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Better Utilization of In-House Resources to Enhance the IAEA's Safeguards State Evaluation Process

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Abstract

According to its statute, the International Atomic Energy Agency (IAEA) has two missions that are carried out by its five technical departments: promoting the peaceful uses of nuclear energy and technology, and verifying that states comply with their commitments to use nuclear material and facilities only for peaceful purposes.

To achieve the IAEA's verification mission, the Department of Safeguards relies on three main streams of information: state-provided information, information from Agency Safeguards activities, and other relevant information available to it, including open sources and satellite imagery, and information from databases maintained by the Agency's other technical departments.

The paper examines the extent to which the Department of Safeguards takes advantage of information resources available in the Agency's other technical departments – including nuclear fuel-cycle experts and information on states' peaceful use of nuclear technologies — to carry out its responsibility to verify the completeness and correctness of states' declarations. The paper explores ways to institutionalize the Department's utilization of human and information resources available in other Departments of the Agency, while still meeting the Agency's fundamental obligations to protect commercial, proprietary, and other confidential information it obtains in implementing Safeguards.

Introduction

When it was founded nearly 60 years ago, the International Atomic Energy Agency had two missions: one was to promote the safe and secure use of nuclear energy and technology, so that all nations might benefit from peaceful uses of nuclear research; the other to ensure that nuclear energy was not misused to further any military purpose [1, Article II].

To carry out these dual missions, the IAEA is organized into five technical departments (See Figure 1). Four of these are focused on ensuring all member states can reap the benefits of nuclear technology in a safe and secure manner: the departments of Nuclear Energy, Nuclear Sciences and Applications, Nuclear Safety and Security, and Technical Cooperation. The fifth department, Safeguards, is focused on preventing the proliferation of nuclear weapons by detecting and deterring the misuse of nuclear material or technology, and by providing credible assurances to the international community that states are honoring their safeguards obligations.

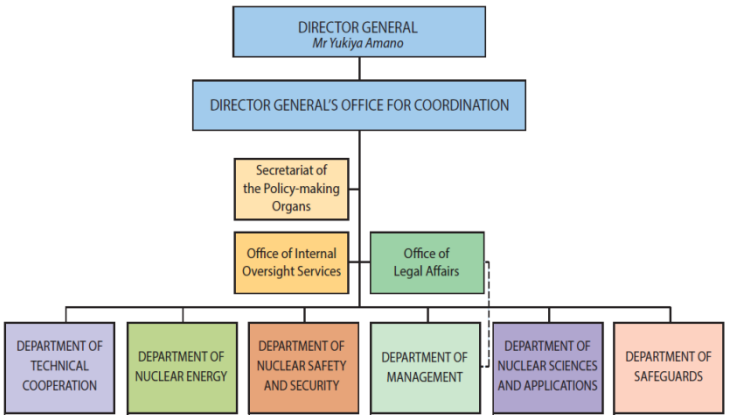


Figure 1: IAEA Organizational Chart [2]

Following the entry into force of the Nuclear Nonproliferation Treaty (NPT) in 1970, the IAEA's authority to detect and deter the use of nuclear material for military purposes was further bolstered by the requirement in the NPT for non-nuclear weapon states that are party to the treaty to conclude an agreement with the IAEA and place all nuclear material under safeguards. In order to detect diversion or misuse of nuclear material and to provide assurances that the state did indeed declare all its nuclear material in accordance with the terms of its safeguards agreement, the Department of Safeguards collects and analyzes a large amount of information from a variety of sources, such as reports made by the state, results of verification activities, and open and other relevant sources [3]. However, two resources may be underutilized: IAEA employees in the other four technical departments, and the enormous information resources compiled and used by the four technical departments as part of their work with member states.

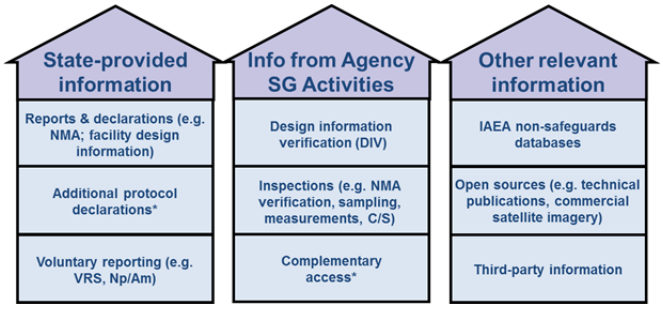
This paper reviews how the Department of Safeguards carries out information collection and analysis using its current streams of information. It then describes some of the resources that are available in the other four technical departments – primarily human resources and in-house databases and information that are the product of IAEA's non-safeguards work – and explores whether a more systematic approach to utilizing in-house resources is feasible and whether it might make Safeguards work more effective. The paper examines some of the issues that might arise from further information sharing, especially the need to ensure that safeguards confidentiality is not compromised as a result.

Department of Safeguards: Information Landscape

As noted above, the primary role of the Department of Safeguards is to detect and deter the misuse of nuclear material for purposes other than those declared. The department does so in two ways: by providing credible assurances that states are honoring their international obligations and by being able to detect any misuse of nuclear material or technology, thereby alerting the world to potential proliferation. To carry out this mission, the department applies a variety of technical measures – literally, safeguards – to verify the correctness and, for states with comprehensive safeguards agreements in force, the completeness of declarations made by states about their nuclear material, facilities and activities.

The department takes in a wide array of information about a state's materials, facilities, and activities, and then evaluates the completeness and correctness of that state's declared information through a consistency analysis of all safeguards-relevant information about that state [3]. The information relevant to and used in safeguards state evaluation can be categorized in three streams (see Figure 2). The foundation of state evaluation is reports and

declarations provided by the state, according to its safeguards agreement with the IAEA. This typically includes nuclear material accountancy reports, facility design information, declarations made under an additional protocol, if present, information provided on the basis of practical arrangements between the IAEA and the state, such as "mailbox" declarations, as well as voluntary reporting by the state, e.g. on holdings and exports of neptunium and americium. The declared data is evaluated against information derived from Agency's own safeguards activities, in the field as well as at headquarters. This includes design information verification, results of field measurements and activities, e.g. NDA measurements, review of containment and surveillance, as well as findings from complementary access, if an additional protocol is in force. Safeguards-relevant information is also obtained from other sources that may include open sources, such as scientific and technical publications, government press releases, commercial satellite imagery, and IAEA's databases maintained by the other technical departments, which is examined in detail later in the paper. All of this information is first assessed for credibility, and then for overall consistency to evaluate the completeness and correctness of the state's declarations [3].



** Where applicable*

Figure 2: Safeguards-relevant information

Resources of the IAEA's Non-Safeguards Technical Departments

The IAEA's approach to safeguards implementation recognizes, and seeks to take advantage of, the fact that several resources produced by IAEA's other technical departments contain information that is potentially relevant for safeguards [4]. These information sources are typically of high quality and credibility, because they contain information produced by the IAEA itself or submitted by states and vetted by the Agency. In this section we describe those resources, before examining in subsequent sections whether and how still better use of them could be enabled.

Some of the Agency resources are publicly-open sources of information freely available on the web, e.g. the INIS database, which is the world's largest collections of published information on the peaceful uses of nuclear science and technology, including from scientific journals, as well as conferences and workshops with and without Agency participation. Databases on research reactors and power reactors – the RRDB and the Power Reactor Information System (PRIS), respectively – contain, inter alia, some information on the technical parameters of reactors, their operating history or utilization data. The INFCIS – Integrated Nuclear Fuel Cycle Information Systems – is a resource produced by the Nuclear Fuel Cycle and Materials Section in the Division of Nuclear Fuel Cycle and Waste Technology. The INFCIS website consists of four databases and one computer simulation system on nuclear fuel cycle activities around the world.

Some resources are available to all IAEA staff, including Safeguards, from Agency IT systems, e.g. IAEA Travel Report System. This system contains reports of all Agency-funded travel, except trips performed as part of safeguards verification activities in the field or other sensitive activities. These trips might range from, say, a workshop coordinated by experts

from the Nuclear Fuel Cycle and Waste section on Strengthening Regional Capabilities for Uranium Mining and Milling to a Technical Cooperation project manager's visit to review the implementation of a regional project to decommission and remediate former nuclear facilities and sites, or a trip to assess the progress of a national TC project to evaluate nuclear reactor technology for near-term deployment, or an OSART mission to assess the safety of a nuclear power plant [5]. The reports typically contain travel dates, locations, and personnel involved, as well as a brief summary of activities performed, outcomes achieved, and recommendations for follow-up.

Finally, some resources are available only in a limited form outside of the administrative unit that generates the resource – this includes many databases produced by other technical departments,[1] e.g. Incident and Trafficking Database (ITDB), Technical Cooperation databases. These resources are available to IAEA staff, including analysts in the Department of Safeguards, on a need basis, with login credentials. In the area of Technical Cooperation, the Programme Cycle Management Framework (PCMF) contains information on national and regional TC projects, including institutions involved and equipment or training delivered as part of a project. The ITDB, maintained by the Department of Nuclear Safety and Security, contains information on incidents of illicit trafficking and other unauthorized activities and events involving nuclear or other radioactive material outside of regulatory control, either reported by the states or from open sources.

The information obtained by Safeguards analysts from these sources can be used for safeguards state evaluation in a variety of ways. For example, a TC project can help provide insight into a state's progress to develop nuclear power, and can be used to assess the completeness of a state's additional protocol declaration, specifically Article 2.a.(x) on the state's ten-year plans for its nuclear program. An RRDB entry for a state's research reactor and its associated experimental capabilities is useful in evaluating the state's design information questionnaire for that reactor and during the design information verification activities in the field. An ITDB incident involving nuclear material confirmed by a state is another data point in evaluating a state's nuclear material accountancy reports.

The IAEA Statute encourages, and on some occasions compels, member states to share scientific information with the Agency, and mandates the Agency to share this knowledge to encourage exchange of information relevant to the peaceful use of nuclear energy among its member states [1, Article VIII]. Safeguards information is stored on separate servers from the rest of the Agency, behind additional firewalls. The Agency is statutorily required to protect sensitive information [1, Article VII, paragraph F].[2] Within Safeguards, information used for state evaluation is restricted to as-needed basis, managed on the departmental IT infrastructure in country files accessible only to state evaluation groups assigned to a given state and management [6]. Any proposals for further improving information sharing within the Agency, in particular any that would involve sharing of information originating from or being maintained within Safeguards outward, would need to take full account of these critical information security requirements, as will be discussed later in the paper.

Enhancing the Use of the IAEA's Information Resources

[1] http://nucleus.iaea.org/

[2] This may also include information in the databases of the other technical departments that may pertain to the security and safety of nuclear facilities or nuclear material.

Through their prior experiences and their work assignments at the IAEA, staff in other technical departments have rich knowledge about nuclear and nuclear-related activities in member states that could prove potentially useful to staff evaluating safeguards compliance in these states. While the Department of Safeguards is the largest single department in the IAEA, the other four technical departments are made up of staff of about a 1000 people who, like Safeguards staff, are drawn from around the world [2]. Staff members in these departments are responsible for facilitating and coordinating projects that involve every facet of the nuclear fuel cycle and a wide variety of nuclear applications, and they work with counterparts in every one of the IAEA's 164 member states. They run a variety of projects and programs, usually at the request of member states, including Cooperative Research Projects, workshops, training courses, and consultancy meetings. As a result, there are a thousand people co-located with the Department of Safeguards who possess a wealth of technical, geographic and facility knowledge about most of the same states and facilities Safeguards deals with. Furthermore, the work they produce – travel reports, publications, meeting materials and databases – contains myriad details that could be of great value to Safeguards.

While Safeguards inspectors and staff in the other technical departments may have access to the same facilities, their interactions with states are likely to form largely different networks of people, especially in states with more than a few facilities. Safeguards staff typically interact with State or Regional System of Accounting for and Control of Nuclear Material (SSAC/RSAC) liaisons in a state, and with facility managers and operators. Members of other technical departments typically interact with both facility operators and other facility staff, as well as with researchers, academics, and government officials with whom Safeguards does not routinely interact. This means that in addition to having different knowledge and technical backgrounds, staff in the other technical departments often have vastly different networks in member states, which gives them a different view of a state and, sometimes, a different entree than Safeguards staff have. The information gained as a result of working with different networks could prove useful for confirming the consistency of declarations about states' nuclear activities, and this is something that should be explored. However, care would have to be taken to ensure there is no conflation of the mission of Agency assistance projects with Safeguards'.

Inter-Departmental Collaboration: Human Resources

The Technical Cooperation (TC) program shows that inter-departmental collaboration can work fairly simply and be highly productive. The TC program is one of the main mechanisms through which the IAEA delivers services to its member states, by helping them build, strengthen and maintain nuclear technology capacities. TC is primarily staffed by program officers who liaise with state representatives and manage and oversee projects, but the technical expertise for each project is provided by staff in other IAEA departments [7]. To run a project, TC helps define the framework with the state by identifying the project purpose and ultimate goal, and then recruits the appropriate IAEA technical staff to help the state achieve its project goals. For example, if a state wants to produce medical isotopes, they might approach TC with a project idea, and TC would put together a team of IAEA experts from the departments of Nuclear Sciences and Applications and Nuclear Energy to work with the state on establishing a supply chain for isotope targets, calculating irradiation times in their reactor, setting up hot cells to chemically process the targets, and procuring medical-

grade kits to transport the isotopes and dispense them at radiopharmacies. To find the right expert personnel, TC contacts the relevant department (usually at the section head level) to see who would be the best equipped to work on the project. This requires TC officers to understand the IAEA's departmental structure, and where people with specific expertise sit. The departments also provide a list of points of contact to TC (now in the form of an online database housed in TC), so the TC program officer has a ready-made list of people to get in touch with as projects arise.

Another example of sharing of in-house knowledge was evident when the Department of Nuclear Safety and Security – which houses the IAEA's Incident and Emergency Center (IEC) – was spearheading the IAEA's response to the 2011 Fukushima Daiichi nuclear power plant accident, working directly with Japan immediately after the earthquake and tsunami. In its normal/ready mode, the staff of the IEC is quite small, numbering about two dozen people. But when incidents or emergencies do occur, using its Incident and Emergency System (IES) the IEC is able to put together teams of staff with specialized skill sets – language skills, technical or specific facility knowledge, emergency management, and communications, for example. In the case of the Fukushima Daiichi emergency, staff from every IAEA department were immediately seconded, especially people with Japanese language skills and knowledge of the Fukushima power plant or similar boiling water reactors. 230 IAEA staff members (including from Safeguards) worked in IEC in shifts covering 24/7 for 54 days [8]. In order to help assemble these teams, the IEC created a survey to compile the skills of IAEA staff and build a database populated with information such as languages spoken, technical expertise, and communications expertise. The IES training program enables IAEA staff to learn and exercise how to respond to emergencies when the IEC is activated. There is also a concise orientation available for quickly bringing a staff member up to speed, if needed. Thus, in order to respond quickly and effectively to large scale emergencies like the Fukushima Daiichi accident or to smaller incidents involving radiological sources, the IEC can efficiently query the necessary skills needed for each individual response by using the database of in-house human resources.

Former IAEA Director General Mohammed ElBaradei regularly promoted a "one-house" approach to implementing all of Agency's programs "…to improve impact, effectiveness and efficiency," as has his successor Director General Yukiya Amano [9]. While inter-departmental collaboration and resource- and information-sharing is the modus operandi for the other four technical departments of the IAEA, the Department of Safeguards is necessarily more constrained in its ability to do so. New hires in Safeguards undergo months-long intensive training in safeguards processes, methods, techniques, etc. Inspector designations have to be accepted by states before staff are permitted to participate in field work. For these reasons, there are limits to the non-Safeguards staff potential involvement in safeguards activities. And, there are stringent confidentiality requirements on safeguards-sensitive information. Because of these constraints, the Department of Safeguards takes advantage of inter-departmental collaboration and information- and resource-sharing infrequently and on an ad-hoc basis. For example, an inspector preparing to go in the field to a research reactor that produces medical isotopes with highly-enriched uranium may reach out to staff from the Department of Nuclear Energy's Research Reactor Section to learn more about the specifics of how medical isotopes are produced to help them understand the process, the equipment and the material flow. Or, analysts evaluating a scientific article about uranium mining in a particular state might contact experts in the Nuclear Fuel Cycle and Material Section to better understand the specific uranium extraction methodology being

discussed. These types of interactions tend to be the exception rather than the rule. Despite the constraints, there are some practical ways to improve information- and resource-sharing and collaboration between Safeguards and other departments.

Inter-Departmental Collaboration: Information Exchange

Through their work, the other four technical departments produce or collect a mountain of information in the form of publications, databases, presentations given by IAEA staff and member states at meetings, and travel reports from field visits. These documents often contain information that is potentially safeguards-relevant for consistency analysis of state-declared information – things like facility photos, specifications of nuclear fuel in reactors, facility design information, and updates on facility construction status. However, details in these data sources that are made available to the general public or even Agency-wide are typically scarce. Furthermore, there is no centralized repository for documents supporting the preparation of or resulting from the technical departments' interaction with states, such as meeting reports or workshop materials. Some of these documents, for larger meetings organized by the Agency, are placed on the IAEA's public website after the fact or uploaded into INIS, but a large portion of material is archived for in-house use only, and is not accessible outside of the originating department. In short, there is a large quantity of information that could prove extraordinarily useful for Safeguards purposes, if Safeguards staff knew what was there and had a means of accessing it. In fact, this information would be useful for all of the IAEA's technical departments, allowing staff to have a much better overview of the work that has been done previously on any given subject so they can learn from it and move it forward rather than duplicating it.

Institutionalizing Information Sharing

As it stands currently, the department of Safeguards does a large amount of data collection and analysis to a very high standard. The purpose of this paper is to point out that there is a wealth of information collected or generated by the other IAEA technical departments that is potentially safeguards-relevant and, while recognized and used to some extent, could be utilized more fully. As Safeguards staff get to know their colleagues both within and outside of the department, they form working relationships that allow for an informal knowledge exchange on an ad hoc basis. But forming working relationships with colleagues across departments takes time, and the Agency's rotation policy hinders the formation of good working relationships. Finding ways to institutionalize in-house information sharing – of both human resources and documents – would allow the Department of Safeguards to better utilize the vast resources that are in-house, and it would likely facilitate better working relationships between and among departments as Safeguards analysts learn more about the IAEA's overall work and get to know their colleagues involved in individual projects.

Some institutional inter-departmental information sharing involving the Department of Safeguards already takes place. For example, a Safeguards country officer will be notified of an incident involving nuclear material by the Division of Nuclear Security (Department of Nuclear Safety and Security) that maintains the ITDB. Once a state confirms that an incident involving nuclear material has occurred on its territory,[3] the state must make relevant nuclear

[3] This could include loss, discovery and seizure, or illicit removal or transfer to another location within a state.

material accountancy reports to the IAEA. Receiving timely notification from the ITDB of gain, loss or transfer of nuclear material enables the Department of Safeguards to evaluate in a timely manner a state's declarations and respond by adjusting safeguards verification measures accordingly. In another example, the Department of Safeguards also supported the Department of Nuclear Safety and Security's Incident and Emergency Centre's coordination of the IAEA's response to the accident at the Fukushima Daiichi power station by making available commercial satellite imagery of the site

The Department of Safeguards and the Department of Technical Cooperation have also established an interface for cooperation on evaluating proposed and ongoing TC projects to ensure that no Agency assistance will be used to further any military purpose [10]. The two departments also collaborate on jointly training their staff on objectives, activities and resources of the other department. This allows staff of each department to understand better how the other operates, what and how information may be shared, and limitations of various data systems.

Existing Challenges and Next Steps

Opportunities certainly exist for similar knowledge exchanges with other departments. The other technical departments employ knowledgeable and experienced experts in every facet of the nuclear fuel cycle, e.g. reactor technologies, uranium mining and milling, fuel fabrication, waste processing. While new safeguards inspectors come from a variety of fields, they have typically been exposed in their previous occupations only to a narrow slice of the nuclear fuel cycle. The department offers a comprehensive in-house training program to familiarize new inspectors with the full fuel cycle, but limited time and resources of the Department make it unfeasible that training could accommodate everyone who is interested or be provided on-demand. The Department could take advantage of the additional subject matter expertise available elsewhere within the Agency to train inspectors and analysts on existing and future advanced nuclear fuel cycle technologies. Such training courses could be organized on a much more frequent basis than courses that are part of the formal Safeguards training program, and especially those that are offered with the help of Member State Support Programs, for example. An added benefit, as noted above, is that given the nature of the other departments' activities in member states and the fact that the Agency's counterparts within those states are frequently not the SSAC/RSAC, it might offer the Department of Safeguards a different perspective on the subject. Separately, if some of Safeguards training were made available to staff from other departments – for example on the goals and approaches of Safeguards – this would augment their work by allowing staff from other departments to gain a better understanding of how Safeguards works, and what types of information they are able to best utilize. The Agency could benefit from coordinating technical training of this nature among its departments to ensure that adequate human and financial resources within departmental budgets are available to make additional training possible.

Information sharing and inter-departmental collaboration can be made easier. The IAEA may wish to create an Agency-wide "skills roster," similar to what the IEC uses or to the Department of Safeguards' own efforts to establish a department-wide skills roster, so that Agency staff, including Safeguards, can find experts in certain technologies, materials, languages, and facilities or facility types. Obviously, much of the work in Safeguards needs to remain strictly compartmentalized, like state-specific details, but some of it does not. Knowing whom to call would benefit staff by making it easier to find an expert quickly and

to ask questions directly where possible, or to consult in general where direct questions may not be appropriate.

Not knowing whom to contact is further amplified by not being aware of what information may be out there, or not being able to access it. Another way to facilitate better information flow would be to create an IAEA-wide searchable database for all workshop and meeting reports, presentations, and information that is generated by IAEA work. As mentioned above, currently, each department (and sometimes individual sections) manages its own information, and makes that information available on an ad-hoc, upon-request basis. While some of that information must remain compartmentalized for security or safeguards-confidentiality reasons, a good deal of it could be shared internally within the IAEA. IT infrastructure does not necessarily pose a challenge, but would need to be developed and secured. INIS is one good example of a large number of publications being brought together into a centralized database; the NUCLEUS system also corrals more than a hundred of the IAEA's databases into one front page. Both of these resources are good examples of what an Agency-wide (but IAEA-only) resources might look like – it would allow for all of the IAEA's work in the area of promoting and facilitating the peaceful uses of nuclear energy and technology such as workshop and meeting notes, presentations and trip reports, to be brought together into a centralized repository. An intermediary step could be a cross-departmental catalog or index of the meetings, conferences, and projects that involve Agency staff to facilitate easier access to information by identifying who has what, and allowing an interested party to make the case for why they need access to it. These efforts would also help mitigate a major negative consequence of a rotation policy – potential loss of continuity of knowledge, where information or knowledge may be lost due to staff members leaving the Agency.

Increasing inter-departmental collaboration is not without its challenges. Recent papers have highlighted administrative and structural characteristics of the Agency that present barriers to more collaboration within the Agency [11]. Additionally, a chief concern is meeting the Agency's legal obligations to protect the confidentiality of certain information provided by member states to their various counterparts in the Agency, particularly with regards to safeguards, security, and commercial proprietary information. Reports and declarations made by states according to their safeguards agreements are categorized at least at the level of safeguards-confidential. Even within the department, all safeguards-relevant information for a particular state is available only to those staff members that are assigned to evaluate safeguards implementation in that state. Similarly, facility-related data provided by states to the research and power reactor databases housed outside of Safeguards is potentially sensitive for security and commercial considerations, and is not accessible by anyone outside of database administrators. However, a lot of information, in Safeguards and elsewhere, is not sensitive, i.e. it would not jeopardize the security and safety of nuclear material and facilities, the commercial interests of nuclear fuel cycle-related enterprises or operators, the confidentiality expectations of state authorities, or safeguards implementation. While there is a limit to how much and what kind of information can be shared out of the respective departments, taking steps to build relationships between Safeguards and the other departments and to make sharable information more accessible can still be undertaken, e.g. in the area of training, a clearinghouse for all non-operationally sensitive information, an Agency-wide roster of in-house experts.

Ultimately, improvements in information sharing and inter-departmental collaboration will need to be encouraged and enabled from above. Recognizing the benefits that may come

from increased collaboration and access to more information resources containing relevant information for all Departments, and Safeguards in particular, and breaking down organizational barriers that are counterproductive to collaboration would encourage a change in institutional practices and culture, and enable the Agency to carry out its mission more effectively.

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