

Back-up plan for On-Site Laboratory at Rokkasho Reprocessing Plant

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Abstract

On-Site Laboratory (OSL) for the Rokkasho Reprocessing Plant (RRP) was established in order to analyze safeguards samples taken at RRP in a timely manner. In case that the OSL is not available for safeguards analysis due to unexpected circumstances while RRP is in operation, it will be required to find other ways to conduct safeguards analysis. However it is not practical to ship the samples to the other safeguards analytical laboratories considering the number of samples taken during operation of RRP and preparation for shipping samples. It is essential to have safeguards analysis available during plant operation especially for a large reprocessing plant which requires timely sample analysis on site. Therefore JNFL decided to cooperate with IAEA and JSGO to conduct safeguards analysis in JNFL analytical laboratory at RRP. JNFL analytical laboratory is designed for operator's process control analysis and material accountancy analysis. It is not designed for safeguards analysis. There are several challenges such as authentication of samples and analytical procedures for JNFL to have the safeguards analysis in JNFL analytical laboratory.

This paper describes the efforts to have safeguards analysis in JNFL laboratory at RRP.

1. Introduction

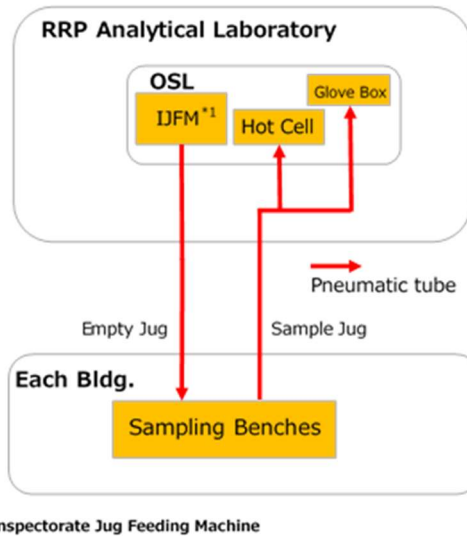
On-Site Laboratory (OSL) for the Rokkasho Reprocessing Plant (RRP) was established based on the recommendations of the Large Scale Reprocessing Plant Safeguards (LASCAR) with timeliness of verification as a fundamental component of its Safeguards evaluation. With the OSL installed in RRP, there is no need for pretreatment and external transportation of safeguards inspection samples, ensuring timeliness through timely analysis.

Although the OSL is located inside the RRP, it is an independent laboratory licensed to use nuclear material. It is managed and operated by the Nuclear Material Control Center (NMCC) under the supervision of Japan Safeguards Office (JSGO) of Nuclear Regulation Authority (NRA), and jointly used with the International Atomic Energy Agency (IAEA).

Samples are taken and collected using a small container called "Jug", which is authenticated and managed at OSL by the IAEA authenticated. Jugs are launched using IAEA authenticated Inspectorate Jug Feeding Machine (IJFM) installed at OSL. Samples taken and collected during safeguards inspections from the RRP process are sent to the OSL through pneumatic transfer tubes using an automatic sampling system. Then by IAEA/NMCC samples are analyzed for density, concentration and isotope ratio, etc. by IAEA/NMCC.

During the commercial operation of RRP (campaign period), OSL will frequently receive samples from as Input Accountancy Tank (IAT), Output Accountancy Tank (OAT) and OSP-

OS. In addition, samples are taken regularly once a month as IIV and once a year as PIV, therefore, OSL analytical work is performed daily basis.



*1 Inspectorate Jug Feeding Machine

Fig.1 OSL Sampling, collection and analysis location

2. OSL fire accident, consideration of alternatives

On March 16, 2021, a fire accident occurred in OSL's Low active Glove Box. Although the scope of the damage was limited, NMCC decided to suspend analytical work within OSL until corrective measures (root cause analysis and measures to prevent recurrence) were taken. In addition, IAEA analysts were not granted access to the OSL, no automatic sampling was available. Therefore, as the recovery of OSL is unknown, Interim Inventory Verification (IIV) scheduled for April 8, 2021 had to cancel sample taking, collection and analysis from the main process.

On the other hand, it is mandatory under international agreements and domestic law to undergo safeguards inspections based on the “Comprehensive Safeguards Agreement (CSA)” and “Regulations Concerning the Use, etc. of International Controlled Material”. If we don't implement alternative measures while OSL recovery is unknown, it may affect the safeguards conclusion.

Under these circumstances, based on a request for cooperation from JSFO regarding the handling of safeguards analysis samples, JNFL has started technical discussions for alternative measure with the inspectorate regarding the feasibility of using JNFL analysis equipment for sampling, pretreatment and storage of safeguards analysis samples.

Also, JNFL cooperated with the site survey of the analytical building for several days, differences with the OSL equipment, and examination of usable JNFL equipment so that the inspectors could understand the current state of the analysis equipment.

The implementation of the site survey and discussion of the JNFL analysis room are as

follows.

- ✓ Confirmation/discussion of function for Jug Feeding Machine (JFM) and how to maintain Jug's CoK.
- ✓ Confirmation/discussion of the analytical lines (Receiving Cells), its application, procedures and how to maintain the CoK inside hot cell for sampling jugs.
- ✓ In parallel, IAEA Nuclear Material Laboratory made immediate arrangements for shipment of working standards to support density measurement and isotope dilution mass spectrometry analyses prior to PIV

After that, OSL was restored in the beginning of May, and the investigation was temporarily suspended because PIT/PIV was to be held in May and preparations were necessary.

3. Establishment of OSL Backup Plan Task Force

The IAEA and JSGO have reached to the conclusion that it is necessary for OSL to prepare for contingencies such as fires, and to consider methods and procedures for collecting and analyzing safeguards analysis samples in case OSL is not available. As a result, in July 2021, the IAEA/JSGO/NMCC/JNFL held an OSL Backup Plan Task Force meeting to discuss developing the OSL Backup Plan under the leadership of JSGO.

At the regular meetings, the following items were mainly discussed.

The IAEA has taken a number of measures to authorize RRP automatic sampling, and OSL Backup Plan shall ensure that these measures can still be in place using JNFL laboratory instead of the OSL.

- **Scenario consideration**

Priority of scenarios (PIV, IIV and Campaign (IAT/OAT)) and available analysis sites (JNFL analysis room, NMCC Tokai Analysis Center, IAEA-NML) were proposed by JSGO/IAEA/NMCC. As a result of the discussion, it was decided that the backup plan for the PIV scenario using JNFL analytical equipment should be prioritized from the perspective of timeliness. Also, it was decided to consider the Campaign (IAT/OAT) scenario. JSGO prepared a roadmap of OSL Backup Plan and it was shared with IAEA/NMCC/JNFL.

- **Subtask teams**

It was proposed and agreed to establish sub-task teams for “Sampling” and “Analysis” to efficiently address various issues related to OSL backup plan review and testing and to optimize usage of Operator's analytical lines and to minimize inspection efforts. In

addition, the Terms of Reference (TOR), which describes the task force's purpose, members, and the scope of issues to be addressed, was prepared.

- Preparation of Requirement

The IAEA decided to prepare all authentication requirements for sampling, storage and analysis. For Sampling, IAEA prepared the test specifications of “Jug Transfer Test” to demonstrate that authenticated samples can be taken using JNFL laboratory premise. And for Analysis, the requirements related to the analysis work procedure were based on the JNFL analysis flow, and the IAEA decided to create a draft analysis flow with additional analysis requirements.

4. Sampling Feasibility Test (Jug Transfer Test)

The IAEA Sampling/Analysis authentication requirements and Jug Transfer Test Procedures were drafted in October 2022. After that, we confirmed details for the procedure through IAEA-CI, and coordinated the test schedule. Jug Transfer Test was performed using JNFL Receiving Cell. Repeatability of jug transfer was confirmed using a total of 66 empty Jugs (including 2 trials) and 3 receiving cells for 9 sampling benches in JNFL equipment.

Despite some improvements need to be implemented to keep the CoK of samples in the receiving cells, the tests have demonstrated that authenticated automatic samples can be taken using JNFL laboratory.

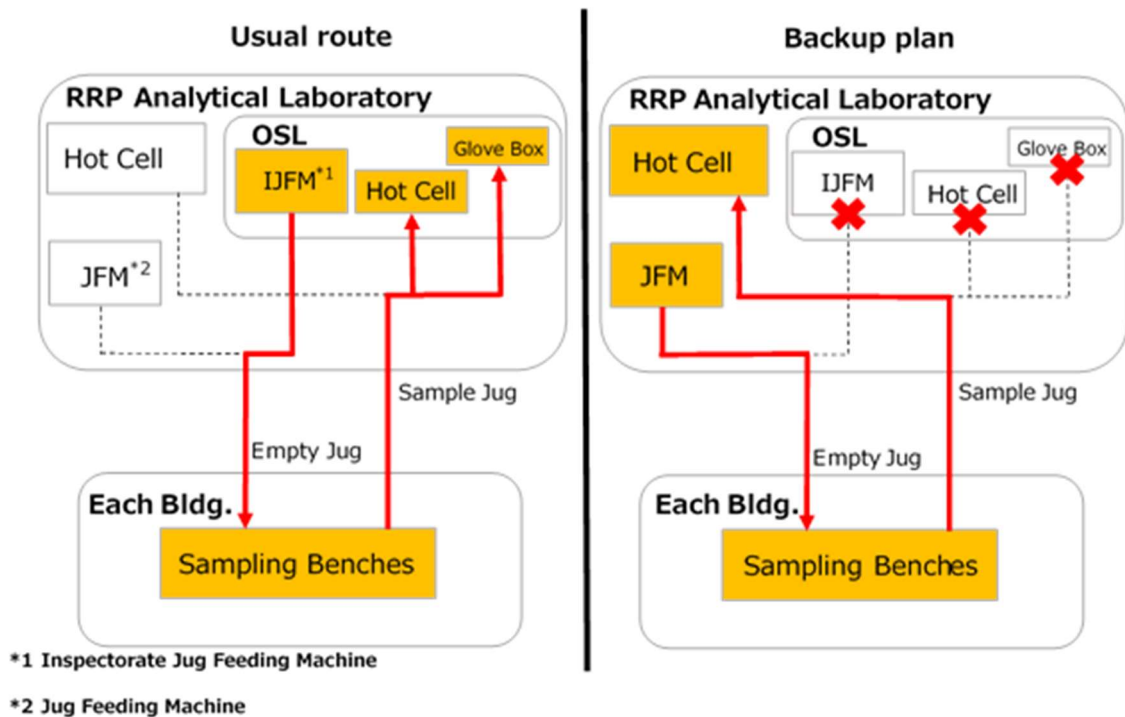


Fig.2 Sampling, collection and analysis location

5. Status of the analytical subtask

Currently, the analytical subtask team is conducting validation testing of analytical methods that will include the design and preparation by IAEA of working standard to authenticate each analytical instrumentation.

As for the analysis, there are many confirmation items such as the creation of procedures, the preparation of standard samples, reagents and analytical instruments, and the maintenance of CoK. Although it is a little behind the initial plan, it is progressing steadily. The outline is described below.

- Analytical instruments

Analytical instruments used in JNFL laboratory are

1. Handheld Density Meter
2. Pu(VI)-Spectrophotometry (Nd spike) *
3. IDMS (Isotope Dilution Mass Spectrometry)
4. HPLC (High Performance Liquid Chromatography)

- Analytical Flow

Based on the analytical flow provided by JNFL to the inspectorate side, IAEA analysis requirements were added.

- Confirmation test

The test consists of “Elementary test Part 1”, “Elementary test Part 2” and “Comprehensive test”

- Elementary test Part 1: JNFL's QC samples, spikes, and reagents are used for testing
Confirmation of basic analysis flow and CoK points
- Elementary test Part 2: Actual IIV samples and/or JNFL QC samples are used for testing
IAEA QC samples, spikes, and reagents are used.
Performance check confirmation by comparison with OSL analysis results
- Comprehensive test: Whole process test including sampling
IAEA QC samples, spikes, and reagents are used
Confirmation of overall feasibility and performance

* Regarding Pu(VI)-Spectrophotometry (Nd spike), JNFL has no operational experience, it tested JNFL internally using Clean Sample and Dirty Sample before the Elementary Test Part 1.

6. Current status of each Subtask team

The current status of each subtask team is as follows

Sampling subtask team

	Jug Transfer Test	Comprehensive Test
Jug Transfer	✓ April, 2022	Planned in FY2023

Analysis subtask team

	JNFL Internal Test	Elementary Test Part 1	Elementary Test Part 2	Comprehensive Test
Density Meter	—	✓ July, 2022	✓ December,2022	Planned in FY2023
Pu(VI)-Nd spike Spectrophotometry	✓ Dec. 2022	Planned in FY2023	Planned in FY2023	Planned in FY2023
TIMS/IDMS	—	✓ June, 2022	✓ March,2022	Planned in FY2023
HPLC	—	✓ July, 2022	✓ December,2022	Planned in FY2023

7. Conclusion

The OSL is installed at RRP, and it is managed and operated by NMCC under JSGO of NRA, and jointly used with IAEA. If the OSL malfunctions due to a fire, etc., the inspectorate will not be able to take, collect and analyze samples until the OSL is restored. In the case of RRP, undergoing safeguards inspections is mandatory under international agreements and domestic law. If alternative measures are not implemented, there is a high possibility that the conclusion of safeguards inspections will be affected. Therefore, developing an OSL backup plan is essential.

JNFL Analytical Laboratory is not designed for safeguards analysis but it could be used as OSL Backup with the JNFL operator efforts and cooperation despite the interference with the routine activities. Currently, some improvements have been raised in the “Jug Transfer Test” and “Elementary test”, but JNFL would like to cooperate with JSGO, IAEA and NMCC.