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Title: VERIFICATION OF EXCESS DEFENSE MATERIAL

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VERIFICATION OF EXCESS DEFENSE MATERIAL

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ABSTRACT

The international community in the post-Cold War period has expressed an interest in the International Atomic Energy Agency (IAEA) using its expertise in support of the arms control and disarmament process in unprecedented ways. The pledges of the U.S. and Russian presidents to place excess defense materials under some type of international inspections raises the prospect of using IAEA safeguards approaches for monitoring excess materials, which include both classified and unclassified materials. Although the IAEA has suggested the need to address inspections of both types of materials, the most troublesome and potentially difficult problems involve approaches to the inspection of classified materials. The key issue for placing classified nuclear components and materials under IAEA safeguards is the conflict between these traditional IAEA materials accounting procedures and the U.S. classification laws and nonproliferation policy designed to prevent the disclosure of critical weapon-design information. Possible "verification" approaches to classified excess defense materials could be based on item accountancy, "attributes measurements," and containment and surveillance. Such approaches are not wholly new; in fact, they are quite well established for certain unclassified materials. Such concepts may be applicable to classified items, but the precise approaches have yet to be identified, fully tested, or evaluated for technical and political feasibility, or for their possible acceptability in an international inspection regime. Substantial work remains in these areas. This paper examines many of the challenges presented by international inspections of classified materials.

1. INTRODUCTION

Following the end of the Cold War, the international community has expressed an interest in the International Atomic Energy Agency (IAEA) using its expertise in support of the arms control and disarmament process in unprecedented ways. The pledges of the U.S. and Russian presidents to place excess defense materials under some type of international inspections has raised the prospect of using IAEA safeguards approaches for monitoring excess materials, which include both classified and unclassified materials. Although the IAEA has suggested the need to address inspections of both types of materials, the most difficult problems involve approaches to the inspection of classified materials.

Traditional IAEA safeguards are based on materials accounting (including measuring the item's fissile mass and material sampling as the nuclear material is placed into safeguards). The key issue for placing classified nuclear components and materials under IAEA safeguards is the conflict between these traditional IAEA materials accounting procedures and the U.S. classification laws and nonproliferation policy designed to prevent the disclosure of critical weapon-design information (e.g., mass). The details of weapon-design information are very complex and expansive. Specific examples that present clear proliferation concerns include the average mass of weapon components in the U.S. stockpile, the masses for specific weapon types, specialized material forms, and weapon-specific attributes (e.g., contours and thicknesses).

Any disclosure of weapon-design information would violate the U.S. Atomic Energy Act and the 1978 Nuclear Nonproliferation Act, as well as Article I of the Nonproliferation Treaty. Accordingly, protection of classified information is a key objective of the United States. Yet, virtually all currently available radiation detection techniques could reveal classified information if used on weapons or components. There are, however, promising approaches that, if they are realized, might offer "verification" measurements that do not reveal classified or sensitive information.

This paper examines some of the challenges presented by international inspections of classified materials. This analysis is intended to delineate some of the problems, as well as reveal possible approaches (along with techniques and technologies), that could allow the adaptation of safeguards concepts to the unprecedented task of providing international verification of classified materials. It is also hoped that these discussions could help to advance various political-technical debates on international inspections of excess classified materials.

2. SAFEGUARDS AND VERIFICATION

The possibility of using traditional safeguards approaches and concepts to verify declarations regarding excess defense materials in classified or sensitive forms has been raised in some quarters. Traditional safeguards are based on materials accountancy and containment and surveillance (C/S) [1,2]. C/S techniques do not appear to pose insurmountable implementation problems, although significant engineering challenges must be solved before they can be used in this new arena. Materials accountancy, as suggested above, does pose substantial difficulties that we do not yet know how to resolve. At bulk processing plants, safeguards declarations are verified through materials accountancy methods involving destructive analysis (DA) and nondestructive assay (NDA) measurements to provide quantitative and accurate mass-based verification of nuclear material. Such measurements are not acceptable for excess defense materials in sensitive forms because they would reveal classified information. At civil facilities, where items are identifiable but the exact isotopics and quantities of nuclear material cannot be determined (e.g., spent fuel storage sites), safeguards are based on item accounting and attributes measurements that provide gross defect verification of the items. This item accounting aspect of international safeguards is not dismissable *a priori* as a potential tool for verifying declarations concerning items that contain classified or sensitive information.

Unlike current applications of safeguards, however, there are no established approaches to the verification of classified or sensitive materials (e.g., nuclear-weapon components) arising from nuclear arms reductions and dismantlement. As a consequence, the applicability of traditional item accountancy in this new area is unclear. Item accountancy requires continuity-of-knowledge through C/S and inspections, along with selected measurements of attribute signatures to provide confidence that the items under inspection have attributes of, or are consistent with, the declared materials. Item accountancy requires the ability to verify and re-verify the items (e.g., through item counting, identification of serial numbers, and attributes measurements when necessary). Seals, surveillance cameras (film and video), and radiation monitors are used to complement item accountability.

An item accountancy approach would have to be carefully examined if considered for classified materials, both in terms of (1) whether it poses problems from the perspective of classification and (2) whether it will satisfy as yet not fully developed nonproliferation or arms control objectives for verification of the classified and sensitive materials.

It is not useful to address the second point until objectives have been clarified. The first point raises concerns because the anticipated approaches will likely involve some type of radiation measurements, which would reveal classified information if those measurements were done through the traditional application of IAEA nondestructive assay measurements. However, it may be possible to consider limited measurements of attribute signatures, as is done in the case of spent fuel, and to use various approaches, including information barriers, to avoid releasing classified information. Such a concept may consist of using "red light/green light" systems that are applied to classified radiation signatures to protect the data (and the analysis algorithms) while allowing determination of whether an item has the declared attributes (green light if it does, or red light if it does not). But such systems have not yet been fully tested and evaluated. By way of example and not as a specific proposal, this approach might include specially designed instruments that would verify that a specific item contained at least some agreed minimal quantity of plutonium or some ratios of plutonium isotopes such as $^{239}Pu/^{240}Pu$. In this example, will these attributes address verification requirements that may be agreed, are they appropriate and, if so, can thresholds for quantity and isotopics be defined and be acceptable from both classification and verification perspectives? The question of whether such an attributes approach could be used to verify excess defense materials requires a clear notion of the objectives in monitoring classified or sensitive items, which are not currently agreed.

3. ADAPTING SAFEGUARDS APPROACHES

The major technical issue involved with adapting safeguards approaches to international verification is to create a credible inspection regime where the classified components can be received into the regime without traditional IAEA verification procedures. Although such a regime and its parameters have not yet been defined, it seems clear that it will have to use many techniques and technologies utilized in IAEA safeguards approaches. Employing such adapted approaches, in principle, minimizes this conflict and provides the basis for a potentially viable and credible international inspection regime. Because information to the Inspectorate must inherently be limited due to classification and other concerns, several potential problems can arise within this option: demonstrating sufficient transparency, realizing acceptance of the international community, and addressing potential anomalies.

However objectives and other issues are decided, several serious problems may arise and require special attention. If only weapons components are placed under a nonquantitative verification regime, while all noncomponent fissile material falls under traditional safeguards, then substantial and significant limits may be imposed on any future verification options. Extreme care must be taken to assure that critical weapon-design information is not disclosed inadvertently.

Additional issues may arise as a consequence of the possibility that classified material will not remain indefinitely in storage (under certain inspection regime options). As processing facilities become operative, it is expected that their unclassified output will be placed under traditional safeguards. As this occurs, establishing a credible chain-of-custody for classified material through the conversion process into (unclassified) disposition or use will be critical to assure the long-term goal of transparency and irreversibility. An important advantage of such an approach is that it can, in principle, place classified weapon-component materials under an interim IAEA verification regime. Then, followed by traditional IAEA safeguards as applied to nonnuclear-weapon states (once the classified components and material is converted to unclassified form).

4. TRADITIONAL SAFEGUARDS ON PROCESSED MATERIAL

Of course, these classification and other issues could largely be avoided if classified components such as pits were processed into bulk form, which could then allow these materials to be placed directly under traditional IAEA safeguards or other agreed approaches. In bulk form, attributes such as mass, isotopics, and amounts of certain alloys typically are considered unclassified. However, there remain classification concerns that will need to be addressed. For example, provisions may be required to process pits from more than one weapon type together so that materials characteristics can be disassociated from any single weapon type.

This approach would have the advantage that the materials are placed under traditional IAEA safeguards consistent with those applied in the nonnuclear weapon states that have signed the Nonproliferation Treaty. A disadvantage is the potential delay in placing these materials under IAEA safeguards until appropriate facilities are made available for processing the items to bulk form. Moreover, any delay in placing classified (and unclassified) excess defense materials under IAEA inspections could be viewed as hindering the goal of transparency.

If such problems arise, seeking to proceed more rapidly, or implementing unilateral, reciprocal transparency measures (which can, in principle, be done in a timely fashion) might prove useful. For example, transparency could be established through visits to certain facilities, perhaps by international safeguards experts. Such visits might allow measurements, which could, in principle, include overall background radiation measurements to demonstrate the presence of nuclear material and correlate receipt of material with shipments from dismantlement activities. This could provide international confidence and demonstrate openness until such time as the excess material is converted to bulk form. Then traditional IAEA safeguards could be applied.

5. CONCLUSIONS

Possible verification approaches to classified excess defense materials based on item accountancy, attributes measurements, and C/S are not completely new and are well established for certain unclassified materials. These concepts may be applicable to classified items, but approaches have not yet been fully developed, tested, or evaluated for technical and political feasibility. The acceptability of such approaches is also unclear, for the inspection regime in which they could in principle be utilized has not yet fully been understood or agreed. Extensive work is still required in these areas.

Given these considerations, no approaches or concepts should prematurely be eliminated from consideration at this time. It may be possible to craft an international (IAEA) monitoring approach applicable to classified components and materials. However, the prospect of delaying the application of international safeguards until classified materials have been converted to unclassified forms and then placing them under more traditional safeguards should not be excluded. Clearly, some U.S. excess materials have already been converted, and this process can be expected (and is planned) to continue. A conversion process that largely deals with classified weapon-grade materials would remove many of the difficulties associated with the verification of classified items. Clearly, any conversion also takes weapon materials one step further away from weapon use. There is value both in placing classified or sensitive materials under international inspections (if approaches can be developed and agreed) and in converting the material to unclassified forms, which can then be placed under traditional safeguards.

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