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A FOUR-DIMENSIONAL PICTURE OF NUCLEAR SAFEGUARDS AND SAFEGUARDS CULTURE

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Introduction

In our previous paper, "Conceptualisation in the IAEA safeguards system and the formation of safeguards culture"[1], we presented a detailed analysis of the history of safeguards implementation in order to identify factors influencing the formation of safeguards culture. In that paper, we concentrated on an objective study of the evolution of several factors (safeguards and technical objectives, safeguards approaches and procedures, and safeguards findings and conclusions), but we chose not to elaborate on the human and social factors.

In the present paper, we expand this study to take into consideration the human and social factors. To do so we use "the four quadrants" concept introduced by Ken Wilber in his integral philosophy.[2]

We adjust these quadrants to the needs of our study as follows:

- Quadrant I (exterior-individual) – an objective analysis of the phenomenon of the IAEA safeguards system;
- Quadrant II (exterior-collective) – the role of state, social, and organisational factors;
- Quadrant III (interior-collective) – the role of cultural, ethical, moral, and national factors;
- Quadrant IV (interior-individual) – the role of individuals; human values, integrity, and responsibility.

Each part of this paper represents a corresponding quadrant.

The study we performed brought us to the conclusion that we should distinguish the notion of the International Atomic Energy Agency (IAEA) safeguards system from the much more general notion of nuclear safeguards.

The IAEA's safeguards system is an international verification system. The IAEA verifies that states comply with their obligations under the respective safeguards agreements. Today, the IAEA safeguards system involves the implementation of safeguards agreements in more than 180 states. By doing so, the Agency fulfils its mandate "to apply safeguards, at the request of the parties, to any bilateral or multilateral arrangement, or at the request of a State, to any of that State's activities in the field of atomic energy."[3] This task is achieved through the conclusion and implementation of the three types of agreements with states: item-specific, comprehensive, and voluntary-offer safeguards agreements.

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1. Valeri Bytchkov and John Carlson, "Conceptualisation in the IAEA safeguards system and the formation of safeguards culture", VCDNP, 19 March 2024. Available at: https://vcdnp.org/iaea-safeguards-system-and-safeguards-culture/.

2. Ken Wilber, "A brief history of everything", second edition, Shambala, Boston, 2007.

3. The Statute of the International Atomic Energy Agency, Article III.A.5. Available at: https://www.iaea.org/about/statute.

The IAEA safeguards system cannot be considered separately from the commitments that states have given under the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and other international treaties and legally binding arrangements concerning the peaceful use of nuclear energy. The IAEA safeguards system provides the means of verifying particular commitments under the NPT and the other relevant treaties and arrangements. Thus, safeguards culture relates not only to implementing the IAEA safeguards system but encompasses states' obligations concerning the peaceful use of nuclear energy and their commitment to accept IAEA safeguards to demonstrate compliance with these obligations.

Part I: Analysis of the IAEA Safeguards System

The previous paper, cited above, analyses the historical development of the IAEA safeguards system and the conceptualisation in this system. What follows is a brief summary of the results of that analysis.

Today, the IAEA safeguards system is used to verify compliance of states with their undertakings concerning the peaceful use of nuclear energy. States undertake such commitments under political arrangements, usually expressed through treaties concluded on a bilateral or multilateral basis. Bilateral arrangements relate mostly to nuclear cooperation, usually involving trade where a supplier state provides nuclear material and specified non-nuclear materials and items to a receiving state under the condition that the materials and items will be used only for peaceful purposes. Multilateral arrangements relate to regional treaties, such as nuclear-weapon-free zones, or global treaties, such as the NPT or the Treaty on the Prohibition of Nuclear Weapons (TPNW).[4] The IAEA safeguards system works through the conclusion of a safeguards agreement between the IAEA and a state or a group of states. There are three types of safeguards agreement, each corresponding to the type of political arrangement to which the state is a party:

- Item-specific safeguards agreements relate to the commitments of a recipient state under a bilateral arrangement concerning nuclear cooperation, such as trade;
- Comprehensive safeguards agreements relate to the commitments of a non-nuclear-weapon State (NNWS) under the NPT; and
- Voluntary-offer safeguards agreements relate to the commitments of a nuclear-weapon State (NWS) party to the NPT to support the IAEA safeguards system.

The safeguards agreements, therefore, will be considered in the context of the political arrangements to which they relate.

The IAEA, through its verification activities, provides evidence of a state's compliance with its obligations specified in the safeguards agreement which the state has concluded with the Agency. In other words, the Agency assists the state to demonstrate adherence to its commitment within the political arrangements to which the state is a party. Presently, the Agency implements safeguards agreements in more than 180 states. Today, the Agency applies item-specific agreements in three states. In five states the Agency applies voluntary-offer agreements and in the rest of the states in which it applies safeguards, the Agency applies

4. Although the TPNW contains reference to IAEA safeguards, there is no reference in IAEA official safeguards documents to the TPNW; the current comprehensive safeguards agreement refers only to the NPT.

comprehensive safeguards agreements. In our further discussion we will concentrate on the implementation of comprehensive safeguards agreements (CSAs).

Under Article II of the NPT, each NNWS party to the treaty undertakes not to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices. Article III.1 of the treaty further requires each NNWS to accept IAEA safeguards on all the state's nuclear material to verify against the diversion of nuclear technology from peaceful uses to nuclear weapons or other nuclear explosive devices.

This idea was realised in the IAEA document INFCIRC/153, which describes the structure and content of CSAs. Paragraph 2 of this document provides for the Agency's right and obligation "to ensure that safeguards will be applied […] on all source or special fissionable material in all peaceful nuclear activities within the territory of the State, under its jurisdiction, or carried out under its control anywhere, for the exclusive purpose of verifying that such material is not diverted to nuclear weapons or other nuclear explosive devices".

Paragraph 2 represents the safeguards objective for CSAs. The objective has two components: (a) to ensure the completeness of safeguards coverage; and (b) to verify that safeguarded nuclear material is not diverted to nuclear weapons. At that time, the Agency did not have any experience or measures to be used for verifying completeness. However, sufficient experience and measures were available to attain component (b), seen as the Agency's ability to detect any diversion of safeguarded nuclear material from a facility placed under safeguards. Nuclear material accountancy, supported by containment and surveillance, was seen as a fundamental measure for detecting such diversion.

As the primary goal was to detect diversion to nuclear weapons, important verification parameters were introduced to regulate the frequency and intensity of verification activities. Those parameters were: a "significant quantity", i.e. the quantity of nuclear material of a given type necessary to manufacture an explosive device; and a conversion time, i.e. the amount of time required to convert the nuclear material being diverted into a weapon-usable form. This implies that the verification concept included the assumption that the state could have unsafeguarded nuclear facilities.[5]

In accordance with the terms of CSAs, the state provides the information and access necessary for Agency inspectors to be able to verify that the state is complying with its obligations under the agreement. The state declares to the Agency quantities and characteristics of nuclear material subject to safeguards as well as design information for the facilities (and information about locations outside facilities) which contain the declared nuclear material. The state also declares design information for those facilities which are planned, in the process of construction, or being decommissioned. Thus, nuclear material and facilities were placed under Agency safeguards based solely on the declaration of the state. Until 1991, the year of the discovery of Iraq's secret nuclear weapons programme, in which Iraq used undeclared nuclear material and facilities, the Agency did not have sufficient means to verify the completeness of a state's declaration.

In the post-1991 period, with the implementation of safeguards strengthening measures including the Model Additional Protocol (INFCIRC/540), the Agency was able to actively ensure the completeness of safeguards coverage. To do so, the Agency developed a new verification

5. In the contemporary safeguards terminology, we call them "undeclared nuclear facilities" to emphasize the fact that such facilities must be declared by the state in accordance with the terms of the CSA.

concept, the state-level concept (SLC). In the initial stage of implementing this concept, termed "integrated safeguards", the Agency introduced a new technical objective: to detect undeclared nuclear material and activities. This concept was implemented in two phases. During the first phase, the Agency carries out necessary verification activities to achieve the conclusion that there is no undeclared nuclear material and activities in the state (which means, indirectly, that all nuclear material has been declared and placed under safeguards). In the second phase, the Agency starts applying a state-level approach (SLA), developed for each state individually, in which verification activities for individual facilities are developed taking into account the increased confidence in the absence of undeclared nuclear material and activities.

The SLC, first named as such in 2004, uses an important distinction between the safeguards objective, which is the overarching purpose of verification described in the safeguards agreement, and the technical objective, which is the objective of the verification procedures. In the CSA, the safeguards objective is formulated in Article 2 of the agreement. This article should be seen in the context of Articles II and III.1 of the NPT. The joint analysis of these articles leads us to the conclusion that the term "diversion" used in these articles means a process of nuclear weapons acquisition, in which the state might use both declared and undeclared nuclear material and activities. The Agency's goal is to detect this process before it has been completed (the principle of timely detection). Such a diversion process will leave indications in physical and informational spaces, which Agency inspectors should be able to detect. So, when performing their routine work, inspectors should be looking for such indications. Based on these considerations, the generic technical objectives under the SLC are:

- To verify that declared nuclear material has been adequately accounted for;[6]
- To detect undeclared production or processing of nuclear material at declared facilities;
- To detect undeclared nuclear material and activities.

The SLC is applied through developing an SLA and an annual implementation plan (AIP) for each individual state. The SLA and AIP documents contain safeguards measures and verification activities necessary to attain the generic technical objectives. These documents are not shared with the state.

The implementation of the SLC meant a significant conceptual change in the Agency's verification activities and led to the formation of a new stage of safeguards culture.

The above is a brief outline of the conceptual development of the IAEA safeguards system. In addition to safeguards procedures and methods, essential elements of this system include the evaluation of safeguards effectiveness and the drawing of safeguards conclusions. For safeguards to reinforce states' commitments against seeking nuclear weapons, states must have confidence in the IAEA's safeguards conclusions: specifically, that there is a high probability of timely detection of any major safeguards violation. This involves several aspects: how the IAEA designs and implements safeguards procedures; how it ensures its conclusions are soundly based; and how it explains this process to states. Under the facility-level concept, these aspects were relatively straightforward. The Safeguards Criteria were particularly important for setting out a standardised approach to this process. For the state-level concept,

6. We prefer this formulation instead of the original one "to detect diversion of declared nuclear material" because of the ambiguity of the term "diversion" in the original formulation. "Adequately accounted for" means that no serious anomalies or inconsistencies have been found in a state's declarations and facility records that would indicate an undeclared withdrawal of declared nuclear material from a facility.

both the processes and the explanation of them are much more complex. This is a major ongoing area of safeguards development, involving substantial qualitative—and therefore cultural—as well as technical dimensions.

Part 2. Governmental, Organisational, and Administrative Factors

In our previous paper we identified three basic levels in the functioning of the IAEA safeguards system: its foundation level, the level of operation design, and the implementation level. In this work, we will consider governmental, organisational and administrative factors associated with each of these levels.

Foundation Level

The ability of human society to collaborate in achieving the peaceful and secure coexistence of nations is a prerequisite to achieving a nuclear-weapon-free world. In this regard, the existence of the United Nations (UN) and of its Security Council (UNSC) are indispensable. The IAEA was created under the auspices of the UN and, according to the Agency's Statute, has a mandate "to establish and administer safeguards" to ensure that nuclear material, information and technology placed under safeguards are not used for any military purpose. The Statute provides that if the Agency, in carrying out its statutory verification activities, determines that a state is in non-compliance with its safeguards obligations, such non-compliance shall be reported to the UNSC.

As outlined in Part 1 above, the NPT and safeguards agreements (including protocols to safeguards agreements) establish the legal basis of the IAEA safeguards system. They set out the commitments which states undertake under the NPT and under the various types of safeguards agreements, including their commitment to accept the Agency's verification activities. Safeguards agreements specify verification principles and safeguards procedures to be implemented by the state(s) and the Agency. The state(s) and the Agency are to cooperate in implementing the applicable safeguards agreements.

For our further consideration of the functioning of the IAEA safeguards system we need to outline organisational aspects of the IAEA and national governments. The IAEA consists of the Board of Governors (BOG), the General Conference, and the Secretariat. The BOG supervises the work of the Secretariat and ensures that the IAEA safeguards system is implemented in accordance with the principles established by the Member States through the Statute and the procedures under the Statute. The Member States exercise their right to shape the system and control its functioning through their participation in the General Conference and in the BOG.

A state nominates certain governmental entities to represent the state during the conclusion and implementation of its safeguards agreement with the Agency. Such entities normally are the Ministry of Foreign Affairs, responsible for liaison with international organisations, and a nuclear regulator (state authority), which holds as a rule, responsibilities for nuclear safety, security and safeguards.

Most characteristics of the IAEA safeguards system at the foundation level do not change with time. However, the safeguards procedures defined in the safeguards agreements are kept under review to ensure they take account of changes in nuclear technology. Safeguards procedures are also subject to ongoing development due to the evolution of the system in the quest for greater effectiveness and efficiency (in quality assurance terms this can be described

as a process of continuous improvement). Such upgrading of the safeguards system is normally carried out by the Secretariat under the oversight of the BOG and with the assistance of Member States. In certain periods, such as the post-1991 period, upgrading may require an adjustment of the relevant legal parameters. An example of this was the development, in 1997, of the Model Protocol Additional to Safeguards Agreements (INFCIRC/540), based on which the IAEA concludes additional protocols (APs) to safeguards agreements.

Level of Operation Design

After having brought into force a CSA (and potentially an AP), the state and the Agency conclude subsidiary arrangements which specify how the procedures laid down in the agreement are to be applied. Subsidiary arrangements specify the points of contact between the state and the Agency and specify reporting requirements. Subsidiary arrangements include facility attachments, which specify, for each facility placed under safeguards, material balance areas and strategic points necessary for verification of inventories and flows of safeguarded nuclear material. Thus, the conclusion of subsidiary arrangements is an important step in the implementation of safeguards. This step is carried out in cooperation between the state authority, the facility operator and the IAEA safeguards inspectors.

In order to design safeguards verification activities, the Agency's inspectors define the objectives of safeguards procedures (the technical objectives referred to above) under each type of safeguards agreement. In the past, under the facility-level concept, inspectors used a technical objective common to all types of safeguards agreements. This technical objective related to the ability of Agency inspectors to ensure timely detection of the diversion (undeclared withdrawal) of a significant quantity of safeguarded nuclear material from the facility placed under safeguards. Verification activities to attain this objective were developed based on analysis of plausible routes for removal of nuclear material from the facility. Based on such analysis, the Safeguards Criteria (the 1991-95 Criteria) were developed which represented, for each type of nuclear facility under safeguards, a list of verification activities to be carried out by inspectors in order to attain the technical objectives. These Criteria were also available to the nuclear regulator and facility operator, making the Agency's verification activity transparent to the state. The Criteria served also as a technical basis for discussing the effectiveness and efficiency of IAEA safeguards implementation with Member States.

With the introduction of safeguards strengthening measures in the post-1991 period, the Agency had to develop a new implementation concept: the state-level concept (SLC). Under this concept, technical objectives are defined separately for each type of safeguards agreement. Generic technical objectives applied in the case of CSAs are outlined in Part 1 above. Safeguards measures and verification activities to attain these objectives are developed based on analysis of the acquisition paths for nuclear weapons-usable nuclear material considered possible in a given state. These measures and activities are listed in state-level approach (SLA) and AIP documents prepared for each individual state. However, the fact that the SLA and AIP documents are not made available to Member States is seen by some states as a lack of transparency of the Agency's verification activities.

The IAEA does not have sufficient human, technical, and financial resources to be self-reliant in the development of innovative verification methods and techniques. Such methods and techniques are developed and provided to the Agency by Member States through Member State Support Programmes. Support is also provided to the Agency through non-governmental organisations and expert groups such as the Standing Advisory Group on Safeguards

Implementation (SAGSI). Also important is the "safeguards-by-design" initiative, encouraging designers to take into account safeguards implementation requirements in their work. This may relate, for example, to making provision in the facility design for the installation of containment and surveillance and monitoring devices to monitor nuclear material flow and to maintain the continuity of knowledge about nuclear material in the facility.

Such support is indispensable for ensuring the continuing effective and efficient operation of the IAEA safeguards system.

Implementation Level

At this level, the cooperation between the state and the Agency in implementing the safeguards agreement is even more pronounced. The state authority responsible for safeguards (normally the nuclear regulator) ensures the collection and timely submission to the Agency of all the information required by the safeguards agreement and, if concluded, the AP. It also ensures that the Agency's inspectors have access to the safeguarded facilities and to the locations in the state specified in the AP. The facility operator is responsible for provision of safeguards-related information, provision of access to nuclear material for verification, and provision of support for installation and use of safeguards equipment.

The Agency is responsible for carrying out safeguards verification activities and, on the basis of its findings, drawing of safeguards conclusions. The Agency's Secretariat reports the results of its verification activities on an annual basis in the Director General's report to the BOG, known as the Safeguards Implementation Report (SIR). This reporting has evolved with time, reflecting the conceptual evolution of the IAEA safeguards system. Presently, the SIR contains an annual Safeguards Statement, which is structured in accordance with the type of safeguards agreements concluded by states. The type of agreement determines the state's obligations under the agreement, the safeguards and technical objectives pursued by the Agency's inspectors in their verification activities, and the formulation of safeguards conclusion.

For a state with a CSA and an AP, if no anomalies have been found that would indicate possible non-compliance of the state with the safeguards agreement, the Secretariat concludes that all nuclear material in the state remained in peaceful nuclear activities.[7] For a state with a CSA but no AP, the Secretariat cannot draw such a conclusion, as it cannot apply all the verification activities which it considers necessary for detecting undeclared nuclear material and activities. For such states, if no anomalies have been found, the Secretariat concludes that declared nuclear material in the state remained in peaceful nuclear activities.

In a case where anomalies have been found, the Secretariat pursues the matter with the state until the issue is resolved. If resolution is not achieved, the case will be referred to the BOG for consideration. The BOG may report the matter to the UNSC in accordance with the IAEA Statute.

The question remains, however, as to how Member States can assess the credibility of the safeguards conclusions reported in the SIR. The SIR is supposed to include the safeguards implementation information which would enable Member States to make such an assessment. In the past, under the facility-level concept, the SIR contained results of safeguards performance evaluated by the Secretariat on the basis of the Safeguards Criteria. The Criteria

7. The Agency is able to reach this conclusion, known as the "broader conclusion", after completing initial evaluations regarding the absence of undeclared nuclear material and activities in the state concerned.

played the role of performance targets. Under the SLC, a safeguards effectiveness evaluation methodology that is transparent to Member States still needs to be developed.

Part 3. Common Values and Objectives, or Safeguards Culture, in the Multinational Environment

In this chapter we will discuss common values, objectives and collective identities of the entities and people involved in the implementation of safeguards. In other words, we will discuss safeguards culture. Culture is a broad notion which includes common values such as ethical standards, moral dispositions, aesthetics, integrity, collective identity and mutual understanding. We will consider aspects of safeguards culture at each of the three functional levels of the IAEA safeguards system.

Foundation Level

As we pointed out in Part 2, the ability of human society to collaborate in achieving the peaceful and secure coexistence of nations is a prerequisite to establishing a nuclear-weapon-free world. Ideally, the goal of peaceful coexistence should be an integral part of the national interests of every state. Human society should be able to agree on this overarching goal as well as on the ways and principles of achieving it. Such ways and principles must be established through international treaties and international law.

In this regard, safeguards culture can be seen in the broadest sense as reflecting the principle that nuclear energy should be used for exclusively peaceful purposes.[8] This is based on a moral disposition towards the prohibition of nuclear weapons and ethical principles of equality and non-discrimination. These sentiments, together with a sense of responsibility and integrity, should be common values for each political or technical actor involved. These values and principles are laid down in the foundation of the UN, the IAEA and the IAEA safeguards system. They are also reflected in international humanitarian law.

These points are of fundamental importance, and it is worth expanding on them here. Safeguards are usually thought of in terms of non-proliferation, that is, preventing the spread of nuclear weapons. But this is not the limit of the safeguards interest. The NPT makes it clear that the division of states between nuclear-weapon States (NWSs) and non-nuclear-weapon States (NNWSs) is not intended to be permanent, and the NWSs are committed, through Article VI, to work towards nuclear disarmament.

Nor are nuclear disarmament obligations limited to NPT States Parties. The International Court of Justice (ICJ), in its 1996 advisory opinion on the legality of use of nuclear weapons, stressed that the elimination of nuclear weapons is an obligation under general law, applying to every state.[9] The prevention of proliferation, therefore, is not only an end in itself, but an essential contribution towards achieving nuclear disarmament. People engaged on safeguards need to

8. "Peaceful purposes" is used here as shorthand for non-explosive purposes. There is no general principle of prohibition of non-explosive military applications, such as naval propulsion, provided there is no diversion to explosive purposes.

9. See John Carlson, "The Legality of Nuclear Weapons – Revisiting the 1996 Advisory Opinion of the International Court of Justice", https://cms.apln.network/wp-content/uploads/2022/03/JohnCarlson_PolicyBrief_79-3.pdf.

be working, not only to ensure safeguards are effective, but to contribute to the development of effective verification for disarmament.

Level of Operation Design

The essential feature of the IAEA safeguards system is a symbiosis of political, legal and technical matters. In implementing the safeguards agreement concluded between the IAEA and a state, the state and the Agency's Secretariat play the major role. The entities responsible for the operational design and implementation of the agreement are as follows (what we mean by operational design is explained below):

- In the state – the ministry of foreign affairs, the nuclear regulator, and the facility operator;[10]
- In the Secretariat – the policymaking organs, Office of Legal Affairs and the Department of Safeguards.

Thus, specialists with different backgrounds and different professional educations are involved in the levels of operational design and implementation. In order for them to be effective, they need to share common values, to have collective identity and mutual understanding, and to have a common understanding of safeguards terminology, which is kept up with the system's development. All this is included in the notion of safeguards culture.

The operational design starts with the conclusion of subsidiary arrangements which provide, for a given state, a comprehensive structure for reporting inventories and flows of nuclear material subject to safeguards. A state with a CSA and AP declares, in accordance with the provisions of the AP, additional information concerning its nuclear programme and nuclear fuel cycle. The IAEA inspectors perform the evaluation and verification of the state's declarations and develop, on this basis, safeguards approaches. These activities require good collaboration and mutual understanding between the state's nuclear regulator, facility operators and the IAEA Department of Safeguards. This is achieved by ensuring the required professional background of the staff involved through education, exchange of information and collective work. The Safeguards Criteria, developed under the facility-level concept of safeguards implementation, served in the past as an important basis for safeguards culture.

In order to facilitate the implementation of the contemporary safeguards system the Department of Safeguards created the State Evaluation Groups (SEGs). The creation of these groups was necessary in order to meet a new challenge – the evaluation of all available safeguards-related information. The SEGs include safeguards inspectors and analysts and are entrusted with the important tasks of conducting state evaluation, acquisition path analysis and development of the SLAs and AIPs for states with CSAs. Their work is guided by the internal guidelines developed in the Department of Safeguards.

10. The CSA provides that the state shall establish and maintain a national system of accounting for and control of nuclear material (SSAC). In the past, the term SSAC was used to refer also to the state authority responsible for safeguards implementation. In the contemporary safeguards literature, the notion of the SSAC and the state authority are distinguished. In most states with nuclear activities, the nuclear regulator is responsible for safeguards implementation. However, in states with no nuclear activities, particularly in states with a small quantities protocol, there is no nuclear regulator and no facility operator. Still, the state nominates an entity responsible for communication with the IAEA secretariat and for provision of safeguards-related information to the Agency.

However, there are still a number of difficulties associated with this process, such as lack of a universal approach, lack of transparency, and problems with the terminology used. Each SEG is challenged with the task of creating an effective, efficient and non-discriminatory safeguards approach for the state under its responsibility. In its work, the SEG is expected to use all accumulated departmental knowledge about safeguards objectives, procedures and technical and analytical tools. There is no information available to Member States to judge the quality of the final product.

We may assume that the development of a new safeguards document of a similar level of quality and comprehensiveness as the former Safeguards Criteria would be beneficial for facilitating the formation of the contemporary stage of safeguards culture.

As we earlier pointed out, the BOG plays an important role in supervising the development of the IAEA safeguards system. In particular, any substantial developments in safeguards implementation concepts and approaches are subject to the approval by the BOG. This process involves discussion of legal and technical matters between the relevant entities of the IAEA and the states.

Implementation Level

This level is characterised by collaboration between the state authority, the facility operator and the IAEA Department of Safeguards. These entities cooperate in implementing the SLAs and AIPs developed by the SEGs. Their common goal is to provide evidence of the state's compliance with its undertakings under its safeguards agreement. As the state's undertakings depend on the type of agreement, we will discuss each type of agreement separately.

A. Comprehensive Safeguards Agreements

The CSA safeguards objective can be fully achieved only if the state has concluded an AP. There are still states which have not concluded an AP; each of them has indicated reasons for deciding against concluding an AP. The overall impact of this situation on the sustainability of the IAEA safeguards system and the NPT is, however, negative. Further communications between states and relevant entities are important in order to overcome political hurdles and agree on the principles and ways to resolve current issues.

B. Item-Specific Safeguards Agreements

During the pre-NPT period, this was the only type of safeguards agreement being implemented. Accordingly, states' undertakings concerning the peaceful use of nuclear energy related only to the nuclear material, facilities and other items placed under safeguards. The majority of states have since joined the NPT and concluded a CSA with the Agency. In the three remaining states, their item-specific agreements continue to be implemented. These states acquired nuclear weapons using materials and facilities which were not subject to safeguards.

The SIR safeguards conclusion for these states confirms that the nuclear material and other items placed under safeguards in these states remained in peaceful activities.

So, provided these states comply with their undertakings under the applicable safeguards agreements, the Agency is able to attain the safeguards goal for this type of agreement. The international community, however, has the expectation that these states should be involved in further political developments towards achieving the overarching goal of nuclear-weapon-free world. Although these states do not have the specific obligation of the NPT NWSs in this

regard, the ICJ in its advisory opinion on the legality of the threat or use of nuclear weapons made it clear that the elimination of nuclear weapons is a general obligation applicable to all states, and emphasised that any realistic search for general and complete disarmament, especially nuclear disarmament, necessitates the cooperation of all states. A first step towards this goal would be the establishment of regional nuclear-weapon-free zones in which the non-NPT states participate.

C. Voluntary-offer Safeguards Agreement

All five NWSs under the NPT have concluded this type of agreement with the Agency.

The formal safeguards objective of this safeguards agreement is to confirm that nuclear material placed under safeguards at the facilities selected by the Agency from the list of eligible facilities provided by the state is not withdrawn from peaceful activities at these facilities otherwise than in accordance with the terms of the safeguards agreement. A more general objective of safeguards in NWSs was to encourage widespread adherence to the NPT by demonstrating to NNWSs that they would not be placed in a commercial disadvantage by reason of the application of safeguards pursuant to the Treaty.

When implementing these safeguards agreements with the NWSs, the Agency also pursues general objectives such as developing safeguards approaches for new types of nuclear facilities, and verification of nuclear material which will be later placed under safeguards in NNWSs. Fulfilment of these objectives strengthens the safeguards system. However, the lack of visible progress in the implementation of the provisions of Article VI of the NPT represents a serious political hurdle for the sustainability of the NPT and hence the IAEA safeguards system.

Part 4. People's Belief and Motivation

In the previous Parts we painted a basic picture of the IAEA safeguards system, discussed the role of states and the Agency in implementing safeguards agreements, and introduced the general notion of safeguards culture. In this Part we will go into the heart of the matter: we will consider the beliefs and motivations of people working at all levels of the system.

Foundation Level

The idea that nuclear energy should serve only peaceful purposes and should not be used in nuclear weapons is shared by the majority of people in the world. The inscription on the Hiroshima Memorial Cenotaph says: "Let all the souls here rest in peace; for we shall not repeat the evil". Many people strongly believe in the moral and ethical grounds of this testament; however, ordinary people can do little to ensure that the evil is not repeated. The people who have the power and means to achieve this goal are the political leaders. They formulate the ideas which provide the means for achieving common human goals and for initiating discussion of the means for achieving these goals. In nuclear policy such ideas include: the slogan "Atoms for Peace", the creation of the IAEA and its safeguards system, and the relevant international treaties and agreements, including the establishment of regional nuclear-weapon-free zones and the NPT. These were mainly the achievements of the 1950s and 1960s, when the 1945 events in Hiroshima and Nagasaki were fresh in people's memory. These achievements were possible due to the sense of responsibility and dedication shown by political leaders of that time. Since then, the non-proliferation regime and the IAEA safeguards

system have proven to be effective political and technical means for achieving the goal of preventing the proliferation of nuclear weapons.

One may hope that a new generation of political leaders will appear on the world's political scene to overcome the contemporary political hurdles in implementing the provisions of Article VI of the NPT. This task is an essential part of improving world peace and prosperity. Specific elements in achieving these goals include the prohibition and elimination of all weapons of mass destruction. There are clear parallels here with the resolution of global environmental challenges: here too efforts are hindered by states giving higher priority to perceived national interests as compared to common international interests.

The IAEA safeguards system, since its foundation in the 1960s, has evolved to become an effective verification mechanism for the NPT. The people who drafted INFCIRC/153 did an outstanding job. In particular, there is an aesthetic value to this document. Aesthetics is an important aspect of any creative work of an individual or a group of individuals. We see the beauty of scientific theories, physical models and mathematical formulas. Theories that have innate beauty work better and serve longer as compared to theories that lack this attribute. In this regard, the CSA described in INFCIRC/153 can be appreciated from an aesthetic point of view. By this we mean that, in spite of a few shortcomings associated with the adaptation of the original safeguards system described in INFCIRC/66 and with the terminology used, the document is well structured, well written and delivers a well-established verification concept, which we have referred to as the facility-level concept. This concept worked satisfactorily in the pre-1991 period, when the likelihood of a NNWS party to the NPT not complying with its obligations under the treaty was low due to both political and technical reasons. Deterrence provided by the risk of early detection of diversion of declared nuclear material also played its role. However, this concept, which we appreciate from the aesthetic point of view, does not cover, in an effective and efficient way, the real mechanisms of acquisition of nuclear weapons by a state where the decisive elements are undeclared nuclear material and activities.

In the post-1991 period, after the recognition that several NNWSs were not compliant with their obligations under the NPT, the IAEA and its member states strengthened the IAEA safeguards system by providing the means for detecting undeclared nuclear material and activities. The implementation of the safeguards strengthening measures, including the Model Additional Protocol, required the development of a new verification concept. This development resulted in the state-level verification concept, the SLC. As a result, the safeguards system gained in effectiveness and efficiency but lost part of its original beauty. This was one of the reasons for the difficulties in gaining acceptance of the SLC. This issue is discussed in more detail below with regard to the NPT. One may hope that aesthetics will be valued by the designers of future verification systems which will be necessary for implementing the provisions of Article VI of the NPT.

Level of Operational Design

During the initial period of introducing safeguards strengthening measures, namely, the end of the 1990s and the beginning of the 2000s, the old safeguards culture based on the FLC was still predominant. Initiatives such as the modified small quantities protocol and the proposal to include in the category of nuclear material subject to full-scope safeguards procedures, as defined in paragraph 34(c) of INFCIRC/153, uranium ore concentrate of specified purity (thus, shifting the "starting point of safeguards" more towards the front-end of nuclear fuel cycle) were made within the FLC. Integrated safeguards, developed around 2000, was a mixture of

the state-level and facility-level concepts and was applicable only for states with a CSA and an AP for which the Agency had drawn the "broader" safeguards conclusion. The state-level concept, first named as such in 2004, reflected a more general idea that the purpose of the IAEA safeguards system is to verify compliance of a state with its undertakings under the applicable safeguards agreement. Thus, the SLC was applicable to all the states with safeguards agreements. Implementation of the SLC had enhanced the effectiveness and efficiency of the IAEA safeguards system. At the same time, it required a new safeguards culture on the part of people working at the levels of operational design and implementation. People working at these levels are, essentially, the relevant staff of a state's nuclear regulator, nuclear facilities, and the Agency's safeguards department.

We mentioned above the aesthetic value of the old FLC. The beauty of the old concept was that it was simple, universal and transparent – and the measures employed were largely quantitative and self-contained. The Safeguards Criteria developed under this concept contained, for each type of safeguarded facility, verification activities applicable for a given type of facility irrespective of the state where the facility is located. Parameters of the verification concept, such as the inspection goal and its quantity and timeliness components, were universal and did not depend on the type of safeguards agreement. The theory of nuclear material accountancy, which was the fundamental safeguards measure under this concept, had been well developed and was widely implemented. For people involved in operational design, the essence of their job was to adapt the relevant part of the Criteria to any nuclear facility placed under safeguards. For the Department of Safeguards as a whole, the Criteria were used as a basis for forecasting its needs in human, technical and financial resources and for evaluating performance.

The introduction of the SLC meant, first of all, the formation of a new stage of safeguards culture. The old and well understood parameters of the FLC, such as the inspection goal and its quantity and timeliness components, had to be replaced with new goals. Such new goals were established by formulating the three generic technical objectives; however no clear timeliness goals had been formulated. In addition to the old fundamental safeguards measure of nuclear material accountancy, a new fundamental measure, state evaluation, had been introduced. In contrast to the old, largely quantitative, measure, the new measure is largely *qualitative*, with a substantial degree of expert judgment, which some people equate to subjectivity. We provide further elaboration on the decision-making process under the FLC and SLC under the subtitle "Implementation Level" below.

Implementation Level

We start this discussion with the role of the states. First of all, each state is responsible to ensure that obligations it has undertaken under the NPT and CSA are respected in its external and internal policies. Further, a state may take additional measures on a voluntary basis with regard to promoting the idea of the peaceful use of nuclear energy and in supporting the relevant national and international institutions working on the implementation of this idea. In this regard, voluntary provision to the IAEA of safeguards-related information is indispensable for maintenance of the high level of effectiveness of the IAEA safeguards system.

We may also consider a special case of a NNWS party to the NPT, which had concluded a CSA with the Agency but does not respect its obligations under the NPT and the CSA, because it plans to acquire nuclear weapons. This situation definitely has an impact on the implementation of the safeguards agreement and, therefore, on the implementation of the

SLA and AIP for the state. Any indication of non-compliance found by the Agency's inspectors under any of the three generic technical objectives, i.e., a problem with nuclear material accountancy, misuse of a safeguarded nuclear facility or the existence of undeclared nuclear material and activities, will have to be followed up with the state. Such a situation, if not resolved, may be interpreted by the Agency as its inability to verify that nuclear material is not diverted to nuclear weapons, and the BOG may decide to refer the case to the UNSC.

Basically, the three generic technical objectives are the objectives of the verification activity of the Department of Safeguards.[11] There are various types of activities aimed at the achievement of these goals, such as: inspecting safeguarded nuclear facilities as provided by the terms of CSA; performing complementary access to the locations in the state as provided by the terms of its AP; and performing evaluation of all safeguards-related information. The effectiveness of safeguards implementation can be judged by assessing the extent to which the technical objectives have been attained. Safeguards effectiveness depends not only on the professionalism and dedication of the staff of the Department of Safeguards but also on the collaboration of the staff of the state's nuclear regulator and the safeguarded facility.

Under the FLC, the Agency draws a safeguards conclusion for each facility placed under safeguards. The basis for the process of drawing such conclusion is paragraph 30 of INFCIRC/153. The paragraph says: "… the technical conclusion of the Agency's verification activities shall be a statement, in respect of each material balance area, of the amount of material unaccounted for over a specific period, giving the limits of accuracy of the amounts stated". In other words, if the value of material unaccounted for (MUF), taking into account its measurement uncertainty, exceeds one significant quantity, we have a serious anomaly indicating possible diversion of nuclear material from peaceful use at safeguarded facility to "purposes unknown". If no such anomaly has been found, the conclusion is that safeguarded (declared) material remained in peaceful use. This is a straightforward and transparent process of drawing a safeguards conclusion based on quantitative assessment of the Agency's verification results. There are, however, exclusions of this rule when the Agency has to use qualitative assessment. These relate to cases of inconclusiveness of verification when measurement uncertainty exceeds one significant quantity, inconclusive results of containment/surveillance, or denial of access to a facility or information.

Under the SLC the Agency draws a conclusion for the state as a whole. In addition to assessing the values of MUF in all the declared facilities, the Agency must perform verification and evaluation activities to detect misuse of declared facilities and the existence of undeclared nuclear material and activities. The process of drawing a conclusion involves the evaluation of huge amounts of various types of information and also involves, in the absence of well-designed evaluation procedures, a subjective judgment by an evaluator concerning the significance of the detected anomalies and inconsistencies. Further efforts are required to develop standard evaluation procedures and to make the process transparent to Member States. It is important to emphasise that it is the Agency's Secretariat that identifies the anomalies and inconsistencies and it is the Board of Governors that determines a non-compliance.

It is important to note that work on the development and implementation of the SLC has not been completed. Further efforts by the IAEA and its Member States are required in the area of

11. In SLAs these three generic technical objectives give rise to more detailed technical objectives; the latter serve as the goals of safeguards measures and verification activities listed in the SLA and AIP.

developing analytical tools used in acquisition path analysis and state evaluation, and in establishing principles for consolidating the work of the SEGs. Further work is required to develop and apply a methodology for evaluating safeguards effectiveness.

Conclusions

The international community has an overarching objective of ensuring that nuclear energy is used safely and for exclusively peaceful purposes, for the benefit of humankind, and not for destructive purposes. The IAEA plays a key role in the achievement of this objective through three main functional areas: nuclear safety, nuclear security and nuclear safeguards. In the first two areas the Agency's functions are largely advisory, but with safeguards the Agency is responsible for verifying, for the international community, that states are meeting their treaty obligations. To perform this function, the Agency, together with its Member States, have developed and implemented the IAEA safeguards system. But this system cannot work on its own. First, states must undertake commitments regarding the peaceful use of nuclear energy and conclude the necessary safeguards agreements. Second, states need to actively participate in the implementation of safeguards agreements, providing Agency inspectors with information, access and support.

We have discussed how the development and implementation of IAEA safeguards is a collaborative endeavour, involving institutions and people at a number of levels: the IAEA; national policymakers and diplomats; national regulatory authorities; facility operators; etc. Safeguards development and implementation involve substantial state inputs, including through the experiences and perspectives Secretariat staff bring with them, the contribution of SAGSI experts, the work of Member State Support Programmes, and so on. In addition, the practice of safeguards is very much influenced by IAEA-state interactions.

In nuclear safety and nuclear security there are well established notions of nuclear safety culture and nuclear security culture, recognised and promoted by the IAEA. These are very much seen as shared cultures, common to all participants – they are not seen as being primarily focused on the Agency's activities nor on national activities. Regarding nuclear safeguards, the notion of safeguards culture is currently in the process of discussion. In this paper, we have emphasised certain basic factors in safeguards culture: the role of states in undertaking their commitments regarding peaceful use of nuclear material, in establishing relevant international treaties and agreements, and in supporting the IAEA safeguards system. Other important factors in the implementation of the IAEA safeguards system are: the formulation of safeguards and technical objectives, the development of safeguards approaches and procedures, and drawing safeguards finding and conclusions.

Looking beyond these basic factors, it is important to see safeguards culture as a common, shared international culture aimed at achieving a global goal, namely, ensuring that nuclear energy is used only for peaceful purposes – or, expressed more strongly, the elimination of nuclear weapons. This is the goal of the NPT, and safeguards must be seen in this context. The recognition of safeguards culture, and the conscious development of safeguards culture to reflect this global goal, will strengthen the contribution nuclear safeguards can make to achieving a nuclear-weapon-free world.

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