

NRA presentation

D-1 Regulatory aspects on source monitoring

SHIOKARAMATSU Masaki
Nuclear Regulation Authority JAPAN

IAEA Regulatory Review Mission on ALPS Treated Water Handling
18th January 2023



Contents

1. Review on TEPCO's quality assurance and TEPCO's source monitoring programme
 2. Regulatory verification of TEPCO's source monitoring (Operational Safety Inspection)
 3. Independent source monitoring by the NRA
- Ref. Presentation at the last Review Mission in March 2022



1-1. Review on TEPCO's quality assurance

Review Result Document (22nd July 2022)

1-8.2. Organizational framework for analysis of ALPS Treated Water

The NRA confirmed that as part of the activities based on the quality management system plan described in the Implementation Plan Chapter III, Part 1, Article 3, TEPCO plans to establish an organizational framework required for the analysis of ALPS treated water and to ensure objectivity and reliability for analytical methods and results by procuring analysts from specialized outsourcing companies and doing comparative verification of the analysis results with third-party institution. In addition to the establishment of this organizational framework, the NRA confirmed that TEPCO also plans to secure resources necessary for the analysis at the entire FDNPS including sea area monitoring



1-2. Review on TEPCO's source monitoring programme

NRA has confirmed that:

- Nuclides selected as to be measured and assessed by the scheme, that each step are confirmed to be valid in current examination process, are measured and evaluated every batch for discharge.
- Nuclides newly selected are analyzed under the same quality management system approved in the last examination.

No.	Nuclide	Analysis method	No.	Nuclide	Analysis method	No.	Nuclide	Analysis method
1	C-14	Separation \Rightarrow β	11	Sb-125	γ	21	U-234	Include in total α
2	Mn-54	γ	12	Te-125m	Evaluate from Sb-125	22	U-238	Include in total α
3	Fe-55	Separation \Rightarrow X-ray	13	I-129	ICP-MS	23	Np-237	Include in total α
4	Co-60	γ	14	Cs-134	γ	24	Pu-238	Include in total α
5	Ni-63	Separation \Rightarrow β	15	Cs-137	γ	25	Pu-239	Include in total α
6	Se-79	Separation \Rightarrow β	16	Ce-144	γ	26	Pu-240	Include in total α
7	Sr-90	Separation \Rightarrow β	17	Pm-147	Evaluate from Eu-154	27	Pu-241	Evaluate from Pu-238
8	Y-90	Evaluate from Sr-90	18	Sm-151	Evaluate from Eu-154	28	Am-241	Include in total α
9	Tc-99	ICP-MS	19	Eu-154	γ	29	Cm-244	Include in total α
10	Ru-106	γ	20	Eu-155	γ			



2. Regulatory verification of TEPCO's source monitoring

- NRA is now conducting 2 types of operational inspection on the Implementation Plan approved on 22nd July 2022.
 - Inspection on the construction of the discharge facility by checking site, checking documents about safety measures, and by interview
 - Inspection on quality assurance of nuclide analysis



2-1. Inspection on the construction of the discharge facility

- NRA inspector interview TEPCO and check the progress of construction
 - Status of overall construction
 - Status of Discharge tunnel
 - Safety measures for the construction work
 - etc.,
- Also, NRA inspector checks non-routine operations on site
 - Installation of the discharge outlet caisson
 - Sampling the tank water for analysis of ALPS treated water
 - Disaster drill
 - etc.,





2-2. Inspection on quality assurance of nuclide analysis

- NRA started the operational inspection on TEPCO's quality assurance of nuclide analysis last December.
 - NRA inspects TEPCO's quality assurance system and implementation to see whether analysis is in accordance with Implementation Plan and it applies ISO 9001/ISO 17025
- Primarily, started inspection on process of procurement for analysis of nuclides difficult to be measured and OBT.
 - Inspection on TEPCO and its contractor. Details are shown in the next slide
- NRA will check analysis result of ALPS treated water before discharge



Operational inspection (15th Dec 2022)



2-2. Inspection on quality assurance of nuclide analysis

- Contents of inspection on procurement shown below.

Subject	Contents	Outline
TEPCO	Process	Process for outsourcing
	Requirement	Specification of requirements
	Validation	Validation of result whether it satisfies the specified requirements
	Response to defect	Action to the result which does not satisfy the specified requirements
Contractor	Execution procedure	Process from receiving orders of outsourcing from TEPCO till setting analytical procedure
	Validation	Validation of result
	Responsibility	Authority and responsibility on management system



2-2. Inspection on quality assurance of nuclide analysis

- From the next time...

Subject	Rough classification of inspection contents	Schedule
TEPCO	Input and Output for design and development of analytical method	Jan
Contractor	Validation of instruments	Jan
	Management of monitoring and measurement instruments	Jan
TEPCO & Contractor	Human resources	Jan
	Management of documents	Feb
	Evaluation and improvement	Feb

- Scheduling to conduct inspection once a month



- Inspection Result will be reported to NRA Commission and uploaded on NRA website



3. Independent Source Monitoring by the NRA

Purpose:

Considering the importance of objectiveness and transparency of monitoring, the NRA conduct source monitoring as an independent regulatory body.

Before starting discharge

Analytical Institute:

JAEA Nuclear Safety Research Center (Technical Support Organization)

Sample to be analyzed:

K4 tank water sampled in March 2022

Points to be considered in analysis:

JAEA's quality control of analysis as bellow;

- Selection and verification of analytical methods
- Traceability of the radiation source (e.g. certificate)
- Record of the calculation of uncertainty



JAEA research facility



3. Independent Source Monitoring by the NRA

Radionuclides to be measured:

- (1) Nuclides to be measured to check TEPCO's analytical result
Major 7 nuclides (Co-60, Sr-90, Ru-106, Sb-125, I-129, Cs-134, Cs-137),
H-3, C-14, Tc-99
- (2) Nuclides to be checked for their existence
Cl-36, Fe-55, Se-79

Reporting:

- For nuclides of (1) & (2),
analytical results including the range of uncertainty
- For nuclides of (1),
identifying discrepancies with TEPCO's results and their reasons if any

After starting discharge

Analytical Institute:

JAEA Nuclear Safety Research Center (TBD)

Radionuclides to be measured:

Selected from Major 7 nuclides, H-3, C-14, Tc-99

Frequency of analysis:

Once a year (TBD)



**Ref. Presentation at the
last Review Mission in March 2022**



1. NRA's review on TEPCO's Source Monitoring program
 - 1-1 TEPCO's plan for Source Monitoring
 - 1-2 TEPCO's Quality Management for analysis work
2. NRA's verifications by regulatory inspections
3. Analysis of nuclides in ALPS treated water conducted by the NRA independently



1. NRA's review on TEPCO's Source Monitoring program

- NRA reviews whether the TEPCO's Source Monitoring program (plans and systems of analysis of ALPS treated water) described in the Implementation Plan conforms to the regulatory requirements*1.
- In the review, NRA judge the appropriateness whether the monitoring program will be conducted based on the quality management system established in the Implementation Plan according to the relevant ordinances*2, which has been approved by the NRA.

*1 **Items required for Measures which should be taken at Fukushima Daiichi NPS in line with the Designation as the Specified Nuclear Facility**

- By taking appropriate measures such as operation management, maintenance management, radiation control, radioactive waste management, emergency measure and on-site and off-site environmental radiation monitoring, etc., "II. Items concerning Measures to be taken for Design and Facilities" shall be ensured to be appropriately and reliably implemented, and workers' and on-site and off-site safety shall be ensured...

*2 **NRA Ordinance for Fukushima Daiichi NPS NRA Ordinance for Quality Control**

- Licensee shall plan, implement, evaluate and improve the operational safety based on the quality management system

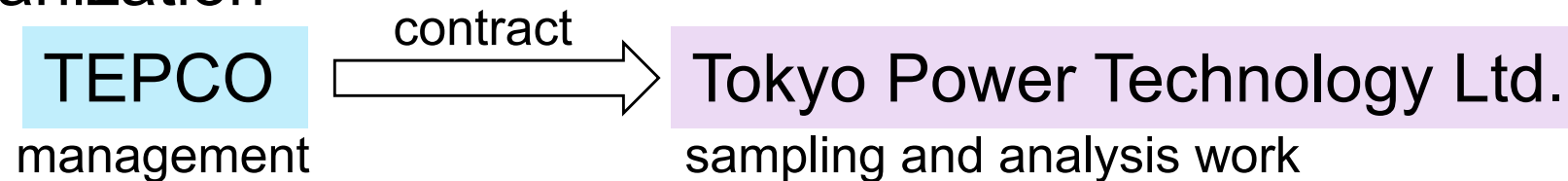


1-1 TEPCO's plan for Source Monitoring program

Outline of TEPCO's plan for source monitoring

- Analytical facilities
 - Chemical analysis building, Unit 5 & 6 analysis room, etc. in the Fukushima Daiichi NPS site

- Organization



- Monitoring procedures in the operation of discharge
 - TEPCO will sample every batch* before discharge
 - * Approximately 10,000 m³ (Ten tanks of 1,000 m³)
 - The analysis of the sample will take 2 months.
- Target nuclides to be monitored
 - Determined after the source term is identified



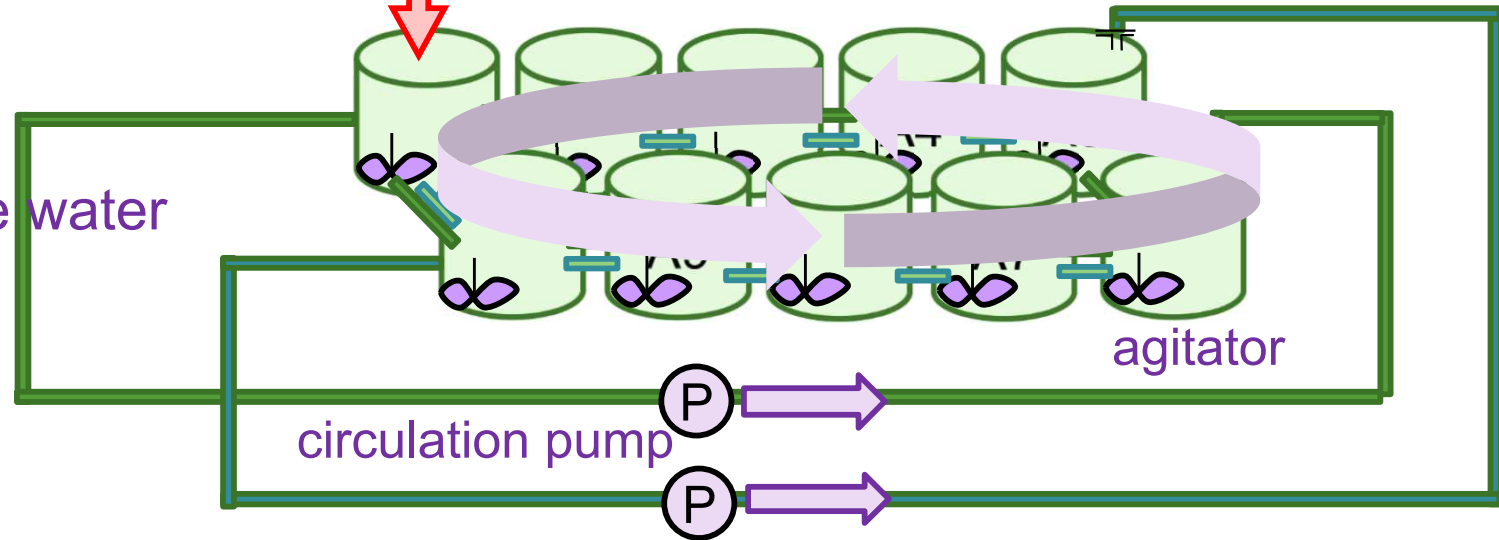
1-1 TEPCO's plan for Source Monitoring program

Procedures of discharge operation

① receive ALPS treated water

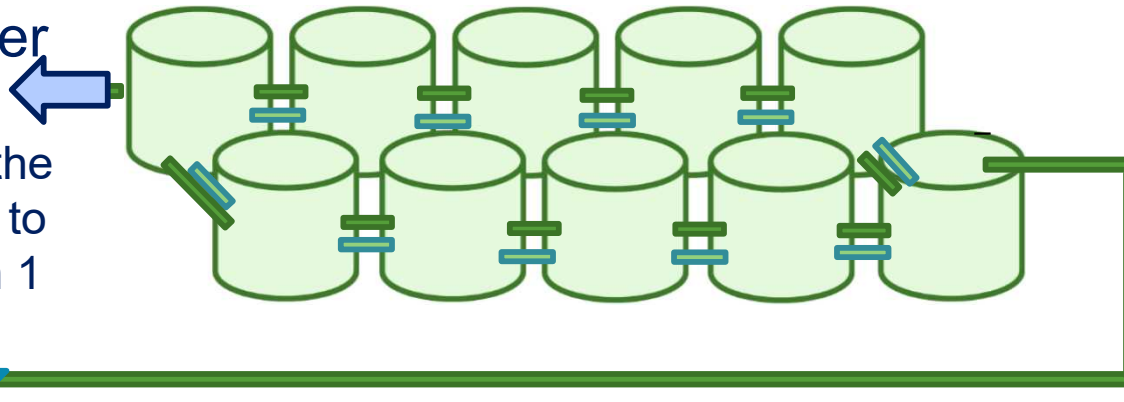


② circulate and agitate the water



③ sample and analyze ALPS treated water

- ✓ TEPCO measures the concentration of **H-3**
- ✓ TEPCO confirms that the sum of the ratios of the concentration of radionuclides **other than H-3** to each regulatory concentration limit is less than 1



④ transfer ALPS treated water for discharge



TEPCO's Specific measures on quality control

- TEPCO requires **the contractor**;
 - Quality control (ISO9001, ISO/IEC17025 accreditation) =>①
 - Securing human resources and competence of analysts and sampling staffs =>③
 - Establishing and revising of sampling & analysis procedures
 - Conducting sampling and analysis etc.
- Based on the QMS, **TEPCO conducts**;
 - Operation and maintenance of analytical facilities and instruments (including analytical environments) =>②
 - Showing analysis condition to the contractor
 - Competence control of analysts (the contractor) & supervisors (TEPCO staffs)
 - Supervising analysis works
 - Evaluation of analytical result data and handling of non-conforming etc.

1-2 TEPCO's Quality Management of analysis work



① Quality control of the contractor

TEPCO explains that the contractor secures the quality by:

- accreditation for analysis of Cs-134/137 and H-3 which are already obtained.
- Conducting equivalent level analysis as ISO/IEC-17025 for other nuclides
- Obtaining ISO/IEC-17025 accreditation for analysis of Sr-90 in the future.



➤ NRA understands that the quality of analysis will be ensured appropriately.

Materials of TEPCO after this pages are shown in 8th Review Meeting of ALPS treated water. 17
https://www.tepco.co.jp/en/hd/decommission/information/committee/pdf/2022/alps_22020701-e.pdf

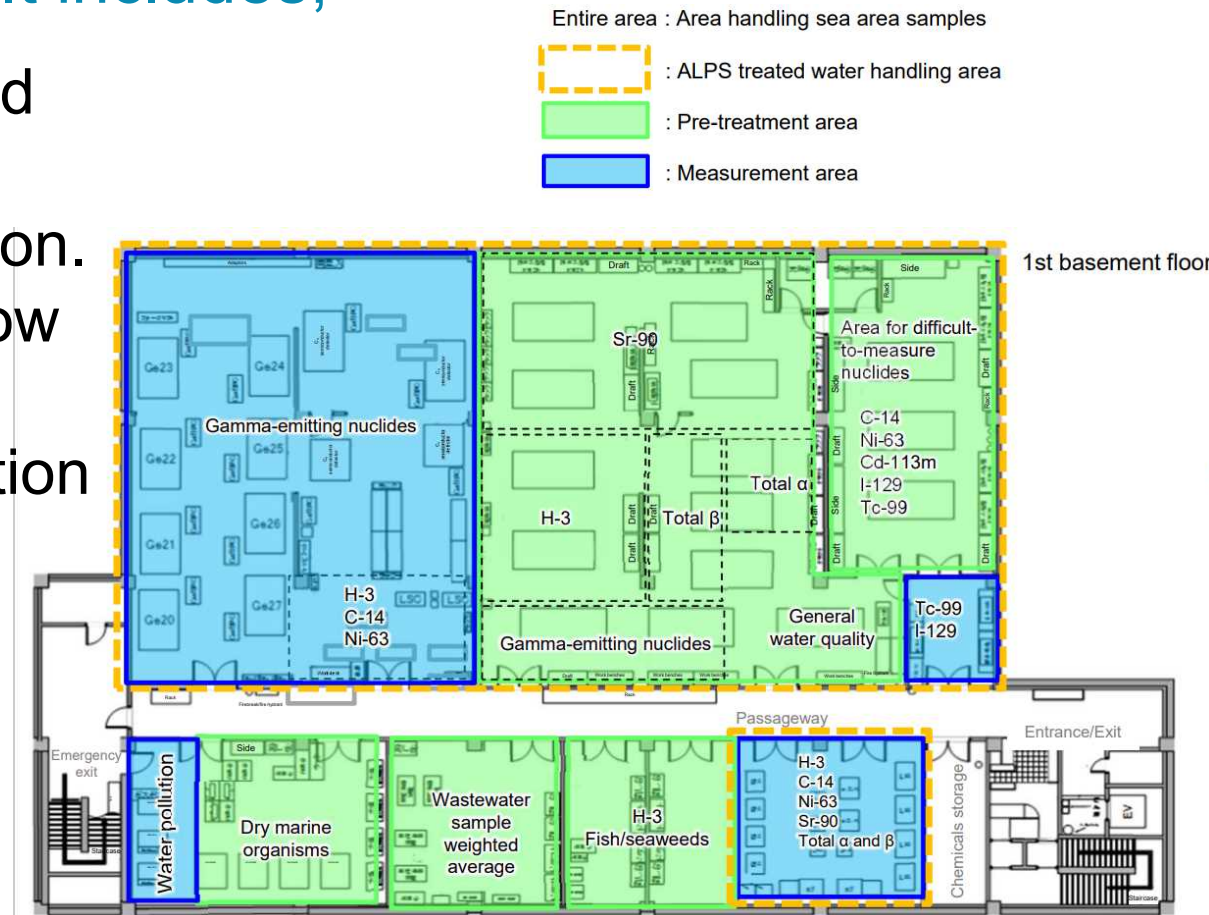
1-2 TEPCO's Quality Management of analysis work



② Analytical facilities and environments

TEPCO plans to conduct nuclide analysis of ALPS treated water in Chemical Analysis Building. It includes;

- Measurements to be conducted in basement floor not to be affected by atmosphere radiation.
- Limiting handling samples to low radioactivity.
- Periodical check of contamination level of the analytical environments and decontamination.
- Expanding the building in the future.



➤ NRA understands that the facilities and environments are maintained for the analysis of ALPS treated water



③ Competence of analysts

The Contractor secure and maintain the competence of analysts:

- High skilled analysts have been increased and they maintain competence so that they can analyze difficult nuclides to measure, such as C-14.
- Analysis skill tests have been conducted with domestic and overseas analysis institution in order to be assessed from a third-party perspective.
 - Proficiency Test Exercise (provided by IAEA)
- Checking the competence of analysts by using the preconditioned samples (nuclides for which ISO/IEC-17025 accreditation obtained)

TEPCO periodically check that the competence of analysts are properly secured and also maintain the competence of supervisors (TEPCO's staffs)

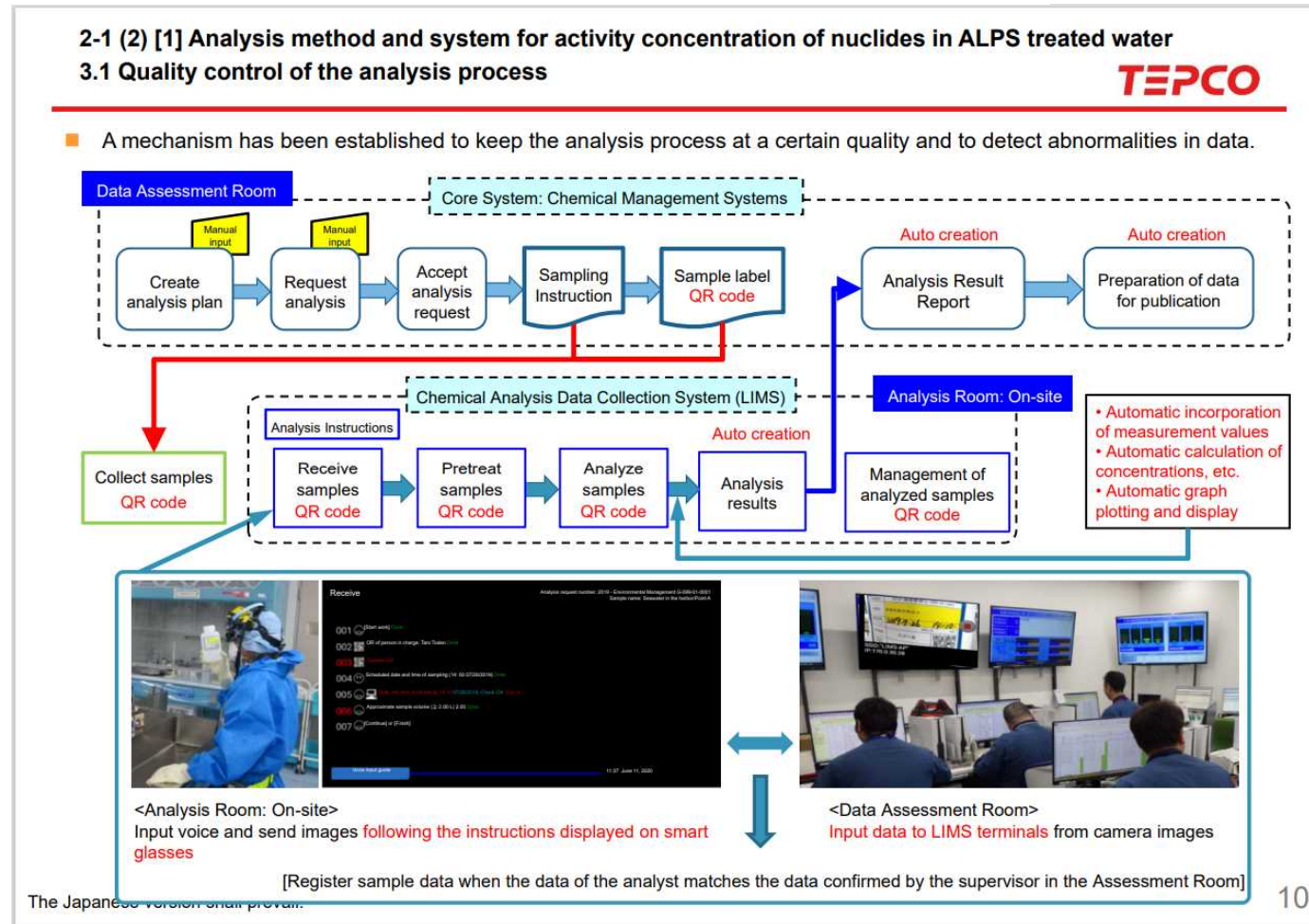
- NRA understands that there is a system to secure and maintain the competence of analyst.

1-2 TEPCO's Quality Management of analysis work



④ Process

TEPCO's plan for analytical procedures



➤ NRA understands some processes are automated so that the quality is maintained stable and erroneous inputs are prevented.



④ Process

TEPCO's plan for devices used for reading analytical data


2-1 (2) [1] Analysis method and system for activity concentration of nuclides in ALPS treated water
3.2 Quality control of the analysis process

TEPCO

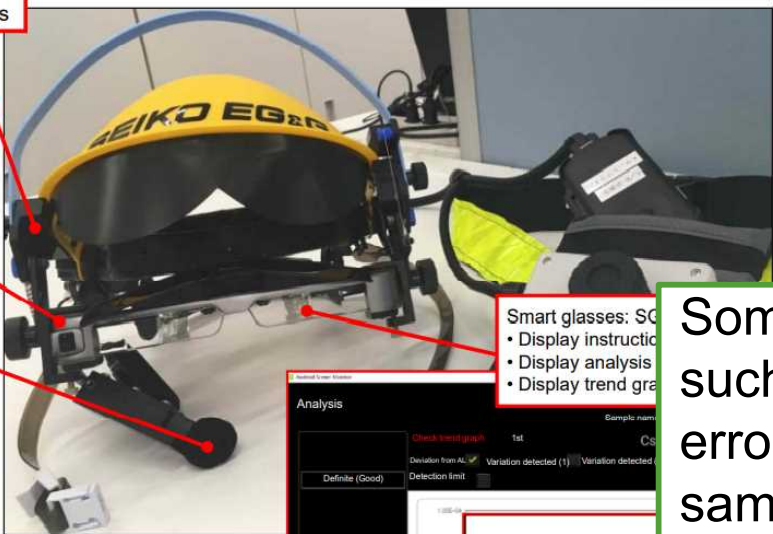
- Smart glasses are used as on-site control terminals of the Chemical Analysis Data Collection System (LIMS)

Camera

- Reads QR codes
- Sends video images



Headphones



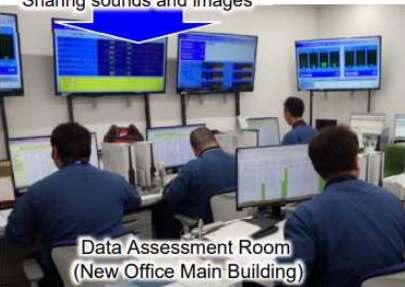
Microphone

- Conversation with staff in the Assessment Room
- Respond to instructions given by the SG

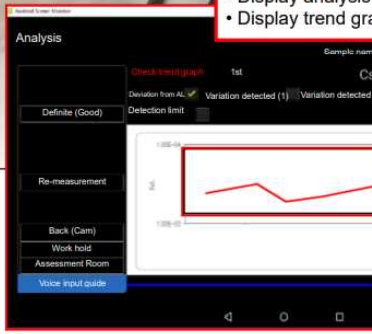
Smart glasses: SG

- Display instruction
- Display analysis
- Display trend gra

Sharing sounds and images



Data Assessment Room
(New Office Main Building)



Some troubles happened in the past such as handling wrong sample erroneously, mistranscription of sampling data, or variation of analysis result depending on each analyst, so prevention of errors and technique standardization of each analysts is important.

➤ NRA understands some devices to prevent human errors will be installed in the analytical process.



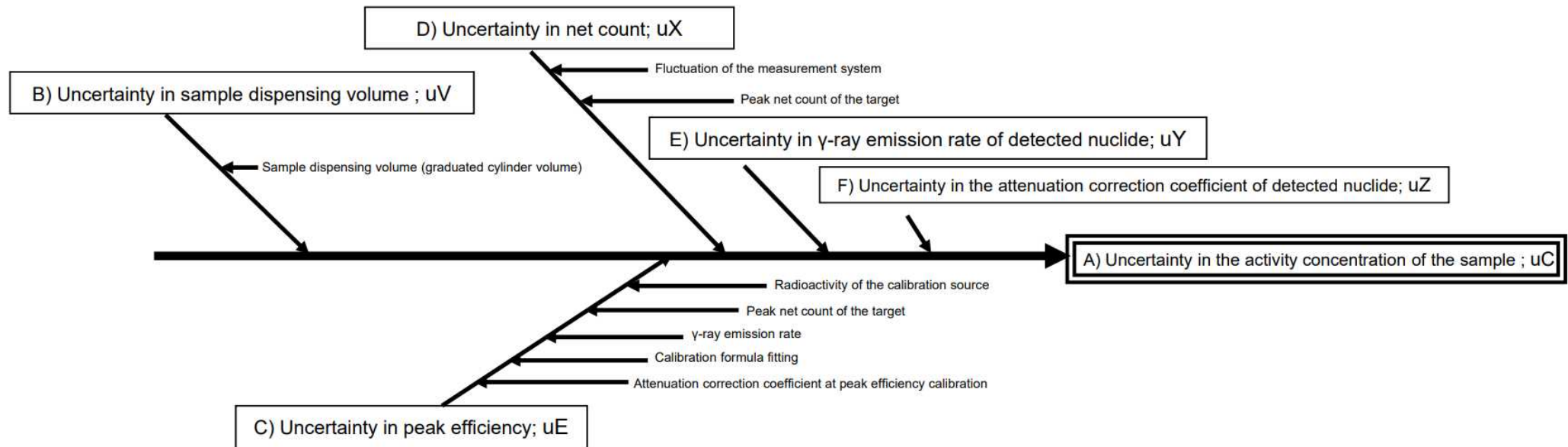
④ Process

• Consideration on Uncertainties

TEPCO characterize uncertainties from;

- sample dispensing volume amounts
- calibration of analytical instruments
- measurement environments or preprocessing etc.

and evaluate the total variation of nuclide analysis results.



➤ NRA understands that each contribution factors to uncertainties are characterized and considered appropriately. 12



1-2 TEPCO's Quality Management of analysis work

⑤ Verification of analysis results

TEPCO will adopt new methods in nuclides analysis as well as conventional methods and verify analysis results by;

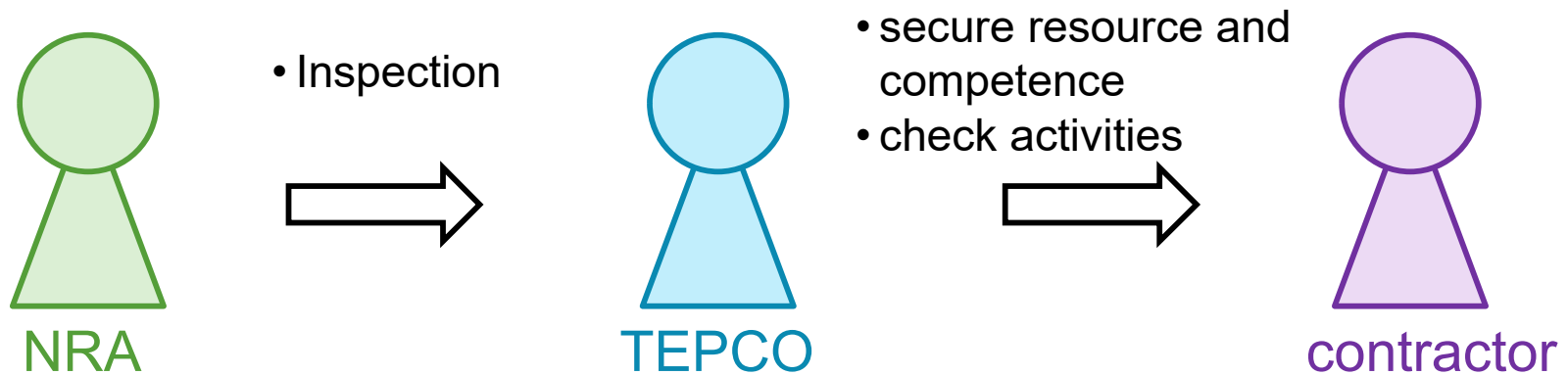
- Confirmation of accuracy by using reference source material in preprocessing process
- Comparing the result data with institution below;

Organization	Accreditation	Accreditation obtained (17025)
KAKEN	ISO/IEC17025	Cs-134,Cs-137 I-131 Sr-90 H-3
Japan Chemical Analysis Center	ISO/IEC17025 ISO9001	Gamma-emitting nuclides H-3 Radioactive strontium Plutonium, etc.
Tohoku Ryokka Kankyohozen	ISO/IEC17025 ISO9001	Cs-134,Cs-137 I-131 H-3



2. NRA's verifications by regulatory inspections

- NRA will ensure the quality of monitoring by checking the record in regulatory inspections.



- NRA will also verify the TEPCO's source monitoring through NRA's own periodical analysis on major nuclides in ALPS treated water.



3. Analysis of nuclides in ALPS treated water conducted by the NRA independently

The NRA explain nuclides characterization activities in ALPS treated water conducted by the NRA in other section.

- Section C
- Topic 3 "Verification/acceptability of source term characterization"



Reference Materials

GSR Part3

3.37. . . . The regulatory body shall be responsible for review and approval of the monitoring and measurement programmes of registrants and licensees.

Requirement 32: Monitoring and reporting

The regulatory body and relevant parties shall ensure that programmes for Source monitoring and environmental monitoring are in place and that the Results from the monitoring are recorded and are made available.

3.135. The regulatory body shall be responsible, as appropriate, for:
(c) Making provision for an independent monitoring programme.

RS-G-1.8

Monitoring in the operational stage

Source monitoring

5.17. The design of the source monitoring programme should be such as to enable the verification of compliance with the authorized limits on discharges and the criteria for discharges specified by the regulatory body. The monitoring of radioactive discharges may entail measurements for specific radionuclides or gross activity measurements, as appropriate. Measurements should normally be carried out before dilution occurs or at the point of discharge (e.g. at the stack for atmospheric discharges or the discharge pipeline for a liquid discharge). In the case of batch discharges, the material for discharge is adequately characterized by the volume of the batch and the radionuclide composition of a sample taken at the reservoir from the homogenized batch prior to discharge.



TEPCO's Quality Management System in the Implementation Plan

The Implementation Plan

Ⅲ Operational Safety of the Specified Nuclear Facility

Volume No.3 Operational Safety pertaining Unit 1, 2,3 & 4

Chapter2 Quality Assurance

Article3 Quality Assurance Plan

TEPCO establish a quality assurance plan as below in the implementation of quality assurance activities for operational safety activities.

...

7.4.2 Requirements for Procurement

- a) products, workflow and its process, and approval of facilities
- b) Competence of staffs
- c) Quality management system
- d) Non-conforming report and response



Independent Source Monitoring by the NRA (Before discharge)

(Reference)

No. GSG-9 Regulatory Control of Radioactive Discharges to the Environment

Independent monitoring by the regulatory body

5.84.

The regulatory body should make provision for independent monitoring. The characteristics of independent monitoring and the resources devoted to independent monitoring should be based on a graded approach and should incorporate best practices and scientifically sound analytical methods. Such monitoring may be undertaken by the regulatory body or on behalf of the regulatory body by another organization that is independent of the operating organization.

5.85.

The purpose of such independent monitoring may be one or more of the following:

- (a) To verify the quality of the results provided by the operating organization;
- (b) To verify the assessment of doses to the representative person;
- (c) To determine the consequences of any unforeseen release of radioactive material;
- (d) To undertake research into exposure pathways, including the contributions to dose from other sources of exposure;
- (e) To provide public reassurance.