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Impact of Selection of a Nuclear Facility in the United States of America for Implementation of International Atomic Energy Agency Safeguards

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ABSTRACT

The United States Nuclear Regulatory Commission (NRC) facilitates implementation of International Atomic Energy Agency (IAEA) safeguards at licensed facilities under the Agreement between the United States of America (U.S.) and the IAEA for the Application of Safeguards in the U.S. (and Initial Protocol thereto). Facilities which are selected from the US Eligible Facilities List (EFL) by the IAEA for the application of safeguards are required under Title 10 of the US Code of Federal Regulations Part 75 (10CFR 75) to provide a completed Design Information Questionnaire (DIQ), initial inventory declarations, and subsequent reports to the NRC in a timely manner; and allow IAEA Safeguards Inspector access ensuring obligations set forth in the Agreement are met. The transition from NRC domestic safeguards to an integration of domestic and international safeguards is challenging. Formulating a plan that adequately addresses the sequence of events necessary to meet U.S. obligations is a challenge for both the NRC as well as the selected facility. This paper will describe impacts to a licensed facility and the US Government while preparing for and upon formal selection of the facility by the IAEA for international safeguards.

Key Words: Safeguards, NRC, Licensees

INTRODUCTION

Authority to issue regulations implementing the Agreement between the United States of America (U.S.) and the International Atomic Energy Agency (IAEA) for the Application of Safeguards in the U.S. (and Initial Protocol thereto) (INFCIRC/288) at licensed facilities was assigned to the US Nuclear Regulatory Commission (NRC)[i] pursuant to the Energy Reorganization Act of 1974. The NRC provides direct support of U.S. efforts to meet its nuclear non-proliferation obligations under the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). Acting as the U.S. National Regulatory Authority (NRA) for its commercial nuclear industry, the NRC is charged with providing oversight for implementation of procedures and practices necessary to facilitate information gathering, timely reporting, and in-field verification. The US-IAEA Safeguards Agreement, also known as the "Voluntary Offer Agreement," stems from discussions held between Nuclear Weapon States (NWS)[1] and major industrial Non-

[1] Article IX.3 of the NPT defines a nuclear-weapon State as one which manufactured and exploded a nuclear weapon or other nuclear explosive device prior to January 1, 1967. Those States are: China, France, the Russian Federation, the United Kingdom, and the United States of America.

Nuclear Weapon States (NNWS), who were concerned that acceptance of safeguards under the NPT would place them at a commercial and industrial disadvantage in developing nuclear energy for peaceful uses. The US-IAEA Safeguards Agreement provides the IAEA the right, but not obligation, to apply international safeguards on source and special nuclear material (SNM) within the UNITED STATES, excluding facilities associated with activities of direct national security significance. Periodically, the U.S. provides the IAEA with an updated list of facilities eligible for the application of IAEA safeguards; adding or removing facilities from that list as necessary (Art. 2(b)). Revisions to this eligible facilities list (EFL) by the NRC and Department of Energy are submitted for a 60-day Congressional review before they are submitted to the IAEA.

In 1979, Senate Hearings were held to discuss NRC activities and facility burden associated with the implementation of the US-IAEA Safeguards Agreement.[ii] The Director of the Office of International Programs (OIP) made a statement to the Committee on Foreign Relations during the hearings. This statement included a basic description of how NRC oversight activities involving nuclear material and other radioactive material at licensed facilities, through inspection and the licensing process, would include rules to ensure the UNITED STATES meets its obligations under the US-IAEA Safeguards Agreement. Since those early discussions of the possible burden to facilities, the US Government and its nuclear industry have experienced the germane impact of implementation of these rules—while taking into consideration a representative cross-section by facility type and its life cycle phase, from early in the design process through to decommissioning.

US-IAEA SAFEGUARDS AGREEMENT OBLIGATIONS INTRODUCED INTO PART 75 OF TITLE 10 OF THE CODE OF FEDERAL REGULATIONS (10CFR 75)

The objective of IAEA safeguards is the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of other nuclear explosive devices or for purposes unknown, and deterrence of such diversion by the risk of early detection[iii]. Whereas the safeguards objective of the U.S. Voluntary Offer Agreement is to detect that declared nuclear material has not been withdrawn (except as provided for by terms of the agreement) while under IAEA safeguards. In order to meet this challenge, the NRC proposed regulations designed to implement the US-IAEA Safeguards Agreement along with general parts of the Subsidiary and Transitional Subsidiary Arrangements. The regulations were published for public comment in 1978. Progress toward the goal of bringing the US-IAEA Safeguards Agreement into force created the need for the NRC to take appropriate actions necessary for its implementation, in relation to all its licensees and Agreement State licensees[2].

After entry into force of the US-IAEA Safeguards Agreement in 1980, the NRC provided oversight for the implementation of traditional IAEA safeguards at several facilities employing rules set forth in 10 CFR Parts 40, 50, 70, 74, 75, and 110[iv]. Regulations in 10CFR 75 contain provisions requiring licensed facilities selected for IAEA safeguards to (1) submit information about their facility for IAEA use, (2) establish, maintain, and follow prescribed material

[2] Agreement State licensees are the persons possessing by-product, source, or small amounts of special nuclear material subject to the licensing authority of individual states under agreements between the state and NRC, made pursuant to Section 274 of the Atomic Energy Act, as amended

accounting and control procedures, (3) provide reports, and (4) permit access to their activities by IAEA inspectors. Essentially, these measures are the same employed by the IAEA in safeguarding nuclear facilities in a Non-Nuclear Weapon State (NNWS) party to the NPT[v].

Pursuant to Article 8 of the US-IAEA Safeguards Agreement, and Code 3.1 of the U.S. subsidiary arrangements-general part, the U.S. is obligated to provide facility information to the IAEA within 45 days of selection by the IAEA. As a result, facility information is provided to the US Government through completion and submission of an IAEA Design Information Questionnaire (DIQ) as soon after notification as possible in order to meet the IAEA timeliness requirement. After a US Government review of the DIQ to be complete and correct, the design information is forwarded to the IAEA through United States Mission to the International Organizations in Vienna, Austria (UNVIE). The DIQ is kept up-to-date with major changes to the facility by submission of a supplemental declaration to the IAEA, when needed.

Material control and accounting (MC&A) regulations established for U.S. domestic special nuclear materials is included in 10CFR 74. However when a facility is selected from the US EFL for implementation of IAEA safeguards, that facility will maintain records in accordance with 10CFR 75 in order to minimize duplication of efforts. Requirements of 10CFR 75 are in addition to any other requirements of Title 10—Nuclear Regulatory Commission Chapter—relating to material accounting and control, that may apply to a licensee. Regulations in 10CFR 74 would apply to aspects of MC&A not directly related to reporting to the IAEA.

A system of records and reports have been established by the U.S. through guidance provided under Code 10 of the Subsidiary Arrangements (Pursuant to Art. 59-65, 67), and included in requirements of 10CFR 75. The guidance provides facility level reporting structure in such a way as to enable the IAEA to examine data efficiently and effectively. Elements of specific reporting requirements for a particular facility are established in accordance with this system in each negotiated Facility Attachment (FA). Alternatively, Transitional Facility Attachments (TFAs) are negotiated when facilities are selected under the Initial Protocol to US-IAEA Safeguards Agreement.

Access rights to operating and accounting records, nuclear material, and other relevant locations are provided in through 10CFR 75 to IAEA inspectors who carry out relevant activities under the US-IAEA Safeguards Agreement (and its Initial Protocol), and Additional Protocol. During routine inspections, access to nuclear material may be limited to the strategic points defined in the FA/TFA (e.g., key measurement points for transfers and inventory of nuclear material). However, inspector access beyond these strategic points may be required during design information verification (DIV) visits. Under the Additional Protocol, access is provided to any location as described in Article 5[vi] as legally granted under the U.S. implementation act[vii].

IMPACT OF SELECTION

The impact to a licensed facility when selected for the implementation of IAEA safeguards varies depending on the type of facility, and whether the facility is selected under the main text of the US-IAEA Safeguards Agreement or its Initial Protocol. This variation has an impact on the NRC in its efforts to ensure all aspects of U.S. obligations under the Agreement are met. Both the operator and NRC are principal stakeholders in ensuring elements of subsidiary

arrangements (FA/TFA) are properly addressed when providing design information, maintaining records, preparing reports, and providing inspector access.

Currently there are three NRC licensed low enrichment (LEU) fuel fabrication facilities and one gas centrifuge enrichment plant (GCEP) reporting to the IAEA under the US Initial Protocol, utilizing a TFA for guidance and a completed IAEA Design Information Questionnaire (DIQ) describing essential equipment and routine operations of the facility. (These facilities, however, are not subject to IAEA inspections) Historically, the IAEA implemented and subsequently withdrew traditional safeguards at several facilities under the US-IAEA Safeguards Agreement. The list of 13 NRC licensed facilities that were selected and inspected at various times between 1980 and 2005 includes: 6 commercial power reactors, 5 LEU fuel fabrication facilities, and two HEU down-blending projects.

Selection for Traditional Safeguards under the US-IAEA Safeguards Agreement (INFCIRC/288)

The IAEA model safeguards agreement (INFCIRC/153) recognizes in Article 4 that safeguards should be implemented in a manner designed to avoid hampering the economic and technological development of a State or international cooperation in the field of peaceful nuclear activities. Interferences created as a result of implementing IAEA safeguards affect the efficient operation of commercial facilities. Consequently, in recognition of this concern, President Lyndon B. Johnson stated on December 2, 1967 that the United States would not ask any country to accept safeguards that the U.S. was unwilling to accept for its own nuclear activities—excluding those with direct national security significance[viii].

In order to minimize cost to the IAEA, it was decided that safeguards would only be applied to a select number of facilities in the U.S., based on advanced designs or sensitivity in terms of international competition. As mentioned previously, the U.S. submits a completed IAEA Design Information Questionnaire (Art. 42) and negotiates a Subsidiary Arrangement (Art. 39) for those facilities formally selected by the IAEA from the EFL under the US-IAEA Safeguards Agreement or its Initial Protocol.

Endeavors to complete an IAEA DIQ for any facility call for an integrated knowledge of plant design and operation. In addition, expert contributions are required from operators in order to answer detailed questions related to developing an IAEA safeguards approach for large complicated facilities (e.g. uranium enrichment, fuel fabrication, reprocessing). For example, accounting for and control of all nuclear material subject to safeguards under the Agreement is based on a structure of material balance areas (MBAs) and key measurement points (KMPs). Subject matter experts in processes identified within an MBA that include KMPs must be consulted in order to gain accurate and complete declarations for nuclear material flow and inventory. This activity requires a large amount of effort from the NRC and the selected facility; furthermore, a poorly documented and thought out KMP and MBA structure can have a significant negative impact on the development of an IAEA safeguards approach.

Licensed facility operators in the U.S. are required to prepare nuclear material inventory and material flow report(s) and send them to the NRC for review. Normally, under domestic regulations (10CFR), data is transmitted electronically in the U.S. from the facility operator to the national accounting program managed by the Nuclear Material Management and Safeguards

System (NMMSS) utilizing proper domestic codes. When selected by the IAEA for safeguards, the facility operator generally performs the same procedure with the addition of IAEA material description codes and measurement basis to their reports. Once this essential data is received by NMMSS, the information is structured into the proper IAEA reporting format outlined in the FA and routed to the NRC, which then finalizes and submits the report(s) to the IAEA. Impact of the additional reporting to the IAEA is primarily absorbed by selected facilities. However, the NRC and NMMSS bare the additional responsibility of ensuring reports from facilities under IAEA safeguards are correct and complete. In the case of a gas centrifuge enrichment (GCEP) facility, MBA structures for international reporting are significantly different than those used for domestic reporting. A certain amount of extra burden may be added to a facility when selected for IAEA safeguards.

IAEA inspections allowed under the US-IAEA Safeguards Agreement include; routine, ad hoc, special, unannounced inspections. (For facilities selected under the Initial Protocol only DIVs are permitted) Moreover, for GCEP facilities a limited frequency unannounced access would be part of the safeguards approach. Activities performed during inspections are described under Article 68-82 of the Agreement. Impact to a licensed facility, and to the NRC, attributed to the extra burden of IAEA inspections being performed depends largely on the facility type. It should be recognized, pursuant to Article 76: *The Agency shall keep the number, intensity and duration of routine inspections, applying optimum timing, to the minimum consistent with the effective implementation of the safeguards procedures set forth in this Agreement, and shall make the optimum and most economical use of inspection resources available to it*.

In contrast to the smaller number of IAEA inspectors assigned to reactors, spent fuel storage or research reactors; bulk handling facilities require a larger contingency of inspectors to perform routine interim inspections and larger more complex physical inventory verifications. Fewer differences in items of a particular stratum of special nuclear material available for verification at item facilities allow for a lower number of person-days of inspection by utilizing randomization of sampling. It should also be noted that the NRC is required to accompany the IAEA at all times during inspections or complementary access at a licensed facility.

When a facility is selected, the IAEA performs an initial site visit or inspection. This activity usually occurs before the FA is finalized. Implementation discussions with the licensee are held on-site, which describe activities to be performed during the course of visits or inspections. Logistics of sampling methods, instrumentation installation, submittal of required records, and IAEA inspector access as outlined in the draft FA, are agreed upon between the IAEA and US Government with input from the facility operator. Design information will usually be verified during the initial site visit utilizing the completed IAEA DIQ and will be verified periodically thereafter or should there be significant changes to the facility. Verification of the initial inventory will be performed during an initial ad hoc inspection, scheduled through the U.S. notification system for IAEA inspection activities. Normally, physical inventory verification criteria will be utilized during the ad hoc inspection for the initial PIL submitted.

Selection for Limited-Scope Safeguards under the Initial Protocol

The Initial Protocol to the US-IAEA Safeguards Agreement allows for a secondary type of selection of facilities on the US EFL that only submit design information, permit IAEA inspectors to verify such information in the facility, maintain accounting records, and provide

accounting reports to the IAEA—without inspections. The technical provisions in the protocol follow closely the comparable provisions in the Agreement itself. Providing an initial protocol to the US-IAEA Safeguards Agreement creates a succinct distinction between facilities selected for full safeguards and those required to only submit information and perform maintenance of records.

Licensed facilities selected under the Initial Protocol to the US-IAEA Safeguards Agreement are also required to provide a completed IAEA Design Information Questionnaire. As in the above case of full selection, subject matter experts in processes identified within an MBA that include KMPs must be consulted in order to gain accurate and complete declarations for nuclear material flow and inventory.

As with full selection, facility operators at licensed facilities are required to prepare nuclear material inventory and flow report(s) with the addition of IAEA material description codes and measurement basis. These reports are sent from NMMSS to the NRC for review before they are forwarded to the IAEA. There is not a significant difference in this burden under the Initial Protocol. It is important to note that accurate and complete information recorded in facility records and reported to the IAEA be identifiable to inspectors and consistent with international standards. Information as it relates to certain items and batches of material should be recorded and referenced in the accounting records, inventory change documents and general ledger, so that data can be traced to its origin. Although the act of maintaining the accurate and complete information isn't an additional impact, providing feedback to inquiries from the IAEA inspector could present some amount of burden to the NRC and facility operators.

Inspections described in the main body of the text of the US-IAEA Safeguards Agreement (Art. 68-82) are not included in its Initial Protocol. Inspectors are only allowed to visit for initial design information verification and any subsequent DIV needed to confirm major changes in a facility or its life cycle phase.

When a facility is selected under the Initial Protocol, the IAEA performs an initial site visit prior to the TFA being finalized. Implementation discussions with the licensee are held on-site, which describe activities to be performed during the course of future visits (if necessary). Logistics of sampling methods, instrumentation installation, submittal of required records, and inspector access as outlined in the draft TFA, are agreed upon between the IAEA and US Government with input from the facility operator.

TRANSITION FROM DOMESTIC SAFEGUARDS TO COMBINED DOMESTIC AND INTERNATIONAL SAFEGUARDS

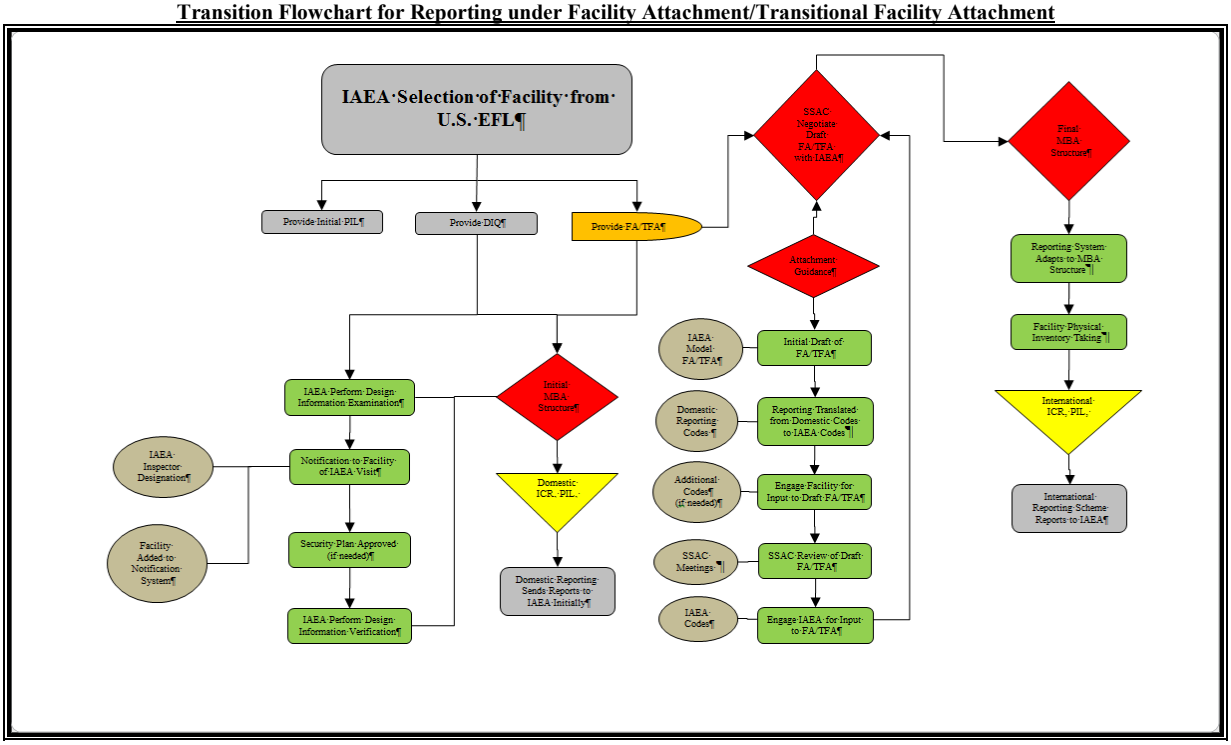
Licensed facilities in the U.S. are inspected by the NRC and report through the NMMSS data management system. Once selected for IAEA safeguards under either the main text of the US-IAEA Safeguards Agreement or its Initial Protocol, operators may experience changes to certain aspects of NRC domestic safeguards oversight. Careful integration of domestic MC&A requirements described in 10CFR 74 and international requirements of 10CFR 75 will normally lessen the operational impact of matching requirements of a particular facility type. Documents are also provided by the NRC to give further guidance for accountancy measures at more complicated facilities. An example might be in the case of bulk handling sites, such as GCEP

facilities, that require special instructions described in documents similar to NUREG/CR-5734[3] and Regulatory Guide 5.67[4].

Transitioning accountancy measures for nuclear material in the U.S. from domestic reporting requirements to those described in the IAEA *Nuclear Material Accounting Handbook (2008)* are normally straight forward. However in the case of bulk handling at an enrichment facility, important aspects of obtaining a facility material balance that would normally be included in a single MBA structure are redistributed over more than one MBA. This redistribution of KMPs over multiple MBAs is described in the FA/TFA of an IAEA selected facility.

Developing the process for transitioning into an IAEA reporting scheme from domestic reporting requires some amount of planning, scheduling and coordination of many components of the U.S. State System for Accounting for and Control of nuclear material (SSAC). Some facilities are regulated by other US Government organizations. Therefore, some US SSAC decisions require interagency cooperation between the NRC, Department of Energy (DOE), Department of State (DOS) and other government entities. Below is a typical depiction of how a facility might make this transition. The process begins with IAEA selection of a facility from the US EFL.

Transition Flowchart for Reporting under Facility Attachment/Transitional Facility Attachment



Initial declarations of the physical inventory listing and completed DIQ are submitted to the IAEA in a timely manner. Development of the reporting structure to the IAEA outlined in the

[3] NUREG/CR-5734-Recommendations to the U.S. NRC on Acceptable Standard Format and Content for the FNMC Plan Required for LEU Enrichment Facilities

[4] Regulatory Guide 5.67- MC&A for Uranium Enrichment Facilities Authorized to Produce SNM of Low Strategic Significance

FA/TFA requires close management by the NRC due to the complexity of coordinating a specific sequence of events through approval and technological challenges. On the left hand side of the flow diagram, the initial MBA structure is used to report monthly inventory change reports and the initial physical inventory. However, during the process of developing the FA/TFA a DIV visit will take place to ensure MBA and KMP structure is as declared in the DIQ. Parallel to those activities, on the right side of the diagram are components necessary to implement a new reporting scheme which fulfills the U.S. reporting obligations.

Impacts to the facility operator, NRC and NMMSS experts include modifications to the computerized reporting scheme. Computerized reporting through the NMMSS data management system ensures U.S. reports are consistent with the needs of the IAEA. Changes to the site accounting software program may be required in order to match specific material description codes in the US Code 10 Subsidiary Arrangement with domestic codes for each MBA agreed upon in the DIV process.

When the final MBA structure is approved and verified by the IAEA it will be utilized by the US Government to provide all reports and records to the IAEA for that facility. Inspections will be scheduled using this MBA structure at a facility selected for traditional safeguards.

Domestically, the NRC as the NRA for licensed facilities ensures operator compliance with the requirements of the U.S. system of accounting and control of special nuclear material by assessment of its effectiveness through a comprehensive inspection program. The auditory oversight ensures operators are capable of recording and reporting changes to inventories correctly, completely and in a timely way and of submitting correct and complete data for inspections. Credit should be given for these activities by the IAEA, in order to minimize efforts and be more efficient in safeguarding U.S. licensed facilities.

MINIMIZING THE IMPACT

Several actions can be taken in order to minimize the impact of selection of a facility from the US EFL for the application of traditional safeguards under the US-IAEA Safeguards Agreement or limited-scope safeguards under its Initial Protocol: 1) Improving communication by exploiting clearer channels for consultation between the licensees, the NRC and the IAEA will provide timely and more correct responses to questions expressed from all parties. 2) Creating on-site procedures for IAEA inspector access into the facility and managing access through sensitive areas to protect proprietary information will minimize confusion when inspectors arrive on site to perform verification activities. 3) Components of the US SSAC should provide training to facilities not familiar with meeting the principles of IAEA safeguards. 4) Resources should be made available for improving IAEA safeguards approaches through advanced technology and concepts while any U.S. facility is selected for traditional safeguards. 5) Minimize redundancy of efforts by encouraging the IAEA to accept NRC inspection results.

GCEPs are considered one of the more complicated and human resource demanding facilities being safeguarded by the IAEA in the world today. Because of this resource demand there is a substantial amount of ongoing deliberation by the IAEA on the safeguards approach requirements for a new GCEP facility in a nuclear weapons State (NWS). In comparison, the European Atomic Energy Community (EURATOM) provides an efficient system for meeting IAEA safeguards agreements in all 28 Member States of the European Union (EU), including

four GCEP facilities, through its Partnership Approach with the IAEA (update 2008). Should a GCEP facility within the U.S. be selected by the IAEA for the implementation of traditional safeguards, the NRC will be required to work closely with the IAEA Secretariat in meeting the U.S. safeguards obligations while drawing their own independent conclusion on the absence of undeclared nuclear materials and activities. Representatives from the NRC will be expected to support the IAEA inspections as described in 10CFR 75, providing an opportunity to share inspection resources with the IAEA. Sharing inspection resources could reduce the impact to the facility and the NRC by reducing the burden on the facility operator, NRC and IAEA.

Rules set forth in 10CFR 75 require that credentials of IAEA representatives be confirmed by the NRC prior to being granted access to any GCEP facility to conduct an NRC-approved inspection or visit to verify information submitted under parts 75.10, 75.11 and 75.31 through 75.43. In addition, the NRC will accompany the IAEA representative at all times during the inspection. This requirement becomes very difficult to accommodate during an annual physical inventory verification inspection, where there might be 5-6 (or more) IAEA inspectors at a facility performing various inspection activities. Resource sharing of inspectors and equipment would be a welcomed solution in reducing IAEA costs, while allowing both the NRC and IAEA to simultaneously perform their required inspection activities.

SUMMARY

Impact to a facility and NRC of selection of a licensed facility under the US-IAEA Safeguards Agreement or its Initial Protocol varies by facility type and its life cycle phase. Regulations in 10CFR 75 contain provisions requiring selected licensed facilities to meet U.S. obligations under the Agreement and minimize duplication of efforts to meet domestic regulations set forth in other Parts of the Regulations. Under the Code of Federal Regulations, the NRC is charged with providing oversight for implementation of procedures and practices necessary to facilitate information gathering, timely reporting, and in-field verification for domestic safeguards for the commercial nuclear industry, while facilitating IAEA safeguards implementation by employing Part 75. Transitioning from only a domestic safeguards regime to combined domestic and international safeguards requires planning, scheduling and a unique understanding of both. It is obvious from a resource perspective that efforts should be made to minimize the impact of IAEA safeguards at selected licensed facilities.

ENDNOTES

[i] Atomic Energy Act of 1954, as Amended (P.L. 83-703)
[ii] Hearing before the Committee on Foreign Relations U.S. Senate 96th Congress 1st Session on Ex. B, 95-2, Agreement with the IAEA for the Application of Safeguards in the U.S., June 22, 1979
[iii] IAEA, The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, INFCIRC/153, corrected, 1972
[iv] Code of Federal Regulations, Title 10 Energy, Office of the Federal Register, 2013
[v] IAEA, Nuclear Material Accounting Handbook, Service Series 15, 2008
[vi] IAEA, Model Protocol Additional to the Agreement(s) and the IAEA for the Application of Safeguards, INFCIRC/540 (corrected), 1997
[vii] Title II—U.S. Additional Protocol Implementation Act. 22 USC 8101, Public Law 109-401, 2006
[viii] http://www.State.gov/t/isn/5209.htm, 2012