Seventh Conference of Nuclear Sciences & Applications
6-10 February 2000, Cairo, Egypt

NS-3 Strengthened International Nuclear Safeguards; Burdens and Effects on Nuclear Technology Development

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ABSTRACT

The present paper deals with the recent direction of strengthening the international nuclear safeguards and the effects on the development of nuclear technology for peaceful applications.

The new basic principles for strengthening the international nuclear control in the direction of undeclared nuclear activities are elaborated, and the national obligations are indicated. The burdens on the development of nuclear technology are discussed. Approaches are proposed in this work for coping with the present and future situations.

Keywords : Nuclear materials / Nuclear technology / Nuclear safeguards.

INTRODUCTION

The nuclear material(s) [NMs] is universally defined as any "Source Material" or "Special Fissionable Material "(1) . In fact NMs are of strategic value and high potential hazard nature. The social value attributed to NMs should be orders of magnitude higher than their replacement cost. According to international treaties agreed upon by a concerned State for the peaceful uses of nuclear energy , NMs should be under the national control of that State within its territory and under its jurisdiction or authority anywhere - and should be under the international control in all of the stages of production, use, storage and transport [2-4].

The main task of a control system of NMs in any nuclear facility under safeguards is based on the accountancy and verification measures of the NMs in that facility at any time fixed by the control system. It is meant by applying such measures to assure the fulfillment of the governing regulations enforced by the concerned State.

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* The views expressed are those of the author and do not necessarily represent the policy of the Government of the ARE.

The basic approach for NM control is the verification of declared NMs in a specific control area [Material Balance Area, "MBA"]. Then , the control system would consider the following verification measures for each MBA : (4)

1. Book auditing and checking of the NM accounting system .
2. Verification of NMs in inventory, in inventory changes, in process area, scrab, waste,.....,etc.
3. Implementation of Containment and Surveillance [C/S] measures where and when found necessary for the purposes of control.
4. Verification of the operations measuring system.

IMPROVEMENT OF INTERNATIONAL NUCLEAR SAFEGUARDS

The global use of nuclear energy for peaceful purposes has been always associated with the principle of non-proliferation of nuclear weapons manifested by the " Treaty on the Non-Proliferation of Nuclear Weapons" [NPT]. In fact the bases of international nuclear non-proliferation are the NPT and the associated nuclear safeguards of the International Atomic Energy Agency [IAEA](2,4).

The IAEA is the competent technical arm of the United Nations Organization (i.e.the world community) responsible to verify and assure with its nuclear safeguards system , compliance of concerned States parties to the NPT and its comprehensive safeguards agreements. The safeguards have gradually evolved, and adapted themselves to existing challenges emerging from international situations. The fundamental tools for implementing international nuclear safeguards are then, the NM accountancy and verification of Declared NMs and nuclear facilities (2,4,5) .

The obligation under the NPT is to accept the IAEA nuclear safeguards on all NMs in all peaceful nuclear activities in the concerned State. The IAEA was applying safeguards only to declared NMs at declared facilities, but it did not have knowledge of undeclared nuclear activities, or of systematic means of finding out about such activities.

New challenges for the international nuclear safeguards urged to further strengthening of the existing IAEA safeguards system, and pushed in the direction of promoting the capability of the IAEA to detect Undeclared Nuclear Activities(6,7).

MEASURES OF STRENGTHENING INTERNATIONAL NUCLEAR SAFEGUARDS

The general direction of the programme to strengthen the IAEA safeguards may be briefly characterized by the following elements (6-8) :

1. To enable the IAEA broader access to and treatment of information on the nuclear fuel cycle [NFC] and related activities in the concerned State .

2. To extend the IAEA rights of physical access to locations indicated by those information.

3. To advance the IAEA safeguards methods and verification techniques .

4. To improve the IAEA inspection regimes and the designation procedures of Safeguards Inspectors ,

and the IAEA communication systems for official purposes.

In order to strengthen the effectiveness and improve the efficiency of the IAEA nuclear safeguards system as a contribution to global nuclear non-proliferation objective , a Model Additional Protocol has been designed for States having Comprehensive Safeguards Agreements with the IAEA [5,8].

Such additional protocols are to be concluded between the IAEA and States Parties to the NPT, i.e., States having comprehensive safeguards agreements with the IAEA according to the IAEA Document INFCIRC/153(Corr.) Such agreements should apply to the Protocol to the extent that they are relevant to and compatible with the provisions of the Protocol. In case of conflict between the provisions of the Safeguards Agreement and the Protocol, the provisions of the Protocol should apply [5,8].

NEW OBLIGATIONS AND BURDENS

According to the terms of the NPT the establishment, implementation and maintenance of the State's System of Accounting For and Control of NMs [SSAC] is an obligation to the Parties[2,3].

The SSAC is considered as the national regulatory organization for the control of NMs in the different parts of the nuclear fuel cycle in a State. It should provide the essential basis for the application of nuclear safeguards according to the Safeguards Agreement. A simplified flow diagram of the NFC showing the parts put under IAEA nuclear safeguards is presented in Fig.1. [4,5].

The Additional Protocol may be entered into force after satisfying statutory or constitutional requirements by the concerned State. Consequently the new obligations of the State Party to the Protocol could be summarized in the following items[8].

1. Provision of Information

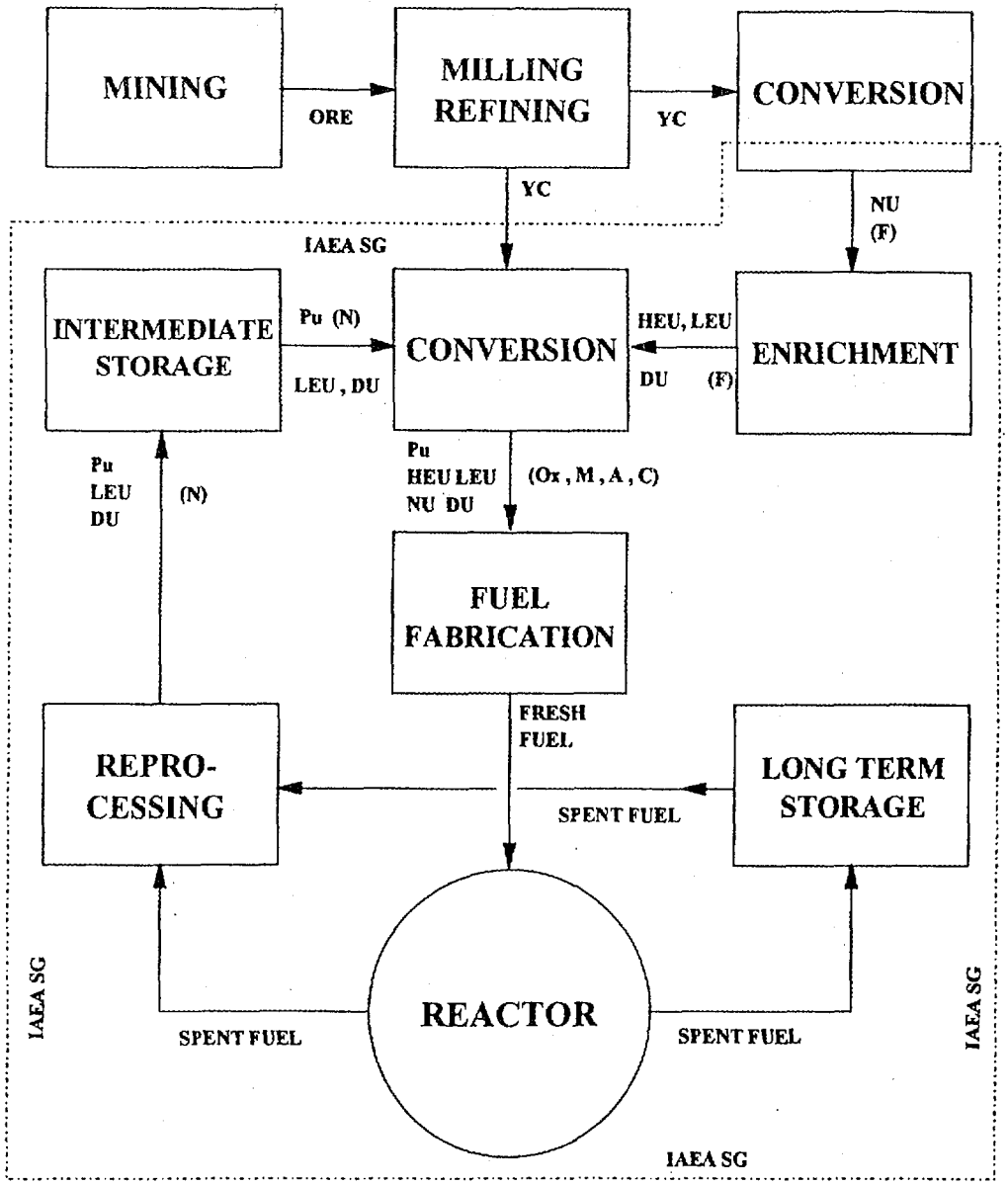
* The description of and information about the location of NFC-related research and development [R&D] activities NOT involving NMs.

* A general description of Each Building on Each site, including its use and , if not apparent from that description, its Contents.

* A description of the scale of operations for each location engaged in specified activities.

* Information specifying the location, operational status and the estimated annual production capacity of uranium mines and concentration plants and thorium concentration plants, and the current annual production of such mines and the concentration plants for the State as a whole.

* Information regarding source material which has Not reached the composition and purity suitable for fuel fabrication or for being isotopically enriched - or intended use of such material, whether in nuclear or Non - Nuclear use for each location at which the material is present in quantities exceeding 10 metric tons of uranium and / or 20 metric tons of thorium; or for export and/or import for non-nuclear purposes in quantities exceeding those quantities for the year.



SG	safeguards	IAEA	the International Atomic Energy Agency
YC	yellow cake	Ox	oxide
NU	natural uranium	N	nitrate
DU	depleted uranium	M	metal
LEU	low enriched uranium	A	alloy
HEU	high enriched uranium	F	hexafluoride
Pu	plutonium	C	carbide

Figure 1. Simplified flow diagram of the nuclear fuel cycle showing the parts put under IAEA Comprehensive Nuclear Material Safeguards.

* Information regarding the quantities , use and locations of NM Exempted from safeguard pursuant to IAEA INFCIRC/153[5].

* Information regarding the location or further processing of intermediate or high-level waste containing plutonium, high enriched uranium [HEU, with U-235 enrichment ≥20%]or U-233 on which safeguards have been Terminated pursuant to IAEA INFCIRC/153[1,5].

* Information regarding Specified Equipment and Non-Nuclear materials for each export and/or import.

* General plans for the Succeeding Ten-year period relevant to the development of the NFC- including planned NFC-related R & D activities when approved by the appropriate authorities in the State.

* A general description of activities and Identity of person (s) (or entity) carrying out such activities at locations identified by the IAEA Outside a site and considered as - might be functionally related to the activities of that site.

2. Complimentary Physical Access

The implementation of complimentary physical access of the IAEA in the concerned State shall include the following ;

* Any place on a site

* Any location identified in item 1.

* Any decommissioned location where NM was customarily used

* Any location specified by the IAEA - other than locations referred to above - to carry out "location specific environmental sampling" and "wide-area environmental sampling".

3. IAEA Inspectors Designation And Visas

The nominated IAEA safeguards inspectors shall have the following treatment;

* Simplified designation procedure to the concerned State.

* Provision of the designated IAEA inspector with appropriate multiple entry/exit and/or transit visas where required for at least one year and be renewed as requested

4. Communication Systems

The concerned State shall permit and protect free communications by the IAEA for official purposes between the IAEA safeguards inspectors an IAEA Headquarters and / or Regional Offices. This would include attended and unattended transmission of information generated by the IAEA containment and/or surveillance measures or by measurement devices [4,8,9] .

Also the IAEA shall have the right to make use of internationally established systems of direct communication, including satellite systems and other forms of telecommunications Not in use in the concerned State [8,9].

IMPACT ON DEVELOPMENT

It may be emphasized that development of the nuclear field in a country goes in parallel to the general development due to the fact that only certified and qualified personnel and proven quality assurance systems, equipment, materials and supplies could be allowed to work in the nuclear industry.

The negative effects on the development, and the burdens may be summarized in the following;

* The concerned State would need to enforce and enlarge its SSAC in order to be able to carry out the extra new duties. This would need extra funds for the introduction of new equipment, training of the national inspectors and for hiring other specialists.

* Revealing of the future national plans of the nuclear field may threaten the national interest or the national security.

* Using unlimited intrusive measures in the industrial field -which is closely related to the nuclear field- would lead to negative or retardive effects on the development of both fields.

* The control of Non-Nuclear equipment and materials for satisfying the purposes of the international safeguards is an extremely exhaustive legal and administrative procedure at the national level , time and effort consuming , and very expensive to implement.

* Sending information - unknown to the inspected country directly from the location or (site) to the IAEA - Head Quarters by satellites or other systems NOT available to the concerned State would not be seen as justified procedures. Improper or delicate or false information could be transferred intentionally to the IAEA and / or to other parties without permission of the State .

* The control of ore mining of uranium and thorium; and the collection, recording , and verification of information, and the control of export / import of such materials for non-nuclear use are impossible in practice.

* Interference with private national and multi-nationl industrial sector in the country would create instabilities and legal confrontation with the State.

* "Environmental Sampling" technique for international safeguards [12,13] is not the same task as "Environmental Sampling " for other applications. For nuclear safeguards, it is a top high-technology not available to most countries in the world. Its processes need the use of "Clean Room " for sample handling and screening capability, advanced analytical laboratory and mass-spectrometry for the measurement and verification of minute traces of transuranic isotopes and fission products. Then, in the case of disagreements or inconsistencies of the inspection findings, comparisons and cross-checking of results should be done. At the least, this should necessitate the IAEA to supply the inspected State with the same technique for fairness and on equal- basis comparisons.

NEW APPROACHES

It may be worthy to think of new approaches which could lead to achieve nuclear non-proliferation advantages with little or even non-negative effects on the nuclear industry and the industrial development in the country. Such approaches should be aimed to ensure that nuclear weapon materials are indeed unattractive and inaccessible , and irreversible for uses other than the peaceful

applications - particularly - the nuclear power fuel cycle. Some of new proposed approaches may be indicated in the following ;

1. The international nuclear safeguards would have to address the implementation of advanced non-destructive and destructive assay techniques, and to establish precisely the NMs isotopic composition and NM accountancy methods. This would need more efforts for R & D in the field of nuclear safeguards [10,11].

2. The use of LEU fuel assemblies -instead of HEU ones in nuclear research reactors and material testing reactors.

3. Recycling of spent fuel without separation of plutonium from uranium and fission products. Some of the investigated fuel cycles include recycle processes such as the direct use of reconfigured pressurized water reactor spent fuel assemblies into CANDU reactors [DUYPIC] [14].

4. In the case of mixed-oxide fuel [MOX , i.e. mixed uranium-oxide and plutonium-oxide fuel] burning in thermal reactors, the once-through fuel cycle operation degrades the plutonium into a form that becomes unattractive and inaccessible for weapons use[14].

CONCLUSION

The present investigation shows that the strengthening of the international nuclear safeguards implicates the detection of undeclared nuclear activities and facilities rather than the verification of declared nuclear materials and facilities in the concerned State . It shows also the unlimited intrusion and negative effects on the development of the nuclear field and the national industrial field as well.

It may be concluded that the extra burdens would be a retarding element to the national development. In order to overcome some of such effects, new approaches would be needed to cope with the present and future commitments for the benefit of both sides of the international nuclear safeguards for non-proliferation and the development in the concerned State.

NOMENCLATURE

NM(s)	Nuclear Material(s) [1]
LEU	Low Enriched Uranium [% Wt of U-235 < 20%][1]
HEU	High Enriched Uranium [% Wt of U-235 ≥ 20 %] [1]
NFC	Nuclear Fuel Cycle [1,4]
SSAC	The State's System of Accounting For and Control of NM[3]
IAEA	The International Atomic Energy Agency - a branch of the United Nations Organization
NPT	The Treaty on the Non-Proliferation of Nuclear Weapons [2]
NDA	Non Destructive Assay measurements [4]
DA	Destructive Assay measurements by sampling and chemical analysis [4]
R&D	Research and Development

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