processes to produce nuclear material in a form suitable for the manufacture of new fuel items, elements, assemblies, stockpiling or nuclear explosive devices. This implies that not only the enrichment and reprocessing facilities, but conversion facilities processing fissile materials subject to FMCT should also be under verification.

Annex III

Other Distributed Documents

During the experts side event, three other documents were distributed, based on Table 1 (p.5), Figure 1 (p.7) and Table 3 (pp. 26-28) of “Principles of the verification for a future Fissile Material Cutoff Treaty (FMCT)” by Annette Schaper, Peace Research Institute Frankfurt Report No. 58/2001 (http://www.hsfk.de/downloads/prif58.pdf, accessed 9 March 2011).