

Small Quantities Protocol to Comprehensive Safeguards Agreement: Transition Challenges for Saudi Arabia to Embark on the Nuclear Energy Program

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Abstract:

As a non-nuclear weapon State, the Kingdom of Saudi Arabia (KSA) is a party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). It has signed a bilateral comprehensive safeguards agreement (CSA), INFCIRC/746, with the International Atomic Energy Agency (IAEA). It is monitored through the original standard text of small quantities protocol (SQP) due to the country's limited nuclear material or activities. Despite significant developments in nuclear energy during the last few years, the KSA has not updated its operative SQP but recently decided to transition towards CSA. Nevertheless, IAEA discovered in 2005 that its ability to verify whether the SQP States continue to qualify for the agreement is undermined due, inter alia, to the suspension of submission of an initial report on all nuclear material subject to safeguards, provision of early design information of the facility and inspection activity are, therefore held in abeyance. The SQP will remain operational if the total quantity of nuclear material within the territory of KSA or under its jurisdiction does not exceed the amount specified in Article 36 of INFCIRC/746 or till the introduction of fuel in the low-power research reactor. A typical regional safeguards model for the Middle East, considered as a golden standard, is to conclude CSA with additional protocol (AP) without implementing the nuclear fuel cycle activities. It is likely that eventually, the KSA may follow suit with the region and conclude an AP to its CSA. However, KSA's ambitions to utilize domestic uranium resources to develop an indigenous nuclear fuel cycle pose additional safeguards obligations and implementation challenges for the country. As an SQP country, preparing for international legal obligations to show transparency in its nuclear energy program for the peaceful use of nuclear energy is a big challenge. This essay analyses the obligations associated with adopting the legal framework for verification and the corresponding challenges that will emerge in its implementation for KSA. The most important areas include the development of regulatory infrastructure, an effective State system of accounting for and control of nuclear material (SSAC), preparation of initial physical inventory listing, inspection regimes, human capacity building, and nuclear import/export control, to name a few.

Keywords: Nuclear Safeguards, Small Quantities Protocol, Saudi Arabia, Comprehensive Safeguards Agreement

1. Introduction

Nuclear safeguards for non-nuclear weapon States are vital technical measures to promote the peaceful use of nuclear energy by substantiating the exclusive use of nuclear material and activities for the benefit of humanity. The SQP to CSA [1], which the IAEA designed in the early seventies to incentivize novice non-nuclear weapon States with negligible nuclear materials and activity, proved a blessing in disguise for the signatory countries. Since SQP undercut IAEA's ability to monitor real-time transparency of nuclear materials and activities as most of the actions in Part II of INFCIRC/153 (Corr.) [2], are held in abeyance, and thus, currently, the original SQP has become a dilemma for the IAEA. Despite substantial international diplomacy to either rescind or amend SQP [3], numerous countries are still party to the original text of SQP, which emerges as a significant challenge for the Agency [3, 4].

The agreement between the KSA and the IAEA for the application of safeguards in connection with the Treaty on the NPT [5] was signed in Vienna on June 16, 2005 and entered into force on January 13, 2009 [6]. The safeguards agreement between KSA and the IAEA was documented in the INFCIRC/746. The SQP was appended to its CSA INFCIRC/746 pursuant to the treaty obligation of NPT. According to the SQP, most of the implementation provisions of PART II of the CSA have been held in abeyance due to presence of the small or no nuclear materials in the Kingdom [6]. However, Articles 32, 33, 38, 41, and 90 of part II of the agreement are operational regarding material in mining or ore processing activities (not subject to safeguards), import and export of pre-c(33)¹ and c(33)² nuclear materials, subsidiary arrangements detailing the scope of the agreement to fulfill its responsibilities, design information of existing and new facilities as early as possible before fuel loading, international transfer of nuclear materials in or out of Saudi Arabia and exchange of safeguards responsibility of the material respectively.

1 Reporting of exports/imports of any material containing U or Th (pre-33(c) material).

2 Nuclear material of a composition and purity suitable for fuel fabrication or isotopic enrichment (33(c)-material) subject to the other safeguards procedures.

The KSA is moving ahead in its nuclear energy program as bids have been received to build large nuclear power reactors, and the introduction of nuclear fuel in the first nuclear research reactor which is currently being installed by INVAP of Argentina, is expected to be operational soon. The SQP will no longer be applicable as and when either nuclear fuel is loaded into the reactor or nuclear material exceeds the limit stated in Article 36 of INFCIRC/746 [6], which follows:

- I. One kilogram in total of special fissionable material, which may consist of one or more of the following:
 - a. Plutonium;
 - b. Uranium with an enrichment of 0.2 (20%) and above, taken account of by multiplying its weight by its enrichment; and
 - c. Uranium with an enrichment below 0.2 (20%) and above that of natural uranium, taken account of by multiplying its weight by five times the square of its enrichment;
- IV. Ten metric tons in total of natural uranium and depleted uranium with an enrichment above 0.005 (0.5%);
- V. Twenty metric tons of depleted uranium with an enrichment of 0.005 (0.5%) or below; and
- VI. Twenty metric tons of thorium.

Whenever the amount of nuclear material exceeds the aforementioned limit, the safeguards procedures in Part II of INFCIRC/746 will no longer be held in abeyance. Consequently, a CSA will take into account for of all nuclear material in the country. The Kingdom has recently shown its intention to rescind the SQP and move on to the CSA [7], which will be in effect after fulfilling the official formalities with the IAEA. Since most of the States with SQP have minimal nuclear materials or any facility, they need more experience in establishing and maintaining the SSAC, reporting nuclear materials, facilitating inspection activities, etc. [8, 9]. Subsequently, the obligation under CSA will pose immense challenges to the implementation of the safeguards agreement in the Kingdom. Moreover, if KSA moves further towards accepting AP due to nuclear fuel cycle related ambitions [10], rigorous requirements would have to be fulfilled to demonstrate the confidence-building measures for the international community. Thus, a reasonable capacity in nuclear safeguards is required to support the transition from SQP to CSA and effectively implement CSA along AP (if applicable). This essay highlights some of the developments made by the KSA in fulfilling IAEA requirements and emerging challenges for the implementation of safeguards obligations under the respective legal framework. Some of the critical milestones yet to be achieved are the establishment of an effective SSAC, training of licensees/plant operators in reporting to State authority, capacity building of Nuclear and Radiological

Regulatory Commission (NRRRC) staff, and development of safeguards infrastructure of NRRRC for licensees' verifications and the promulgation of regulations and its flexibility to adapt to the AP (if applicable).

2. Establishment of the national nuclear regulatory authority

The Kingdom's State nuclear law has been developed in consultation with the IAEA and enacted in connection with the international legal instruments [11]. The NRRRC has been established to implement the Kingdom's international obligation under the safeguards agreement with the IAEA [12]. The NRRRC is the competent authority designated by the Kingdom responsible for maintaining a SSAC as a regulator. Moreover, NRRRC is responsible for the transmission of correct and complete reports, declarations, and other relevant information to the IAEA. NRRRC has designed the technical regulations for the implementation of safeguards in the KSA. Some critical functions of NRRRC are evaluating and issuing licenses for nuclear materials-related activities, facilitating IAEA inspection under CSA/SQP and/or AP, conducting inspections and audit activities of licensees, etc.

3. Legal framework

A robust national framework is vital for effective regulatory control for the safe, secure, and peaceful application of nuclear energy and ionizing radiations. The KSA is a party to NPT and has a safeguards agreement (INFCIRC/746) with the IAEA [6]. The government recently promulgated the Law of Nuclear and Radiological Control as a national legal framework through Royal Decree No. M/81 of 25/7/1439 AH (10/4/2018 AD) to fulfill the Kingdom's obligations invoked by signing safeguards agreements and other relevant treaties and conventions [13]. This demonstrates a firm commitment of KSA to the responsible use of nuclear materials and exhibits transparency of its nuclear activities within the international community.

According to the national legal framework [13], a license is required to carry out any activity related to nuclear materials unless an exemption from the NRRRC is granted as per the rules described in Article V of the Law on Nuclear and Radiological Control. The licensee will be responsible for safety, security, and safeguards, and maintaining the account and operational records of nuclear and radioactive materials, and submitting periodic reports to the NRRRC. As described in Article XIII of the law, the NRRRC will adopt an accounting system to manage and monitor the inventory of nuclear materials. Moreover, the Commission is responsible for the verification of the implementation of the safeguards agreement and coordinating with the concerned agencies to facilitate the entry of the IAEA inspectors into the Kingdom. The Commission is also responsible for

setting up an inspection program for activities and facilities and has powers to conduct periodic and unscheduled inspections to examine the appropriateness of procedures for nuclear safety, security, safeguards, etc., as per Article XX of the law.

It is essential to highlight that in some cases, the national legal framework would require some modification if AP is adopted. The national legal framework is believed to have the flexibility to cater to the obligations under CSA and AP (if applicable).

4. State system of accounting for and control of nuclear material

According to Article 7 of the IAEA safeguards agreement (INFCIRC/746), the KSA is required to set up and operate a SSAC. The NRRC is working on the development and management of the SSAC. The organization is solely responsible for controlling nuclear-related items such as nuclear material goods, technology, software, and/or nuclear-related information and non-nuclear dual-use items. In order to effectively implement the nuclear law, the regulation (NRRC-R-12) Nuclear Material Accountancy and Control regulation has been designed to define the responsibilities of the licensee and to establish the requirements for the application of the National System of Control of Nuclear Material and Nuclear Activities [14]. The main objective of this regulation is to implement the obligations under the CSA (INFCIRC/746) between the Kingdom and the International Atomic Energy Agency. The regulation provides the information and responsibilities for the licensees to carry out nuclear activities regarding accountancy and control of nuclear material and provisions of related information. It further describes the procedures for establishing and maintaining accounting for and control of nuclear material by the authorized person at the facility and location outside the facility (LOF) level. An effective SSAC will facilitate the NRRC and IAEA inspections to measure and verify nuclear material flow and physical inventory accurately.

Furthermore, the licensee has to provide the design information of the facility immediately after the decision is taken to construct the facility and will submit it to the NRRC and other relevant information about the LOF. The facility operator will submit a special report in the event of loss of nuclear material and breach or any damage of containment and surveillance equipment. Moreover, the operator of the facility is liable to submit an activity program regarding the domestic and international transfer, import, and export of nuclear material and ore containing uranium or thorium.

5. Responsibility of State under original SQP

The KSA is a party to SQP based on the original text of 1974 (GOV/INF/276/Annex II). Indeed, a very small quantity of nuclear materials well below the threshold limit is currently present across the Kingdom to maintain an SQP [15]. The possible existence of source material could be in the form of depleted uranium as shielding for medical and industrial radiographs and small laboratory-scale samples for education, training, and research purposes in national laboratories, universities, and oil drilling companies. Thus, the KSA is meeting the criteria to qualify for the SQP so far. The lab-scale nuclear materials are usually not under the license and should be disposed of at a safe and secure place. The obligations of the SQP based on the original text on KSA have remained operational if the quantities of nuclear material within the KSA territory or under its jurisdiction anywhere do not exceed the limits as stated in paragraph 37 of INFCIRC/153 (Corr.), or until nuclear fuel is introduced in a research reactor [8].

Furthermore, plans are underway to build the first nuclear power plant to generate electricity in the Kingdom. Under the current agreement with the IAEA, the KSA is required to report to the IAEA regarding the design information of the facilities, such as the research reactor, at least 180 days before nuclear fuel is loaded into it. In addition, KSA has to report to the IAEA any exports and imports of nuclear material (if applicable) and any material comprising uranium and thorium that has yet to be processed so finely qualifying for fuel fabrication or enriching isotopically. Moreover, the establishment of the operational SSAC, for which regulations have been formulated, and KSA is working actively to fulfill this obligation.

Upon rescission of the SQP and transition to CSA, the new responsibilities of KSA are to negotiate subsidiary arrangements if they have not been done before and make their best effort to achieve its entry into force as soon as possible within 90 days of CSA becoming effective. In addition, the KSA must provide the initial report on all nuclear material with a complete description of the material and the location information in the State within 30 days of the last day of the calendar month in which the CSA comes into force, and provision of information on nuclear material customarily used outside the facility (if available) with complete details. The KSA is responsible for providing the design information of the existing facility during the discussion of the subsidiary arrangements, such as the low-power research reactor. For new facilities, the time limit for the provision of design information to the IAEA should be specified in the subsidiary arrangements and should be provided as soon as possible before fuel is loaded. Finally, to facilitate access for IAEA inspectors, the KSA must provide IAEA access to locations and information necessary for the inspectors to conduct inspections, the most critical safeguards measure to verify the State obligations.

6. Developing human resources

Trained human resources with specialized skills and abilities are required for the NRRC's effective functioning, which poses a big challenge for an SQP country like the KSA. The staff must carry out various activities, ranging from regulatory development to inspections, and need multidisciplinary background and specialized training. The workforce has to be versed in communicating and explaining technical issues to administrations, diplomats, licensees, and IAEA inspectors.

In most cases, the possessors of nuclear materials in the country are unfamiliar with the international obligations about reporting of nuclear materials under the safeguards agreement. Therefore, the training of possessors of nuclear materials holders to maintain up-to-date records related to all nuclear materials in their custody and reporting to NRRC is essential. Moreover, this process is vital for annual reporting to the IAEA and verification by the NRRC and IAEA inspectors when it is required. In addition, capacity building is necessary in searching out various installations, industries, and R&D activities that are using nuclear materials subject to safeguards. Additionally, performing outreach to different entities that may come under the new national regulatory control regarding safeguards agreements has to be undertaken. In the case that the KSA signs AP, it is highlighted that the national legal framework may require modifications, and substantial efforts and capacity building are necessary by the NRRC to convey new regulations and responsibilities to the entities affected by the AP.

In consultation with the IAEA, the King Abdullah City for Atomic and Renewable Energy supports human capital development through academic programs in nuclear engineering. It is essential to highlight that the curriculum should be complemented by introducing nuclear safeguards courses to stimulate students' interest and establish a safeguards culture through education and training. In addition, specialized courses in safeguards to train the practitioners working in the field are also essential. For instance, the Kingdom's first low power research reactor (LPRR) will commence operation soon. It is of utmost importance to conduct training sessions for capacity building of the research reactor staff in nuclear safeguards before introducing fresh nuclear fuel in the reactor in handling all aspects of safeguards implementation-related activities with the IAEA and NRRC.

7. Conclusion and the way forward

The KSA has made significant progress in its nuclear power generation infrastructure to diversify its energy mix program. For instance, a national legal framework has been formulated, NRRC and Saudi Nuclear Energy Holding Company have been established, a research reactor facility in collaboration with Argentina has been built, and the

government has received technical bids for two large nuclear reactors. As a non-nuclear weapon State, KSA is a party to NPT, efficiently fulfilling its obligation regarding the safeguards agreement of small quantities protocol appended to its CSA (INFCIRC/746). However, there may be a proliferation risk due to the exemption of most of the reporting and inspection obligations. Eventually, the Kingdom is gearing up for a full-scale civilian nuclear energy program, including a front-end nuclear fuel cycle. The government has finally decided to revoke its SQP and adopt the CSA. This will facilitate KSA to load the fuel in the low-power research reactor, undertake construction of new power plants, and perform other activities under the verification regime of the IAEA. Despite significant developments in nuclear infrastructure, enormous challenges still exist for KSA to fulfill the requirement of the IAEA through stricter checks on its nuclear activities. The development of a strong-trained manpower is a prerequisite to address and tackle such issues. The most crucial challenge for KSA in the transition from SQP to CSA lies with NRRC in developing and operating an effective SSAC and preparing it for the implementation of CSA to meet complete requirements of the agreement, including bringing into force the timing of subsidiary arrangements, training of NRRC and operating personnel in safeguards, collecting and inspecting the initial physical inventory listing information to be provided to the IAEA for all nuclear material subject to safeguards and preparing for the IAEA inspections for verification of information contained in the report. It is essential to highlight that KSA should work more closely with the regional States and IAEA to benefit from their experience and best practices for safeguards implementation effectively and efficiently.

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