Establishment of the Safeguards at Rokkasho Reprocessing Plant (RRP)

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Abstract: The IAEA has never before been experienced with designing a credible safeguards approach for a large scale reprocessing plant. The safeguards discussion was initiated in 1988, but at that time no available model or guideline that could be used as a reference. The IAEA the State and JNFL has studied and discussed the safeguards approach and safeguards system, and established effective, efficient and credible safeguards for RRP, under extensive cooperation manner. This paper presents overview of the safeguards system at RRP from the operator’s viewpoint:

Keywords: Large scale reprocessing plant safeguards

1. Introduction

Rokkasho Reprocessing Plant (RRP) has an operating throughput of 800tU/y and is under active test using actual spent for final confirmation of equipment and system, and the commercial operation is scheduled in August 2007.

In order to establish an effective and efficient safeguards at RRP, the safeguards discussion with the IAEA was initiated in 1988, but at that time no available model or guideline that could be used as a reference. Therefore, during the period of 1988 through 1992, a multinational forum, referred to as LASCAR (Large Scale Reprocessing Plant Safeguards)\(^1\), provided the following recommendations that how an effective safeguards approach could be implemented to a large scale reprocessing plant with maintaining an efficient use of resources.
- High accurate measurement systems for the nuclear material accountancy;
- Timeliness of verification by advanced nuclear material accountancy techniques
- Redundant and independent containment and surveillance systems;
- Early consultations on facility characteristics especially early and continuing design information verification;
- Authentication of equipment and systems made available by operator;
- On-site verification capabilities (On-site laboratory);
- Data acquisition and transmission; and
- The on-going or needed research and development tasks.

The Project objectives were to plan, coordinate and integrate all activities necessary to ensure that an effective and efficient safeguards would be implemented at RRP on a schedule consistent with construction and commissioning of the plant and resource expenditures within the IAEA, the State, JNFL, and Member States Support Program capabilities for the IAEA safeguards.

Funding for the safeguards systems have been shared between the IAEA, the State and JNFL. A significant amount of development work and provision of safeguards systems has been through the Member State Support Programs. The large efforts were made for RRP safeguards establishment in cooperation with IAEA, the State and JNFL has yielded a robust safeguards approach, which employs state of the art technology and innovative methodology.

Facility Description and MBA Structure

RRP is comprised of the Spent Fuel Receipt and Storage area (currently in operation), the Head-end, a Main Process which includes uranium oxide conversion, the U/Pu Co-denitration Conversion Process, the Mixed uranium/plutonium Oxide (MOX) and Uranium Oxide Storages, the Waste Treatment areas including the Vitrification process for the high active liquid waste and Storage areas.
For nuclear material accountancy purposes, the facility is divided into five Material Balance Areas
3. Development of Safeguards Equipment and the Use of Operator's Equipment

3.1 Development of safeguards equipment and joint use

The IAEA, the State and JNFL have cooperated in the development of unattended verification systems including NDA systems, automatic sampling authentication system and C/S equipment. Frequent Working Group discussions were held with the IAEA concerning the safeguards systems, cost sharing and responsibilities.

The measurement, monitoring and surveillance systems required for the implementation of the safeguards approach to RRP encompass a wide range of technologies and applications. There are more than 50 measurement and/or monitoring systems and approximately 70 camera systems. This represents not only a large financial burden, but a huge demand on human resources for preparation of user requirements, installation and testing. Therefore, systems have been developed and installed that will be jointly used by the State and IAEA inspectorates, and in some cases also by the operator. In this way costs and responsibilities have been shared by all three parties [2].

In the spirit of cooperation, Japanese side provided about 3/4 of the initial investment for the safeguards system at RRP.

3.2 Use of operator's equipment for safeguards inspections

The LASCAR recommended that the Inspectorates should utilize independent equipment to the extent possible. However the LASCAR also recommended that the plant operator's equipment would be utilized through appropriate authentication, if the installation of independent safeguards equipment is impracticable due to limited resources of the IAEA, plant space difficulties, plant safety features, etc.

With the cooperation of the operator, utilization of the operator's equipment is widely implemented in RRP based on signal splitting through appropriate authentication. Considering that they will be operated in unattended and remote mode, there has been a large effort made toward assuring that neither the systems nor the data can be tampered. The authentication measures employs physical containment, use of reference standards and so on.

3.3 Providing timely analytical results by Onsite Laboratory (OSL) with Automatic Sampling Authentication System
The On-site laboratory (OSL), dedicated to analysis of safeguards samples, has been built in RRP analytical laboratory so as to be connected to RRP through pneumatic tubes for sample transfer from sampling benches located throughout the facility. The OSL provides very timely analysis results for the IAEA and the State. This is particularly critical in a high throughput facility such as RRP. Results are needed within days so that the inspectors can evaluate material flows and inventories. It also allows the inspectors to identify questionable results or to request follow-up activities, such as additional analysis. For the reason of timely results and the cost of shipping samples to the IAEA laboratory in Austria (SAL), this lab will be jointly used by the IAEA and the State and strict measures will be implemented to assure that independent results will be obtained. The sample integrity and authenticity will be achieved by the Automatic Sampling Authentication System (ASAS) which is based on use of Independent Jug Passage Detectors (IJPD) installed on the Pneumatic Transfer Network (PTN) and the Solution Measurement and Monitoring System (SMMS) information during sampling. The IJPD sensors will track the empty sampling jug from its origin to the sampling bench and then to the OSL. The ASAS will provide sample integrity and authenticity by information of the IJPDs, density and solution level fluctuation information from the SMMS during the sampling and the OSL and the operator declared data.

4. Overview of the Safeguards Approach

4.1 Initial and Continuing Design Information Examination / Design Information Verification (DIE/DIV)

The possibility of verifying 100% of the safeguards relevant design features of a commercial size reprocessing plant is beyond the available resources of both the IAEA and the State inspectorates. Therefore, priorities were established for verification of design information in the areas of building layout, cell design, equipment designs, installation and testing, piping and pipe penetrations, active trenches and vessel calibrations.

DIV was performed based on following concept in order to optimize the limited resources.
- Classification of all plant components to be verified based on the safeguards significance in order to prioritize the verification;
- Random verification for the medium and low significant class in order to reduce verification activities.

The tools of DIV such as endoscopes, 3-D Laser Range Finder for DIV (LRFD), wall thickness gauges, digital photography, and portable electromanometers, along with human observation were used to compare the engineering drawing and actual equipment. Due to the sensitive nature of much of design information, it was necessary that it must be kept in the IAEA and the State controlled cabinets at the RRP.

4.2 Key of Safeguards Approach

Considering large throughput of the RRP, the sensitivity and complexity of accepted technologies, and the inherent inaccessibility of nuclear materials, a robust and comprehensive safeguards approach was needed. It was also recognized that by simply adhering to the minimum verification requirements called for in the IAEA Safeguards Criteria, there would be inadequate sensitivity for detecting the diversion of a significant quantity of material or misuse of the facility. In order to overcome these difficulties, additional measures should be needed, which are SMMS, Plutonium Inventory Measurement System (PIMS). The objectives of additional measures are as follows;
- Provide additional assurance that the plant is operated as declared;
- Improve and/or support verification of the material accountancy system for conventional and Near-Real-Time-Accountancy (NRTA) in unattended mode;
- Monitoring of material (solution and powder) flows in process and inventory, and maintain continuity of knowledge on the verified design of the plant; and
- Provide validation of the other safeguards systems, including the automated sampling system.

The primary areas of verification activities can be divided into inventory changes, inventories and
flows within the MBA. In addition, Other Strategic Points (OSP) are identified that will provide confirmation of the operational status of the facility as declared. The safeguards approach is based on material accountancy as the fundamental measures, unattended NDA systems, C/S measures, process monitoring, environmental sampling and continuous inspector presence.

A summary of inspection activities with safeguards equipment in each area is provided in Figure 2 “NDA and C/S Systems at Each MBA (RRP)” and Figure 3: “Inspection Activities on Rokkasho Reprocessing Plant (RRP)”.

5. Conclusion

JNFL has implemented quite accurate material accountancy system even waste stream. However, in case of a large scale reprocessing plant, it is obviously difficult to detect of 1 Significant Quantity (SQ) of plutonium by conventional material accountancy. Therefore a number of monitoring systems and unattended verification systems have been introduced along nuclear material flow, which is from the spent fuel storage until the product storages. These systems will provide credible safeguards assurance as additional safeguards measures, because any possibility for removal of nuclear material from processes will be eliminated. Currently, the uranium test was done and the active test is being performed. Through these confirmation tests, evaluation parameters for verification on monitoring will be obtained. Also appropriate inspection accountancy procedure and inspection schema will be established and confirmed.

REFERENCES


Figure 2 NDA and C/S Systems at Each MBA (RRP)
Figure 3 Inspection Activities on Rokkasho Reprocessing Plant (RRP)