

# Safeguards Challenges and Safeguards R&D in JAEA

## Masato Hori

*Deputy Director, Integrated Support Center for  
Nuclear Nonproliferation and Nuclear Security*

*Japan Atomic Energy Agency*



Panel Discussion 2

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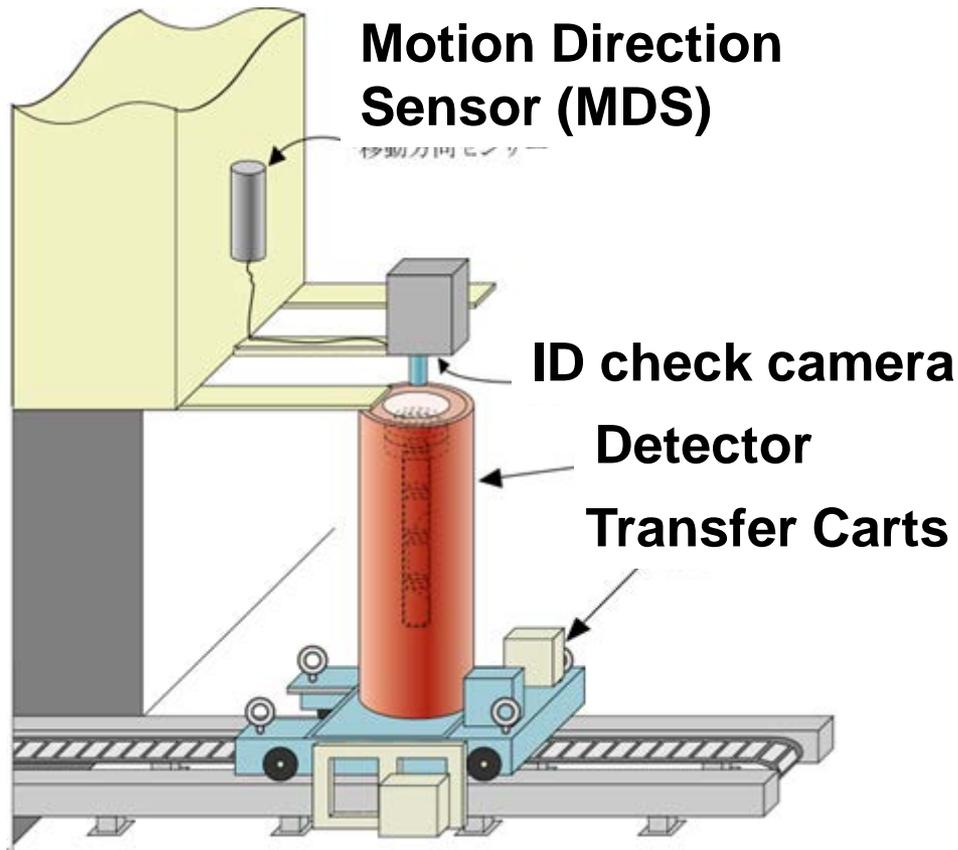
# Safeguards Challenges

Effective and efficient safeguards for

- Spent fuel transfer
- Large scale spent fuel dry storage
- Shutdown facilities
- Facilities under decommissioning
- New facility type: Small Modular Reactor, Accelerator Driven System

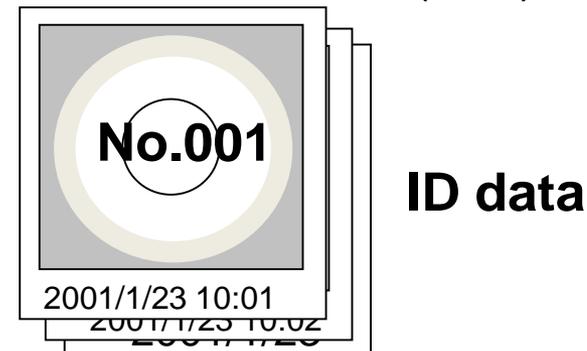
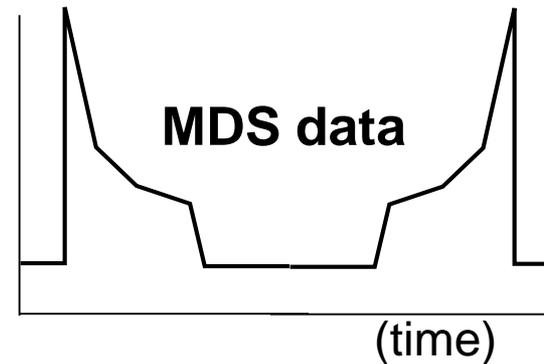
# Unattended NDA system at PFPF

- Once triggered by radiation detector, ID checked by camera and NDA system automatically activated.
- Acquired data is transferred to data review station.



Receipt

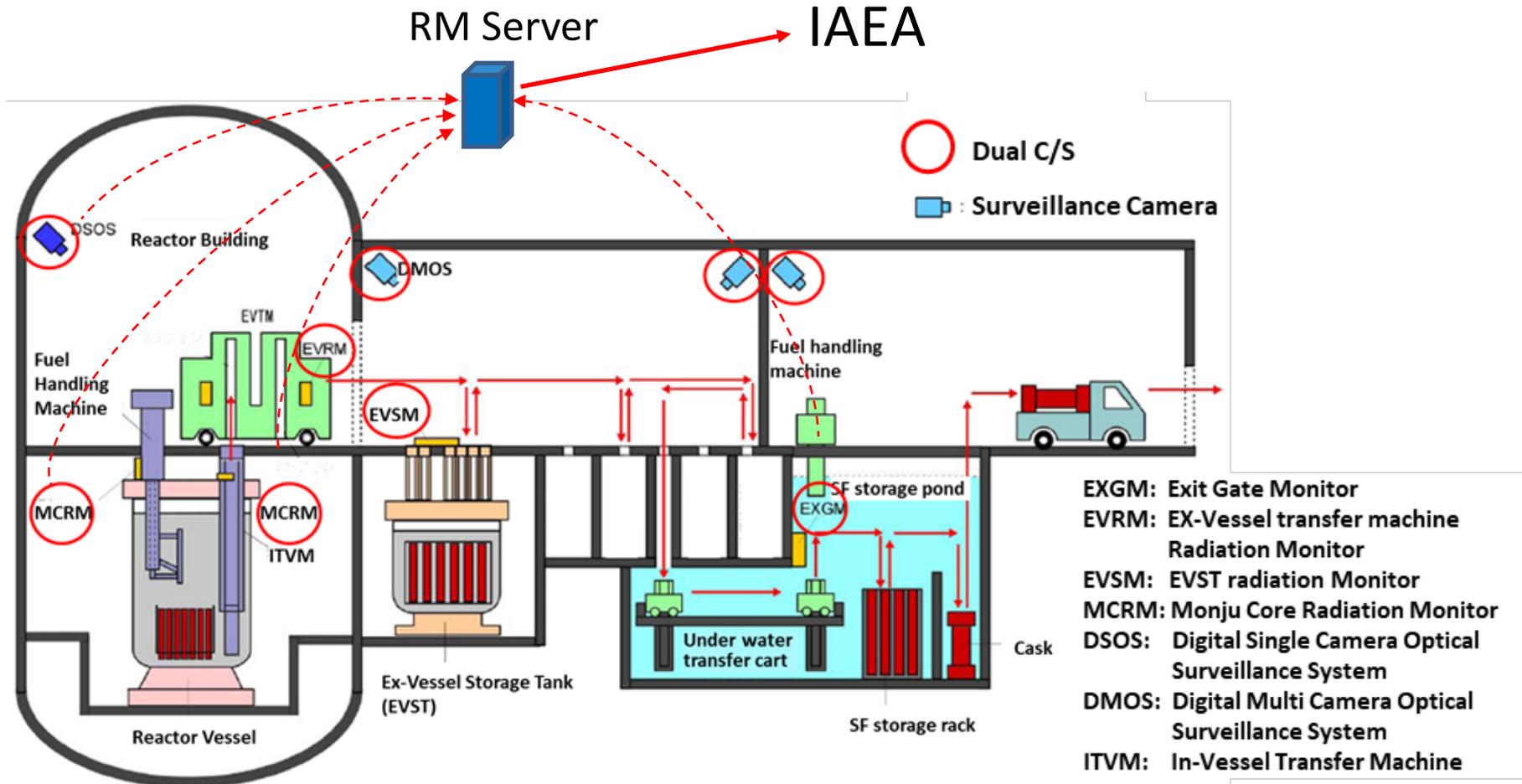
Shipment



Date	Time	Pu mass
01/1/23	10:01	3232 ± 12.2
01/1/23	10:02	3216 ± 11.8
01/1/23	10:03	3178 ± 11.1
01/1/23	10:04	3265 ± 12.1
01/1/23	10:05	3221 ± 12.4

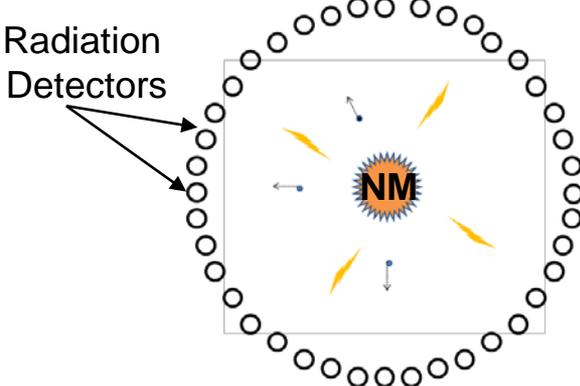
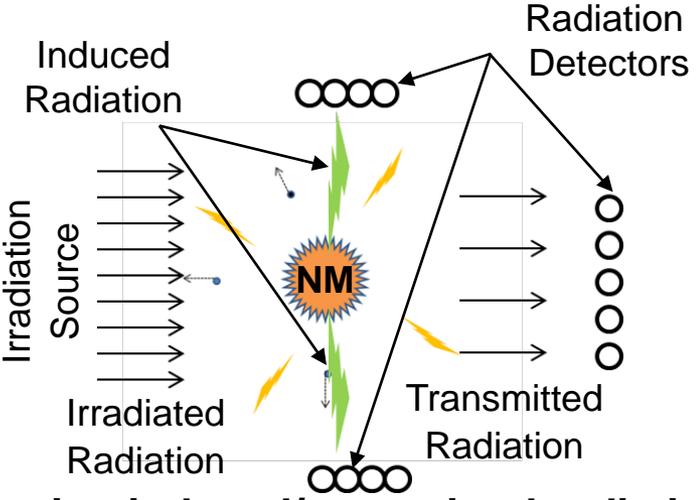
Measurement Data

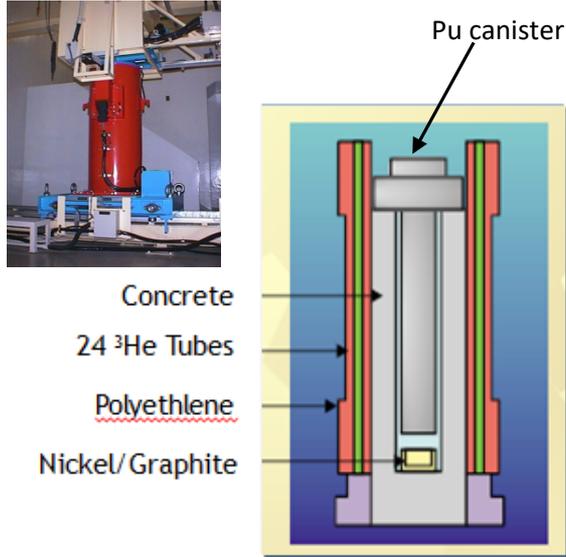
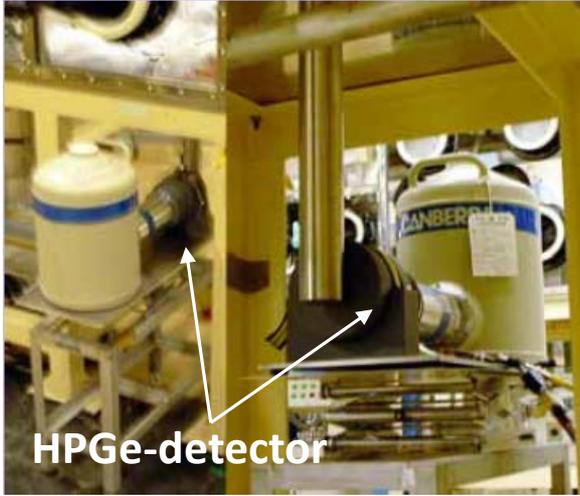
# Dual C/S and Remote Monitoring



**"Monju" Safeguards equipment for spent fuel transfer**

# NDA Technologies

NDA Types	Brief Explanation	
<p><b>Passive Type</b></p>	<p>Detection of self-emitted radiations from NM</p>	 <p><b>Detecting self-emitted radiations from NM</b></p>
<p><b>Active Type</b></p>	<p>Using outer sources of radiation to activate NM</p> <p>Detection of induced / transmitted radiations</p>	 <p><b>Detecting induced/transmitted radiations</b> <b>(Detecting changes of radiations)</b></p>

<p><b>Pu Quantity</b> (<sup>240</sup>Pu-effective)</p>	<p>- PCAS [Plutonium Canister Assay System]</p> <p>* Counting of Spontaneous Fission Neutrons from <sup>240</sup>Pu etc.</p>	
<p><b>Pu Isotopic Compositions</b></p>	<p>- HRGS [High Resolution Gamma-ray Spectrometer]</p> <p>* Counting of Self-emission Gamma-rays from Pu isotopes</p>	

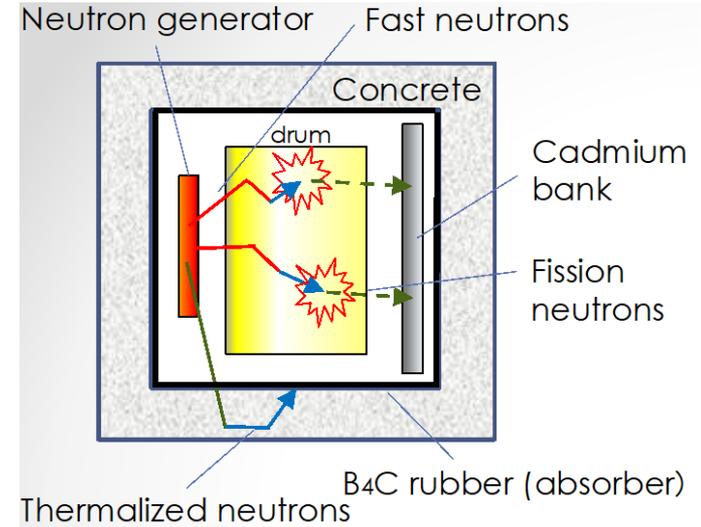
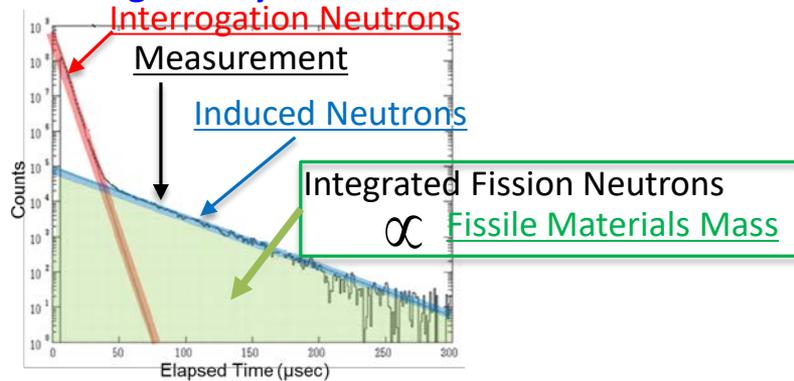
# Active type NDA

## Safeguards R&D

Fissile material Quantity

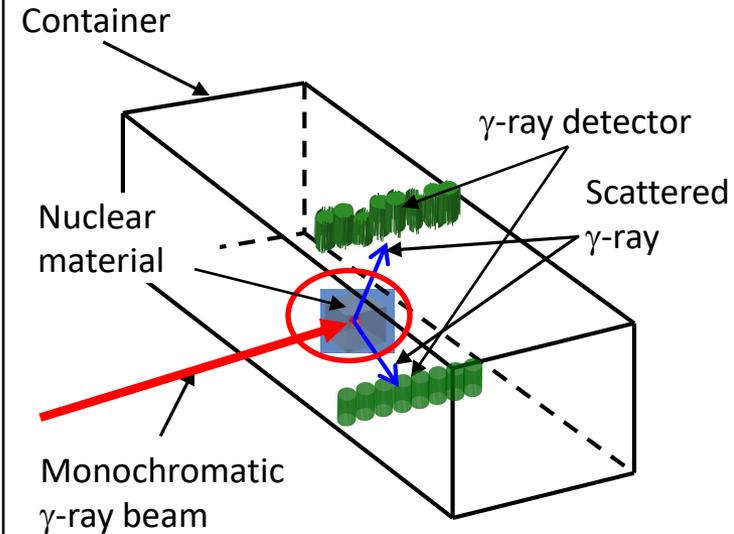
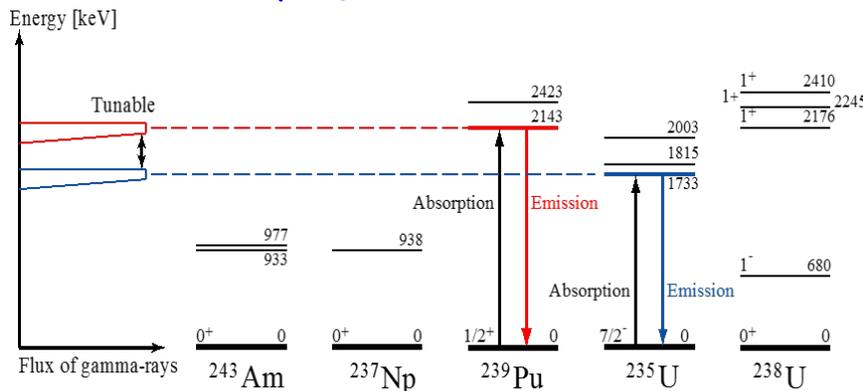
- FNDI  
[Fast Neutron Direct Interrogation method]

\* Counting of Induced neutron interrogated by Pulsed fast neutron



Identify each Isotope

- NRF NDA  
[Nuclear Resonance Fluorescence]  
\* Counting of Induced  $\gamma$ -rays Interrogated by monochromatic  $\gamma$ -ray beam



# FNDI Method (JAWAS-N)

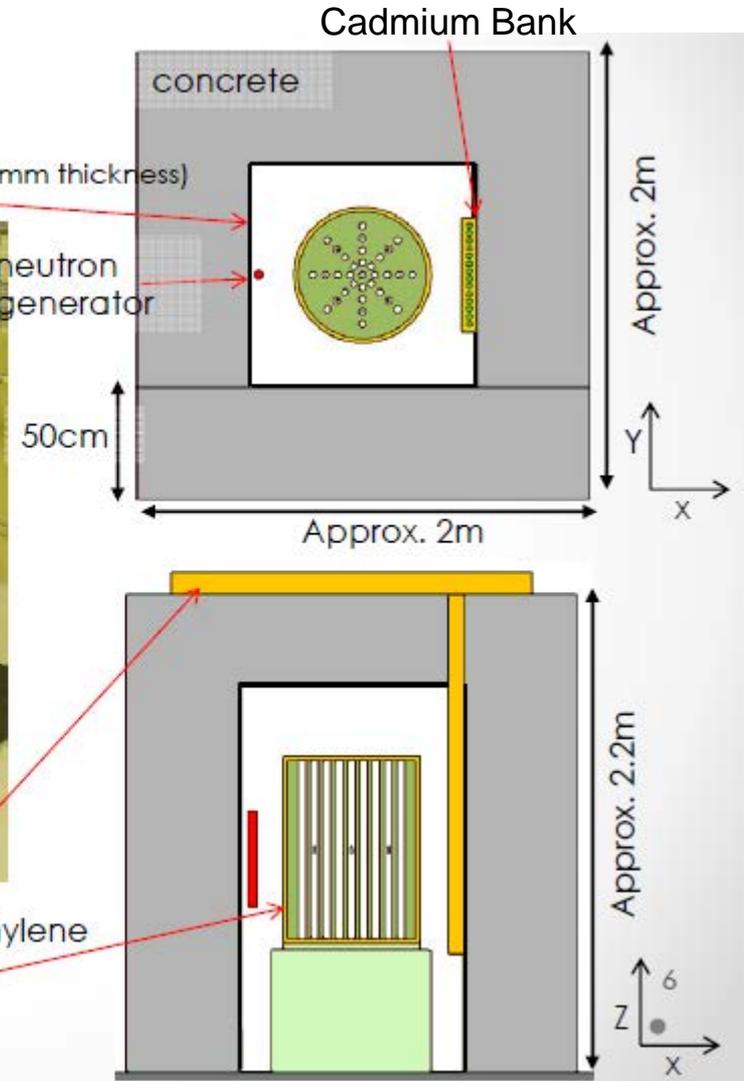
**JAWAS-N:**  
**J**AEA **A**ctive **W**aste **A**ssay **S**ystem - **N**ingyo



Basic characteristic tests have been tried since 2014.

Drum with PMD※

※Polyethylene Moderator



# JAEA's Safeguards R&D and support to IAEA

- Develop NDA or other technologies to support effective and efficient safeguards implementation
- Provide technical skills, knowledge and training to support IAEA verification activities

# IAEA Inspector Training

## Reprocessing Plant Safeguards

As part of Member State support programme to the IAEA, JAEA is hosting annual training course on safeguards for reprocessing plants safeguards for IAEA and NRA inspectors.

## JNC-1 (site-level approach) and DCVD

Upon request, JAEA is hosting the JNC-1(TRP, PCDF, PPF,PF, Tokai R&D) and DCVD training courses

Reprocessing training



DCVD training

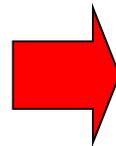
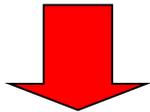


# Dismantled Research Reactor in JAEA

	JPDR	JRR-1	Old JRR-3
Type	BWR	Water boiler type	Heavy water moderate and cooling type
Thermal power	45MW (JPDR II 90MW) Electric Power 12.5MW	50kW	10MW
Period of dismantling activities	Around 15 years	Around 9 years	Around 3 years
Estimated cost of dismantling *	10.1 B yen (89.4 M US\$)	0.9 B yen (7.96 M US\$)	2.9 B yen (25.7 M US\$)

\* excluding waste disposal cost

# Dismantlement of JPDR



Type	BWR
Thermal power	45MW (JPDRII 90MW)
Electric power	12.5MW
Reactor vessel	2m diameter 8m height
Fuel	2.6%UO <sub>2</sub>
Thermal neutron flux density	$3.8 \times 10^{13} \text{n/cm}^2 \cdot \text{sec}$ (average)