Integrated Safeguards (IS) for MOX Fuel Facilities

- Development of Approach and Applications -

Japan Atomic Energy Agency

Plutonium Fuel Development Center

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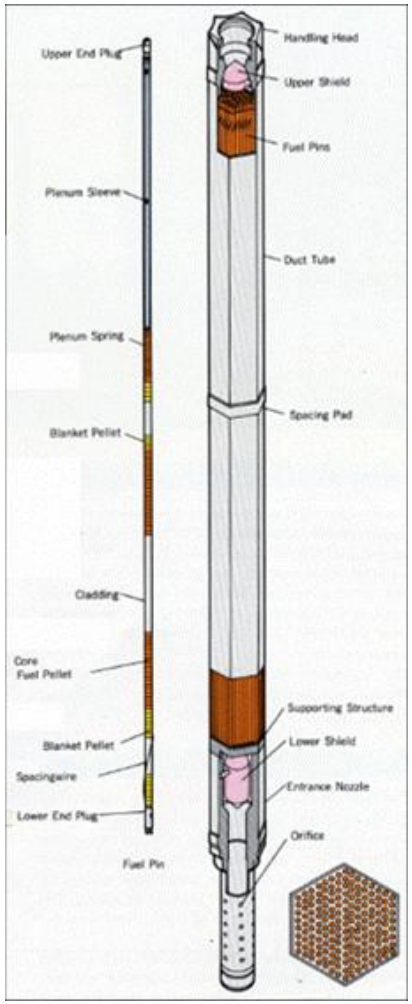
1. Overview of Plutonium Fuel Production Facility
1.1 Feature of the facility

The Plutonium Fuel Production Facility (PFPF) was constructed to supply MOX fuel for the prototype Fast Breeder Reactor (FBR) “MONJU” and the experimental fast reactor “JOYO” in 1987. The advanced technologies for MOX fuel fabrication were utilized to build the efficient process.

Features

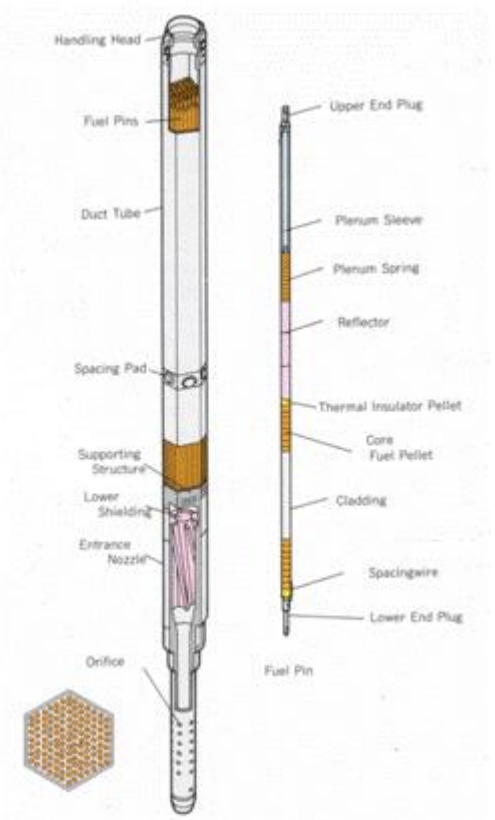
1) The remote operation from the process control room
3) Increased productivity (up to 5 tons of MOX fuel per year)
4) Reduction of radiation exposure during operation
4) On-line real time material accountancy by the central control computer
5) Introduction of advanced safeguards systems

1. Overview of Plutonium Fuel Production Facility
1.2 Specification of Fuel Assembly



MONJU

	MONJU	JOYO (MK-Ⅲ)
Pellet	5 ㎜ϕ × 8 ㎜H	5 ㎜ϕ × 9 ㎜H
Pellet density	85%TD	94%TD
Pu concentration	20／32wt% (Inner/Outer)	20／30wt% (Inner/Outer)
Assembly	4,200 mm	2,970 mm
Number of Pin	169	127
MOX weight	34 kg	11kg
Pu weight	7 / 9 kg (Inner/Outer)	2 / 3 kg (Inner/Outer)



JOYO(MK-Ⅲ)

1. Overview of Plutonium Fuel Production Facility
1.3 Feature of the Safeguards Systems

HRGS
(High Resolution Gamma Ray Spectrometry)

MAGB
(Material Accountancy Glove Box Assay System)

NDA System

Receipt

Feed Storage

Process

Assembly Storage

Shipment

NDA System (RMS)

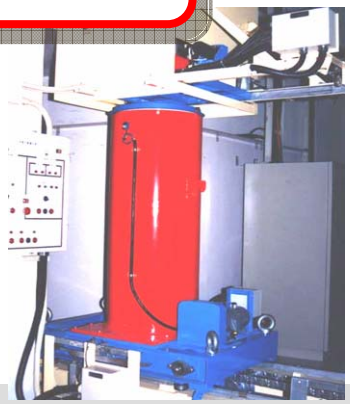
C/S System

NRTA

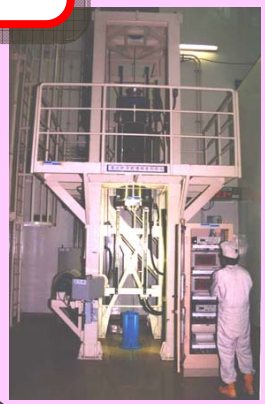
NDA System (RMS)

C/S System

PCAS
(Plutonium Canister Assay System)



DMOS
(Digital multiple optical surveillance system)

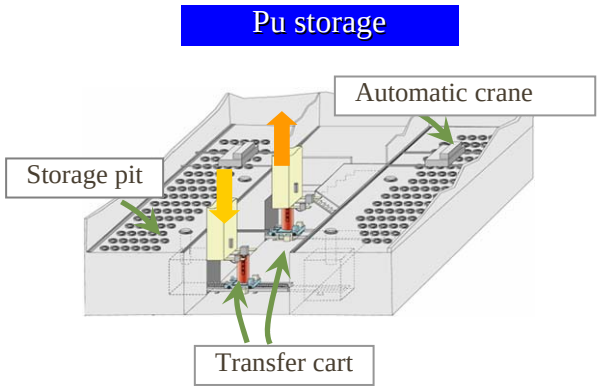


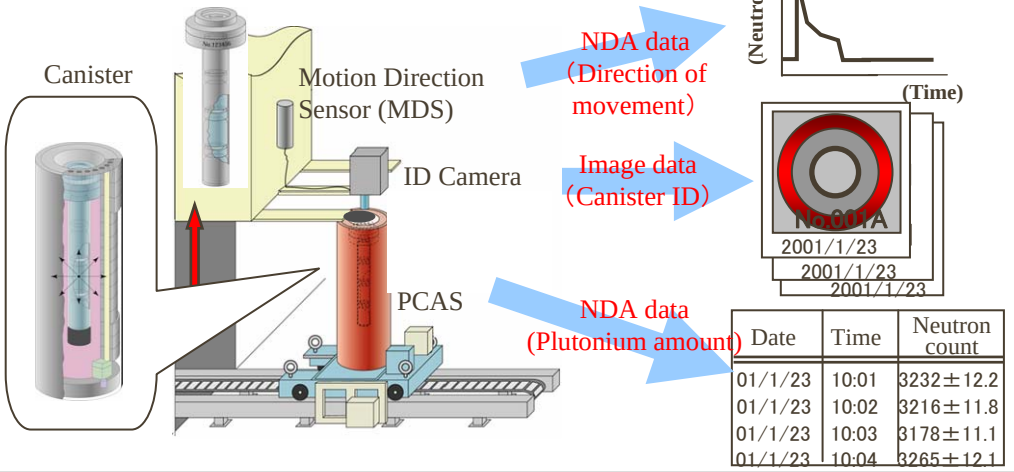
FAAS
(Fuel Assembly Assay System)

1. Overview of Plutonium Fuel Production Facility
1.4 The unattended NDA Systems

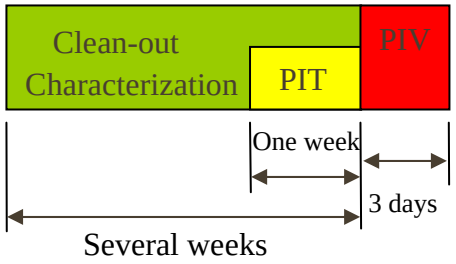
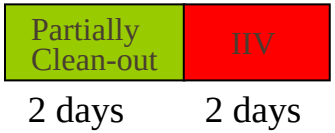
- The storage canisters containing plutonium powder in the plutonium feed storage are measured by unattended NDA system called PCAS just before transferring from/to the feed storage area. The detector part of PCAS was designed as part of the automated canister-transfer system in the feed storage area. By combining the NDA system and the transfer system, flow verification of canisters can be performed without inspectorate.
- This system had been upgraded to the remote monitoring system in 2005.

Improvement of efficiency of safeguards activity





1. Overview of Plutonium Fuel Production Facility
1.5 Inspection at PFPF

	Frequency	Activity	Burden of plant operation	PDI / month
PIV	Once a year	- Book audit - Material balance evaluation - NDA (β =0.1) - DA sampling - IC/ID		About 30 PDIs
IIV	Once a month (11 times a year)	- Book audit - Material balance evaluation - NDA (β =0.8) - DA sampling - IC/ID		About 14 PDIs (Total: 154 PDIs/year)

2. Development of the IS approach for PFPF
2.1 Implementation of the integrated safeguards to Japan

The integrated safeguards was applied to Japan on September 2004.
The facility level IS approaches have been implemented as follows.

LWR (without MOX), SF storage facility : 2004.9
LEU fuel fabrication plant : 2005.1

Efforts by IAEA for the LWR, LEU facility and etc.

- Relaxation of timeliness goal
  (e.g. Spent fuel : 3 months → 1 year)
- Development of the standard approach

Consideration of IAEA on the MOX facility

- The standard approach is not developed
- Timeliness goal is not relaxed
  Because
  / Plutonium is direct use material
  / The number of the MOX fuel fabrication plants is small
- Inspection effort should be reduced without loss of effectiveness of SG by introduction of new SG concept.

2. Development of the IS approach for PFPF
2.2 Purpose of development

Purpose of development of IS approach for the inspectorate

- Further improvement of efficiency and effectiveness of safeguards

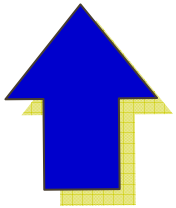
Purpose of development of IS approach for the operator

- Reduction of support jobs for the inspection
- Reduction of burden of the plant operation by the inspection
- Establishment of the approach corresponding with the plant operation
- Contribution to the establishment of safeguards approach for the future MOX fuel fabrication plant.

2. Development of IS Approach by PFPF
2.3 Concept of the draft IS approach

Requirements to the approach

- Improvement on transparency of facility operation
- Improvement on early detection capability of the diversion
- Improvement on deterrent effect of the diversion
- Decrease of inspection efforts
- Decrease of burden of the facility operation



Optimum combination

Safeguards measures for IS approach

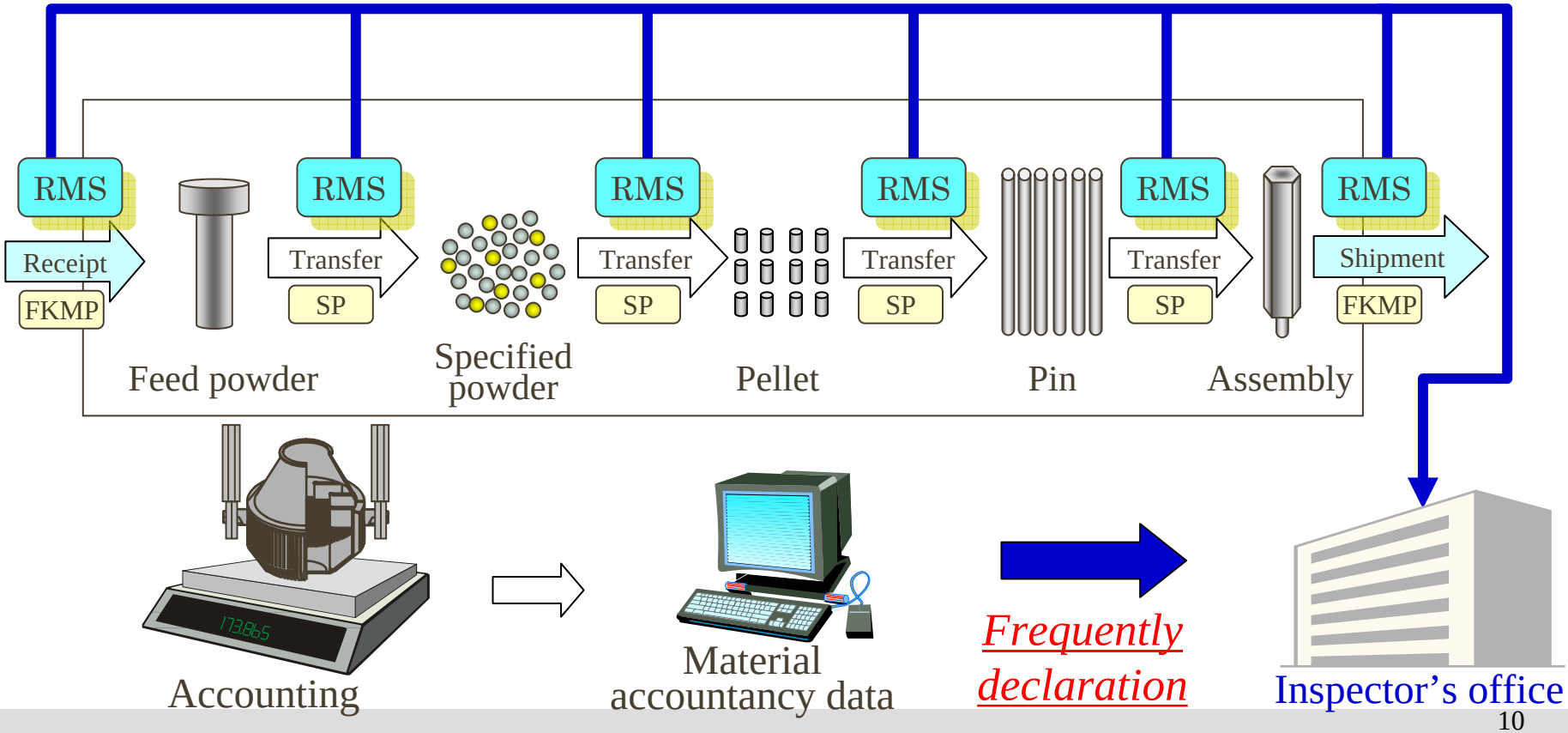
1. Frequent declaration of the material accountancy information
2. Frequent NRTA evaluation
3. Remote monitoring of the nuclear material flow
4. Application of the random interim inspection (RII)

2. Development of IS Approach by PFPF
2.4 Improvement of transparency

Measures

- Frequent declaration of material accountancy data
- Expansion of the remote monitoring system to the entire facility

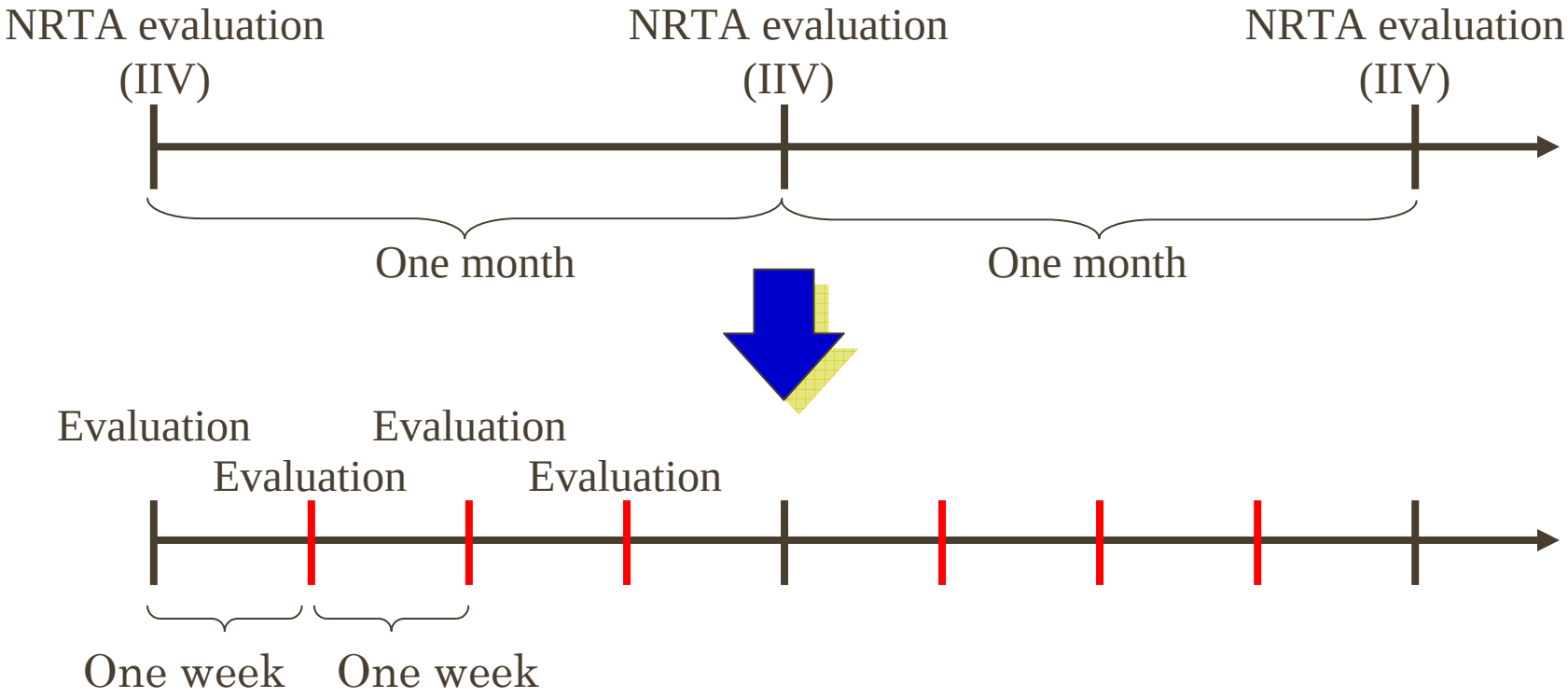
Remote monitoring of material flow by RMS



2. Development of IS Approach by PFPF
2.5 Improvement of early detection capability

Measures

- Frequent NRTA evaluation
- Expansion of the remote monitoring system to the entire facility

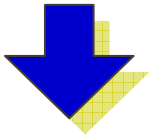


2. Development of IS Approach by PFPF
2.6 Improvement of deterrence effect

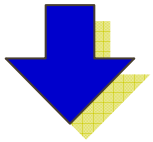
Measures

- Introduction of the short notice random interim inspection

IIV: Inspection activities are performed at scheduled date in advance

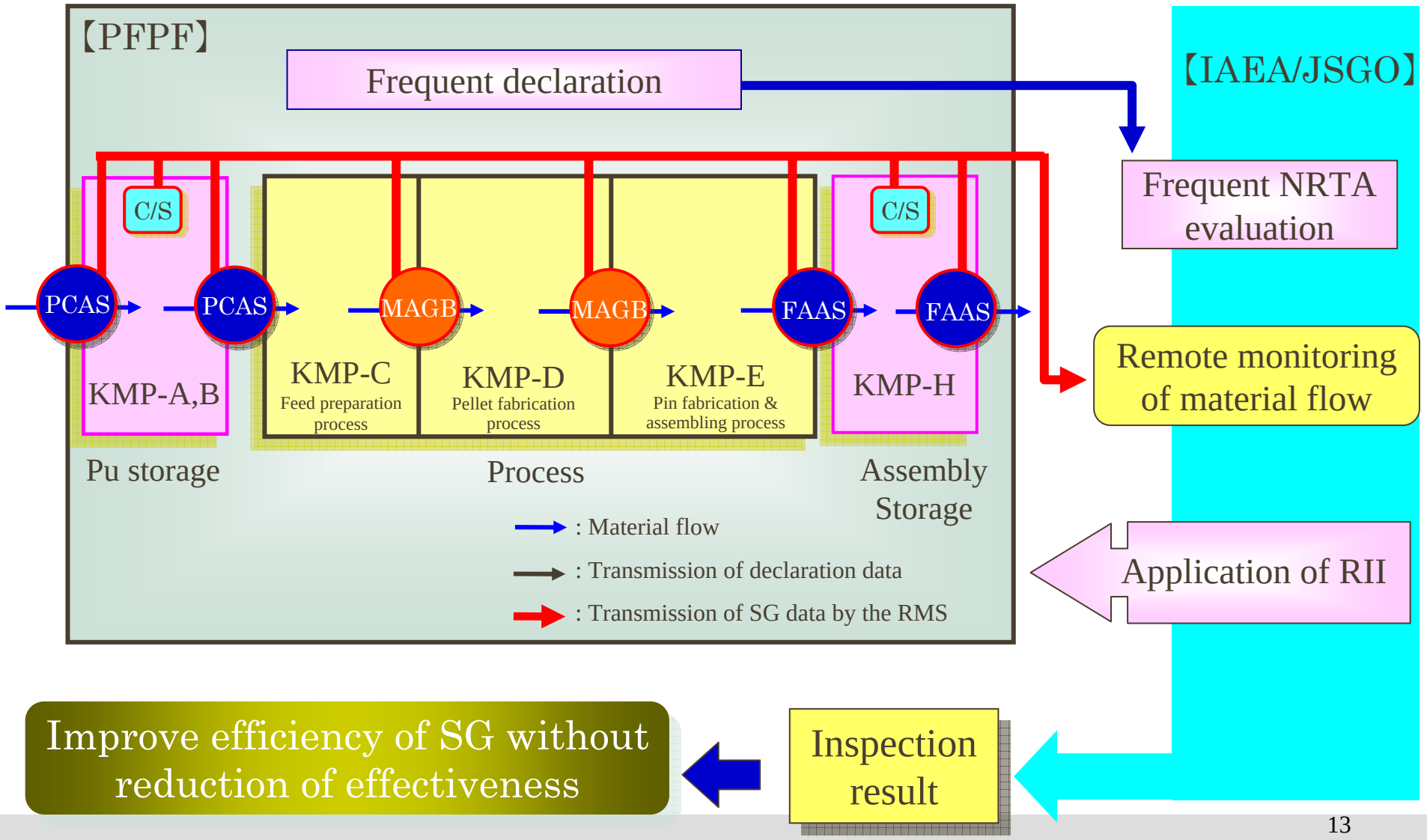


RII: Inspection activities are performed at randomly selected date.
The inspection date is notified with short time.



Deterrence effect is improved because
the operator can not know when the RII would be performed.

2. Development of IS Approach by PFPF
2.7 Overview of IS approach for PFPF

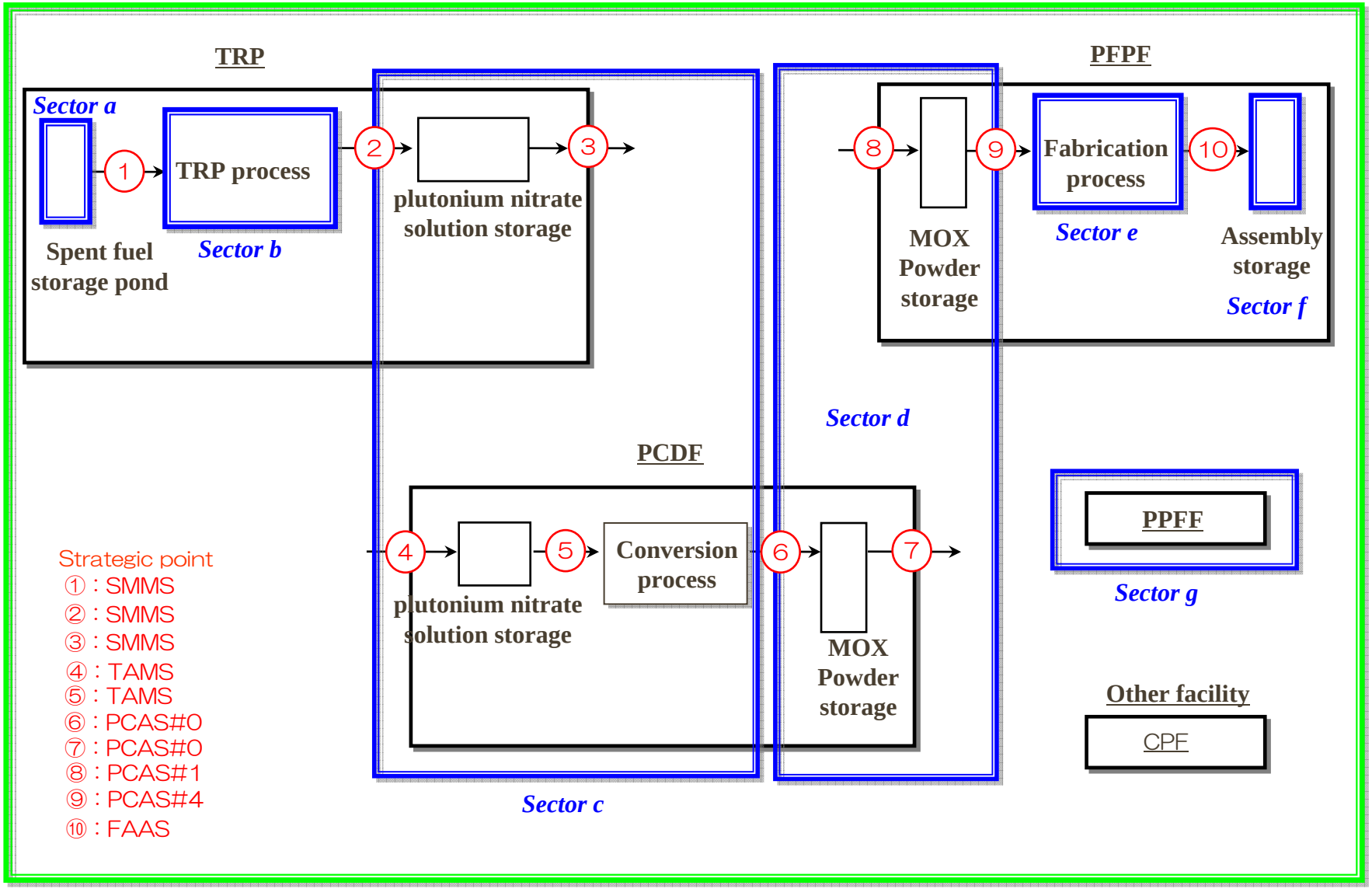


2. Development of IS Approach by PFPF
2.8 Comparison of current safeguards and IS

Inspection	Current Safeguards approach	Integrated Safeguards approach
PIV	- Once a year (scheduled date) - About 30 PDIs for 3 days - The facility operation is stopped	- Once a year (scheduled date) - About 30 PDIs for 3days - (In the future, the inspection activities would be reduced.) - The facility operation is stopped
IIV	- 11 times a year (scheduled date) - 14 PDIs for 2 days (total: 154 PDIs) - The facility operation is stopped - The nuclear materials in the entire facility are verified	-
RII	-	- Less than 10 times a year (randomly selected date) (totally 30 times in JNC-1 site) - 2 PDI for 1 day (total: 20 PDIs) - The facility operation is not stopped - The nuclear materials in randomly selected area are verified (except for hold-up and waste)
Flow verification	- 100% verification for nuclear material flow at FKMP	- 100% verification for nuclear material flow at SP

3. IS Approach for JNC-1 Site

3.1 Overview of JNC-1 Site



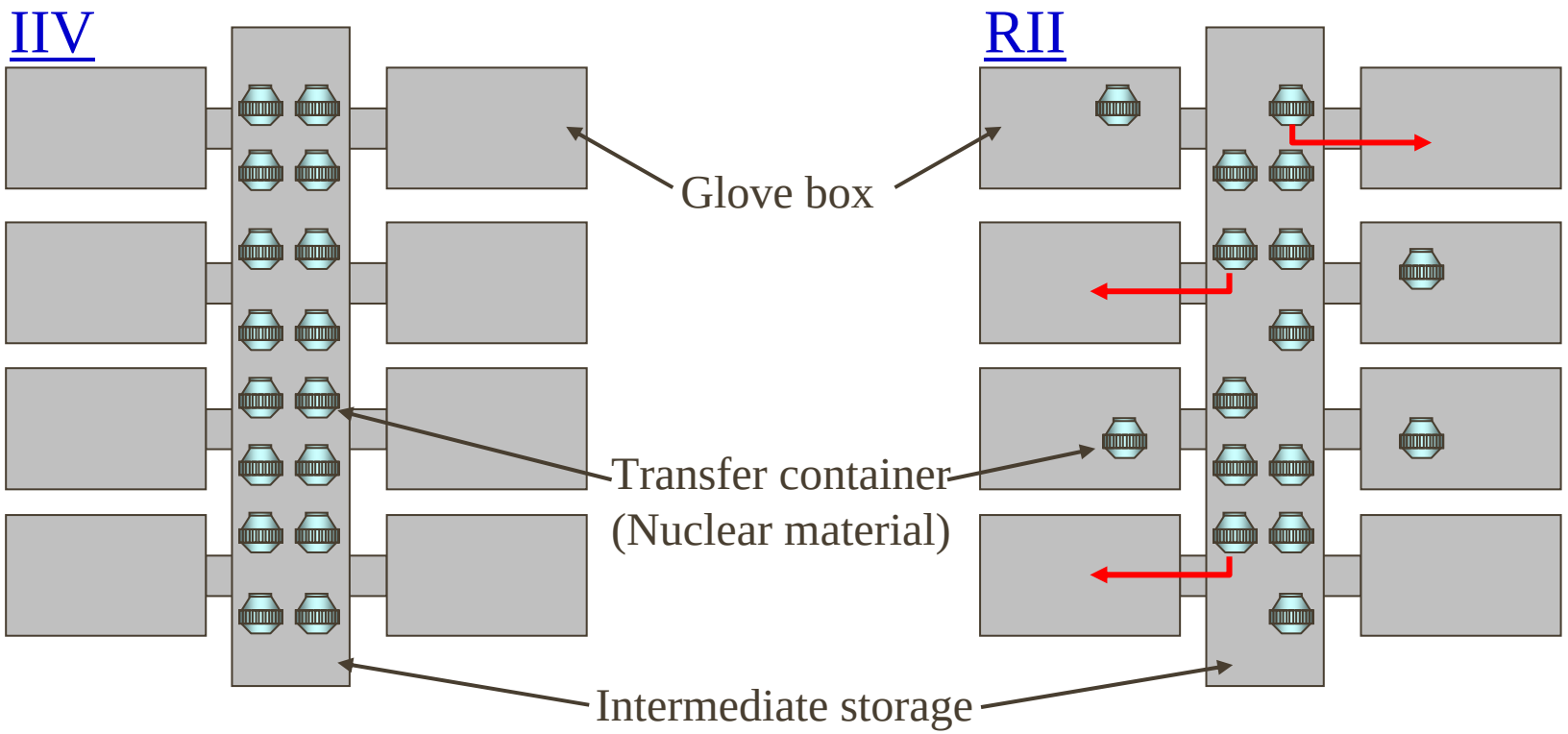
3. IS Approach for JNC-1 Site
3.2 Features of the Site Approach

Features of the JNC-1 site approach

- The approach is developed for all nuclear facilities (TRP, PCDF, PFPF, PPFF and etc.) in the site.
- The areas where the same nuclear material stratum (physical and chemical form) is handled are defined as the sector.
- The specific safeguards approach is developed and applied to each sector.
- The strategic points (SP) are established between sectors.
- The safeguards approaches for each sector are developed based on four measures as well as PFPF (frequent declaration of MA data, frequent NRTA evaluation, application of RMS and introduction of RII)
- The random interim inspection (RII) is performed at randomly selected sector.

4. Consideration of RII procedure

4.1 Situation of the process at the day of inspection



- All nuclear materials are itemized and stored in the intermediate storages
- The nuclear material in the glove box is the only hold-up

- Some of nuclear materials are in the intermediate storage and others are in the glove boxes
- Some nuclear material are transferred from the intermediate storage to the glove boxes

4. Consideration of RII procedure
4.2 Basic procedure of the RII

- Verification objects are selected before starting of plant operation (by AM 9:00)
  / Basically, the notification time is AM 8:30. The operator provides declaration data to the inspectorate in 15 - 20 minutes after notification. The inspectorate makes the sampling plan (the verification plan) by AM 9:00. The inspection activities are started at AM 9:00.

- If items which are planned to treat at the day of RII are selected, these items are verified before treatment
  / The operator provides information on the item which are treated the day of RII by AM 8:50.
  / The inspectorate makes the sampling plan by AM 9:00. If above items are selected, these items are verified at first.

- If items which are treating in the glove box are selected, these items are verified after treatment.
  / The CoK of selected items are maintained by the portable surveillance cameras which are set up around the glove box.

4. Consideration of RII procedure

4.3 Overview of the RII

- The process operation is not stopped
- The inspection activities are performed within one day
- Hold-up and waste will not be verified. (These are verified only during PIV and inter- campaign

- Date : Randomly selected day
- Notification time : 8:30 (30 minutes in advance)
- Accesses time : As soon as possible after notification
- Verification of NM : From 9:00
- Verification area : Verified sector and area are randomly selected
- Verification activity
  - / Inventory verification by NDA and DA
  - / Confirmation of the operation condition
- Inspection efforts
  - Two inspectors will perform inspection activities for one day.
- Number of RII
  - Less than 10 times / year (totally 30 times / year in JNC-1 site)

5. Conclusion

- The concept of the integrated safeguards approach for JNC-1 site was agreed between Japan and IAEA.
- The detail RII procedure has been discussed in the present. Applicability of it will be confirmed in the rehearsal
- The integrated safeguards approach for the MOX fuel fabrication facility will be implemented to the PFPF in the near future as the first case in the world.
- By implementation of this approach, not only inspection effort but also the burden of the plant operation will be reduced.
- JAEA understands that the concept of this approach would be contributed to the establishment of the SG approach for the future MOX fuel fabrication plant.