

IAEA Safeguards in Pakistan and Emerging Issues/Challenges

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Abstract. Implementation of IAEA Safeguards in Pakistan dates back to March, 1962 when a trilateral safeguards agreement (INFCIRC/34) was signed for the supply of Pakistan Research Reactor-1 (PARR-1). Since then Pakistan has concluded several safeguards agreements with the Agency. All the safeguards agreements concluded by Pakistan are governed under the Safeguards Document INFCIRC/66/Rev.2, which is a model for countries not party to NPT (Treaty on the Non-Proliferation of Nuclear Weapons). As per this model the item-specific safeguards are applied to Pakistan's nuclear facilities. Being a 66-type country, some times, very peculiar nature of safeguards issues arise that are not common in the States with Comprehensive Safeguards Agreement (CSA) and which pose challenges for both the IAEA and the country. In Pakistan, not only nuclear material, but non-nuclear material is also subjected to safeguards under the respective Safeguards Agreement. At KANUPP, for example, the heavy water used as moderator and coolant, is under IAEA safeguards. The Suspension and Termination options of INFCIRC/66/Rev.2 are atypical from comprehensive safeguards and are utilized in Pakistan to resolve various issues. For example, the HEU plates are targeted in a safeguarded research reactor (PARR-1) for Mo-99 production, which are then separated in an unsafeguarded Moly Production Plant employing the suspension clause of INFCIRC/66/Rev.2. The Additional Protocol substantially enlarges the IAEA's ability to check for clandestine nuclear activities and facilities. The requirements of the Model Additional Protocol are basically designed for the non-nuclear-weapon states-parties to the NPT; the nuclear weapon states are, however, free to choose among or limit the application of the provisions of the Model Additional Protocol. The INFCIRC/66/Rev.2 countries (countries not party to the NPT) may analyse the impact to their programme, of adhering to the Additional Protocol. However, INFCIRC/66/Rev.2 countries, just like the nuclear weapon states, are also free to choose among the provisions of the Model Additional Protocol.

1. Preface

The focus of the international community has always been to ensure that nuclear energy is used peacefully and safely. The ultimate objective of the international community is the fulfilment of general and complete disarmament on global level. Concern about the potential military use of nuclear material, the development of international trade in nuclear material and related equipment, and the entry into force of certain international treaties have led to the establishment of systems of international safeguards. The safeguards is basically a set of measures against the use of nuclear material, facilities and equipment for the development of nuclear weapons and other nuclear explosive devices. IAEA has served as a focal point so as to accelerate and enlarge contribution of atomic energy to peace, health and prosperity throughout the world and to ensure so far as it is able, that the assistance provided by it or on its request or under its supervision or control is not used in such a way as to further any military purpose through the implementation of its safeguards system.

2. IAEA Statute

Article-III A.5 of the IAEA Statute authorizes the Agency to establish and administer safeguards designed to ensure that special fissionable and other materials, services, equipment, facilities, and information made available by the Agency or at its request or under its supervision or control are not used in such a way as to further any military purpose; and 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. The Agency's rights and responsibilities with respect to application of safeguards are further explained in Article XII of the Agency Statute.

3. IAEA Safeguards

Safeguards are technical means of verifying compliance with legal obligations relevant to the peaceful uses of nuclear energy. Their objectives are political, that is, to assure the international community of the peaceful nature of safeguarded nuclear activity and to deter the diversion or misuse of safeguarded materials or facilities through the risk of early detection.

The objective of Safeguards, in the agreements concluded under the NPT, is the timely detection of diversion of significant quantities from peaceful nuclear activities to the manufacture of nuclear weapons or other nuclear explosive devices or for purpose unknown and deterrence of such diversion by the risk of early detection. However, in safeguards agreements concluded under the non-NPT system (INFCIRC/66/Rev.2) the same concepts apply but within the domain of specific facilities.

The safeguards system has a number of basic features which should be understood. The first is that the application of safeguards is primarily but not exclusively based on information provided by the State as to the existence of nuclear material or equipment that should be subject to safeguards. The Agency, however, has a right to undertake special inspections to ensure that all nuclear material that are subject to safeguards are in fact safeguarded and for that purpose to obtain and have access to additional information and locations to guard against possible undeclared activities.

The second is that safeguards cannot by themselves prevent a violation by a State of its obligations not to divert nuclear material from peaceful purposes. The system is designed as an early warning mechanism to initiate the necessary procedures for remedial action in case of violation. Under the IAEA Statute, non-compliance with safeguards obligations is to be reported to the United Nations Security Council (UNSC) for appropriate action. The third is that safeguards cannot assess the future intentions of States. The system can be analogized to a radar device which can only report on the existing situation.

4. Safeguards in Pakistan

Pakistan is amongst the category of States that are not party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). The rights and obligations of the IAEA and Pakistan under the safeguards agreements for this category of states are based on guidelines contained in Safeguards Document (INFCIRC/66/Rev.2 or its earlier versions) adopted by the IAEA Board of Governors. Agreements in this category cover only specified facilities and materials. Assurances by the IAEA are necessarily limited to the safeguarded facilities or materials and do not extend to cover the totality of the State's nuclear activities. As per this model the item-specific safeguards are applied to Pakistan's nuclear facilities. Pakistan has the following facilities under IAEA safeguards:

1. Pakistan Research Reactor-1 (PARR-1)
2. Karachi Nuclear Power Plant (KANUPP)
3. Hawks bay Depot, Karachi
4. Pakistan Research Reactor-2 (PARR-2)
5. Chashma Nuclear Power Plant-1 (C-1)
6. Chashma Nuclear Power Plant-2 (C-2).....Under construction

4.1. Safeguards Agreements

Implementation of IAEA Safeguards in Pakistan dates back to March, 1962 when a trilateral safeguards agreement (INFCIRC/34) was signed for the supply of Pakistan Research Reactor-I (PARR-1). The

safeguards agreements with Pakistan have normally entered into upon the conclusion of a Project Agreement between the IAEA and Pakistan; upon unilateral submission by Pakistan; or upon the conclusion of a supply agreement between two or more States that requires the application of IAEA safeguards. All the safeguards agreements concluded by Pakistan are governed under the Safeguards Document (INFCIRC/66/Rev.2 or its earlier versions).

Pakistan has concluded several safeguards agreement with the Agency as shown in the Table 1. Apart from these safeguards agreements concluded with the Agency, Pakistan is participating in IAEA's reporting scheme of any exports of Neptunium (Np) and Americium (Am), as a voluntary commitment.

Table 1: Summary of Various Safeguards Agreements with the Agency

S.#	Facility	Agency Publication	Type of Agreements	Date of Signing
1.	Pakistan Research Reactor-1 (PARR-1)	INFCIRC/34	Trilateral	05 Mar, 1962
2.	Karachi Nuclear Power Plant (KANUPP)	INFCIRC/116	Trilateral	17 Jun, 1968
3.	Karachi Nuclear Power Plant (KANUPP)	INFCIRC/135	Trilateral	17 Oct, 1969
4.	Fuel Reprocessing Plant	INFCIRC/239	Trilateral	18 Mar, 1976
5.	Hawks Bay Depot	INFCIRC/248	Bilateral	02 Mar, 1977
6.	Pakistan Research Reactor-2 (PARR-2)	INFCIRC/393	Bilateral	10 Sep, 1991
7.	Chashma Nuclear Power Plant-1 (C-1)	INFCIRC/418	Bilateral	24 Feb, 1993
8.	Chashma Nuclear Power Plant-2 (C-2)	INFCIRC/705	Bilateral	22 Feb, 2007

4.2. Subsidiary Arrangements (SAs)

Safeguards' detailed implementation procedures are found in a technical set of subsidiary arrangements, which are tailored to the specific requirements of safeguarded facilities. Subsidiary arrangements are implementing instruments that do not require approval of the IAEA Board of Governors. They are concluded between the IAEA Secretariat and the State Party simultaneously, with or subsequent to the conclusion of the safeguards agreement. Subsidiary arrangements are considered confidential. They are accessible only to the IAEA Secretariat and the State Party. They are not available to other Member States, except that specific information relating to safeguards implementation may be given to the Board of Governors to the extent necessary for the IAEA to fulfil its responsibilities in implementing the agreement. The SAs for PARR-1, PARR-2, KANUPP and Hawks Bay Depot are in force while the SAs for C-1 are under negotiations with IAEA.

4.3. Inventory of Facilities, Equipment, and Materials

All INFCIRC/66/Rev.2-type safeguards agreements require the Agency to establish and maintain an inventory of facilities, equipment, and nuclear and / or non-nuclear materials subject to Agency safeguards. The Agency lists the inventory items into three categories referred to either as Category I (Main Part), Category II (Subsidiary Part), or Category III (Inactive Part). Main Part lists any facility, equipment or material transferred/supplied under agreement; while Subsidiary Part lists any facility while it contains any equipment or material listed in the Main Part of the inventory; the Inactive Part lists such material that would normally be listed in the Main Part but is not listed so because of exemption or suspension.

Pursuant to the terms of safeguards agreements INFCIRC/116, 248, 393 and 418 to which Pakistan and the Agency are parties, the IAEA sends to Pakistan the Annual Inventory of Facilities, Equipment, and Materials and Lists of Information under safeguards. According to the INFCIRC/34 and INFCIRC/135, there is no such obligation for the IAEA. However, Agency can send the Annual Inventory of Facilities, Equipment, and Materials under these Agreements to Pakistan upon official request.

4.4. Safeguards Procedures

The IAEA's safeguards system has three basic features: material accounting, containment and surveillance, and on-site inspection.

4.4.1. Material Accounting

Material accounting establishes the quantities of material under safeguards present within defined areas and the changes in those quantities that take place within defined periods of time. The establishment of a State System of Accounting for and Control (SSAC) of Nuclear Material is an essential requirement for states having Comprehensive Safeguards Agreements (CSAs) with the Agency, concluded under INFCIRC/153. There is no such binding for states which have facility-specific safeguards agreement with the Agency under INFCIRC/66/Rev.2, such as Pakistan. For the facilities which are under IAEA safeguards in Pakistan, a system of records and reports have been agreed with the Agency under respective safeguard agreements and have been maintained at each of these facilities. Pakistan submits to the Agency the material accounting reports of its safeguarded facilities at agreed frequencies as shown in Table 2 below.

Table 2: Frequency of Material Accounting Reports

S.#	Facility	Frequency
1.	Pakistan Research Reactor-1 (PARR-1)	Biannually
2.	Karachi Nuclear Power Plant (KANUPP)	Monthly
3.	Hawks Bay Depot	Biannually
4.	Pakistan Research Reactor-2 (PARR-2)	Biannually
5.	Chashma Nuclear Power Plant-1 (C-1)	Monthly

4.4.2. Containment and surveillance

Containment and surveillance (C/S) measures are used to restrict or control the movement of or access to materials under safeguards. Containment measures are designed to take advantage of IAEA seals and the physical barriers such as walls, containers, tanks or pipes. IAEA seals are tamper safe that help to detect movements of nuclear materials or equipment.

Surveillance is used to detect undeclared movements of nuclear materials, tampering with containment, fabrication of false information or interference with safeguards devices. The recent one among the various surveillance systems used by the IAEA is Digital Single Channel Optical Surveillance Systems (DSOS) along with camera units. PC-Cards are used to record images of the area under surveillance at some preset intervals. After the surveillance period, PC-cards are taken out for review. A number of DSOS Modules are working at KANUPP and C-1. In addition to these, All-In-One System (ALIS) are also installed, some time temporarily, at these facilities. At a Candu type on-power fuelling reactor, Bundle Counters and Core Discharge Monitors are installed to detect the discharged bundles. At KANUPP, the VIFM (VXI Irradiated Fuel Monitors) system is working.

4.4.3. On-site inspections

The purpose of on-site inspections is the verification of compliance with the safeguards agreements and resolving any question arising out of the implementation of safeguards at the facility. The routine inspections at Pakistan's safeguarded facilities, where appropriate, usually include the following activities:

- Audit of records and reports
- Verification of safeguarded materials by physical inspection, item counting and identification, measurement and sampling
- Checking and replacement of IAEA seals
- Servicing of containment and surveillance equipments
- Review of surveillance records
- Annual Design Information Verification

The intensity and frequency of routine inspections are usually specified in the safeguards agreement and vary with the type of facility and the nature and amount of safeguarded material. Frequencies of routine Safeguards Inspections carried out at safeguarded facilities in Pakistan are as given in Table 3 below.

Table 3: Frequency of Routine Safeguards Inspections

S.#	Facility	Frequency
1.	Pakistan Research Reactor-1(PARR-1)	Annually
2.	Karachi Nuclear Power Plant (KANUPP)	Quarterly
3.	Hawks Bay Depot	Annually
4.	Pakistan Research Reactor-2 (PARR-2)	Annually
5.	Chashma Nuclear Power Plant-1 (C-1)	Quarterly

In addition to the above routine inspections, inspections during Refuelling Outages (RFOs) at C-1, technical visits at facilities during construction like the C-2 power plant, initial inspections, visits for installation of various containment and surveillance equipment etc. are also carried out by the Agency inspectors.

5. Emerging Issues/Challenges

Being a 66-type country, some times, very peculiar nature of safeguards issues arise that are not common in the CSA States and which pose challenges both to the IAEA and the State. Some prominent safeguards issues of such nature that have been confronted in Pakistan are:

- Safeguarding of non-nuclear material
- Substitution of nuclear material
- Suspension of nuclear material
- The Additional Protocol

5.1. Safeguarding of non-nuclear material

In Pakistan, not only nuclear material, but non-nuclear material is also subjected to safeguards under the respective Safeguards Agreement. At KANUPP, the heavy water used as moderator and coolant is under IAEA safeguards. Apart from the Agency's analytical laboratory, the Agency have also proposed to use chemical laboratory instruments at KANUPP for analysis of isotopic of heavy water samples. This is because of the better precision of the Spectrophotometer available at KANUPP's Laboratory than required by international standards for accounting and that the instrument can be used for verification of heavy water for bias defects.

5.2. Substitution of nuclear material

Paragraph 26(d) of the INFCIRC/66/Rev.2 provides an inimitable option for substitution that is not available under INFCIRC/153 for CSA States. A number of fresh fuel bundles have been place in KANUPP's inventory under safeguards as a substitute material under this substitution tool and safeguards on nuclear material stored at Hawks Bay Depot have been terminated under Section 11 of the INFCIRC/248.

5.3. Suspension of nuclear material

The suspension option available under paragraph 24 of the INFCIRC/66/Rev.2 is utilized in Pakistan to resolve various issues. For example, the Highly Enriched Uranium (HEU) target plates are irradiated in a safeguarded research reactor (PARR-1) for Mo-99 production, which is then separated in an unsafeguarded Moly Production Plant, employing this suspension clause. The nuclear material contained in solid residue, returns to safeguards upon de-suspension. The Safeguards Approach for this arrangement has already been agreed between the Agency and Pakistan.

5.4. The Additional Protocol

IAEA began efforts to constrain NPT member-states' ability to acquire nuclear weapons, after secret nuclear weapons programs in Iraq and North Korea exposed weaknesses in existing agency safeguards. That effort eventually produced an Additional Protocol, designed to strengthen and expand existing IAEA safeguards, for verifying that non-nuclear-weapon states-parties to the NPT use nuclear materials and facilities only for

peaceful purposes. The Model Additional Protocol is contained in the Agency document INFCIRC/540 (Corrected). The Additional Protocol substantially expands the IAEA's ability to check for clandestine nuclear facilities by providing the agency with authority to visit any facility, declared or not, to investigate questions about or inconsistencies in a state's nuclear declarations.

The IAEA is responsible for validating that NPT states-parties are complying with the treaty, which bars all states except China, France, Russia, the United Kingdom, and the United States, the P-5 countries, from acquiring nuclear weapons. The requirements of the Model Additional Protocol are basically designed for the non-nuclear-weapon states-parties to the NPT; the nuclear weapon states are, however, free to choose among or limit the application of the provisions of the Model Additional Protocol. The Agency has, however, requested all non-NPT (INFCIRC/66/Rev.2) countries to consider adoption of the Protocol measures. The non-NPT countries, just like the nuclear weapon states, are also free to choose among the provisions of the Model Additional Protocol. So far, only one non-NPT country has signed the Additional Protocol.

6. Conclusion

Since the inception of the application of IAEA safeguards in Pakistan in 1962, the atmosphere of coordination between the Agency and Pakistan in fulfilling respective safeguards obligations has been exceptional. Pakistan has been extending its utmost cooperation with the Agency in resolving the emerging issues of safeguards implementation at its safeguarded facilities, whether these relate to the problems involved in safeguarding of non-nuclear material such as heavy water or testing and installation of new safeguards equipment such as core discharge monitors. The emerging issue of developing and implementing detailed procedures related to substitution and suspension of nuclear material in Pakistan have also been appropriately agreed upon with the Agency.