

# JAEA's contribution to Disarmament and Potential Technologies for Nuclear Disarmament Verification

**Hirofumi TOMIKAWA**

*General Manager*

*Technology Development Promotion Office*

*Integrated Support Center for Nuclear*

*Nonproliferation and Nuclear Security*



*Japan Atomic Energy Agency*

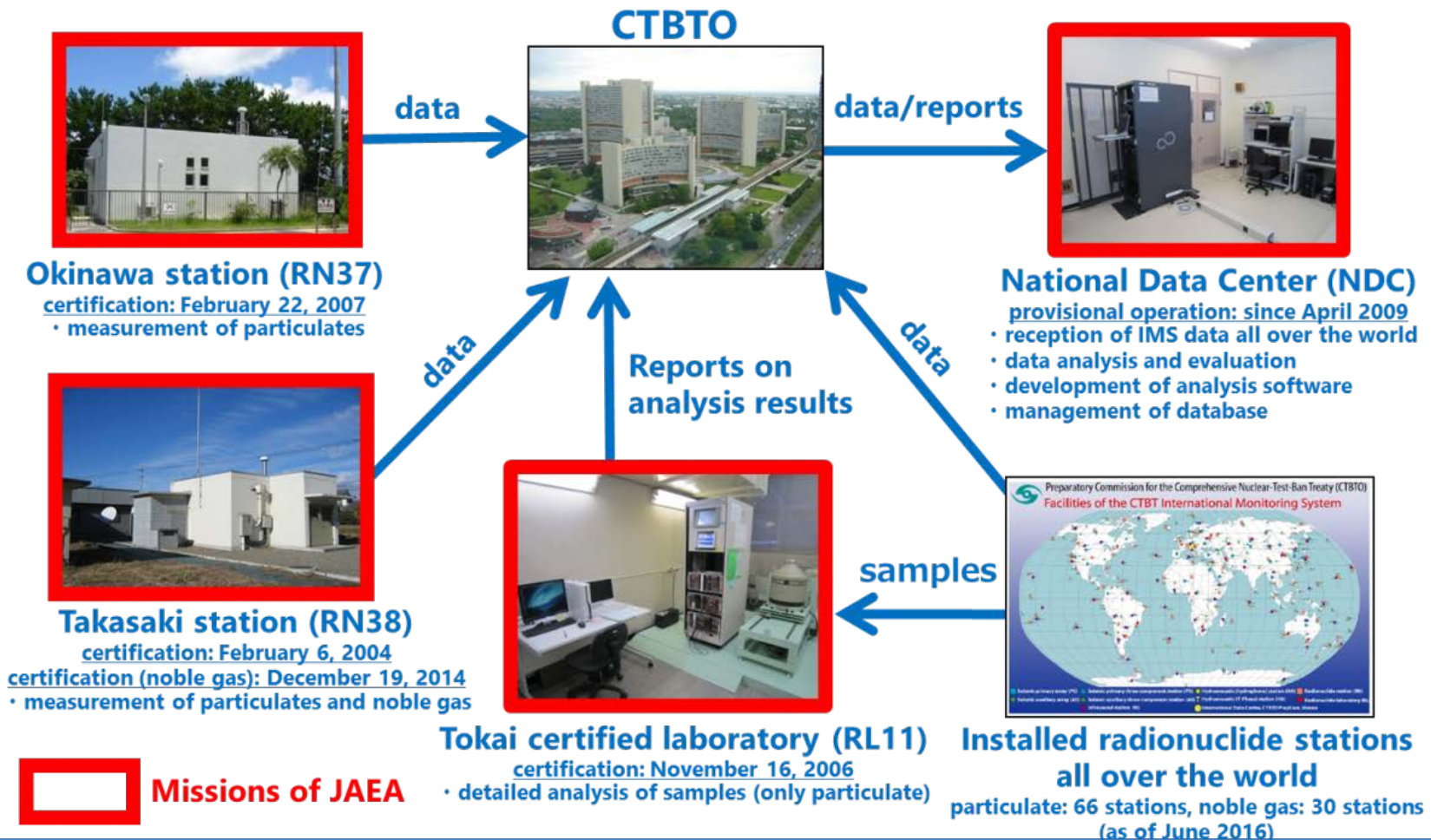


**Panel Discussion 2**  
**The International Forum on Peaceful Use of Nuclear Energy, Nuclear Non-Proliferation and Security**  
**29 November 2016**

# JAEA's Contribution to CTBT International Verification Regime

## Comprehensive Nuclear-Test-Ban Treaty (CTBT);

- Prohibition of any nuclear weapon test explosion or any other nuclear explosion in any spaces
- Establishment of verification regime to verify that each member state adheres the treaty



# JAEA's contribution to Disposition of excess Weapon Plutonium

## Background

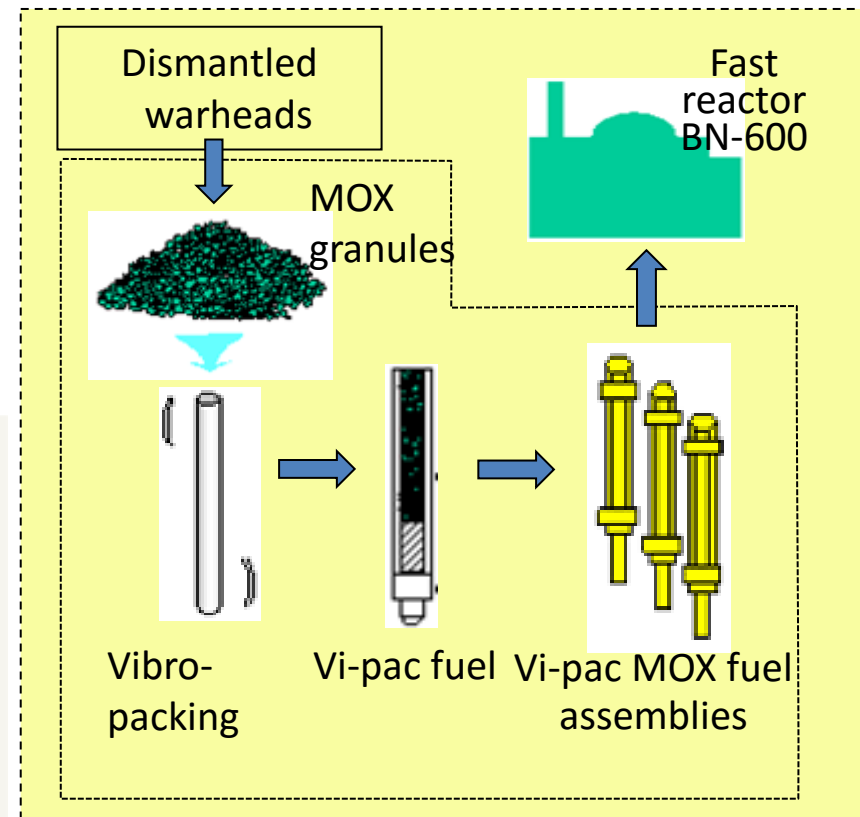
- After 1996 nuclear safety summit held in Moscow, Japan, France, Canada, Germany and other countries began cooperation with Russian Federation in order to evaluate the options and costs to dispose surplus weapon grade plutonium.
- Based on the evaluation, Japan proposed vibro-packed fuel option (burning vibro-packed MOX fuel using Russian fast reactor BN-600) at 1999 G8 Summit.

## Cooperation by JAEA

Cooperation with Russian national laboratories to implement R&D activities;

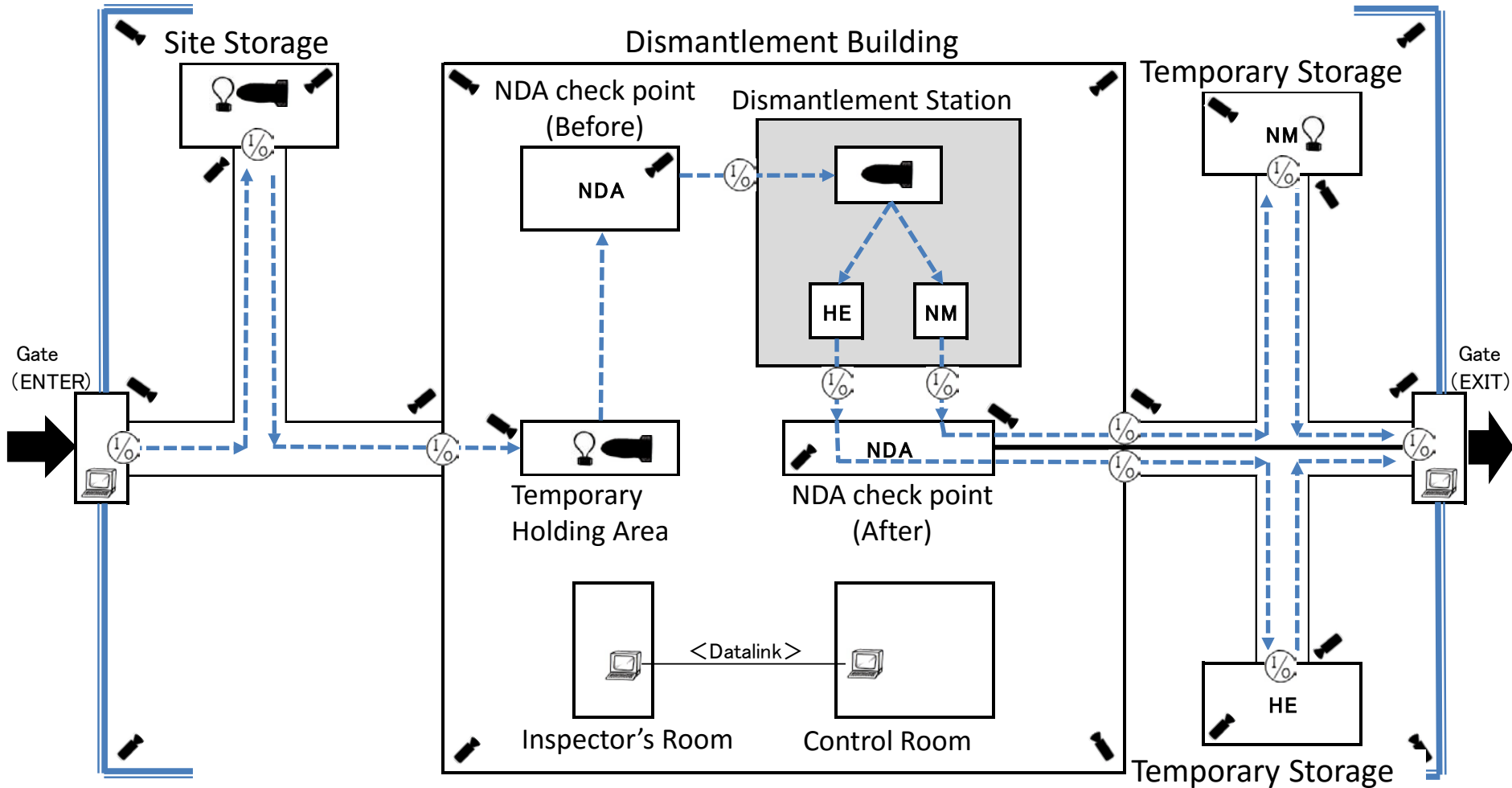
- Fabrication of MOX fuel using vibro-packing technology
- Irradiation in a Russian fast reactor (BN-600), etc.







## Process of disposition



# What should be verified for nuclear disarmament?

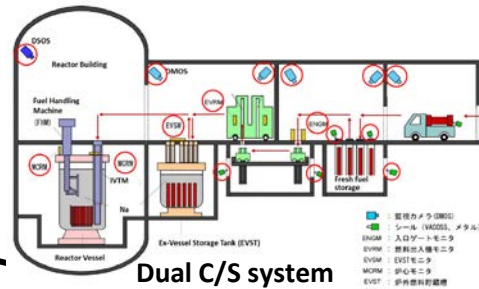
(Example: Dismantlement of nuclear warhead)



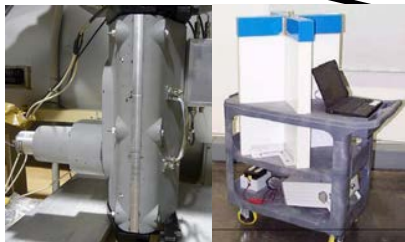
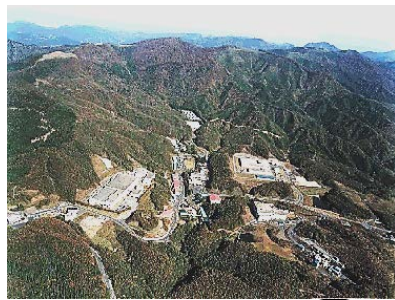
-  : Nuclear Warhead
-  : Optical Fiber Seal
- NM** : Nuclear Material
-  : Monitor
-  : In/Out Access Control
- HE** : Explosive Material
-  : CCTV Camera
-  : Containment Area
- NDA** : Non-destructive Assy

# Nuclear Fuel Cycle Facilities in JAEA

**Tsuruga (Monju)**  
**FBR**



**Ningyo-toge**  
**U Enrichment**



Enriched monitor

U holdup counter

**Tokai**  
**Reprocessing**



Vitrified Counter

Hull monitor

**MOX fabrication**



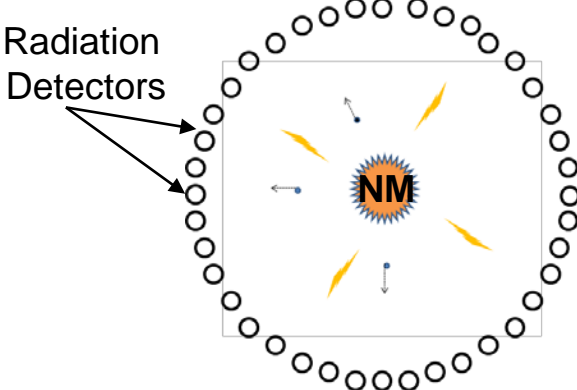
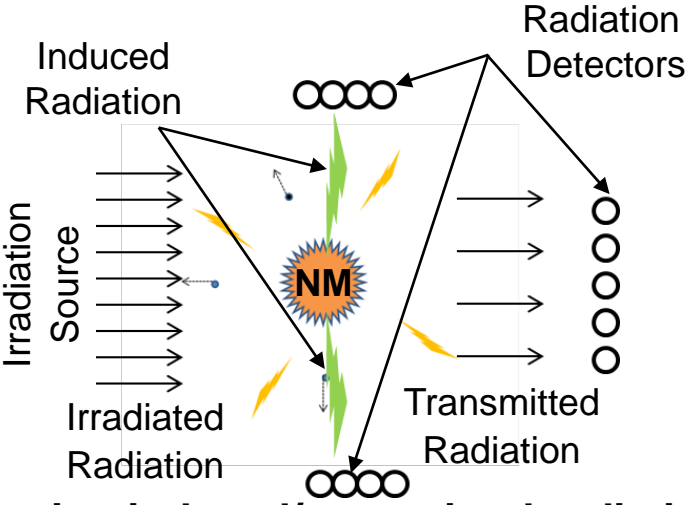
GB assay system

Fuel Assembly assay system

**Tokyo**

**A variety of nuclear measurement and C/S systems has been developed to meet IAEA's SG requirements and enhance nuclear security.**

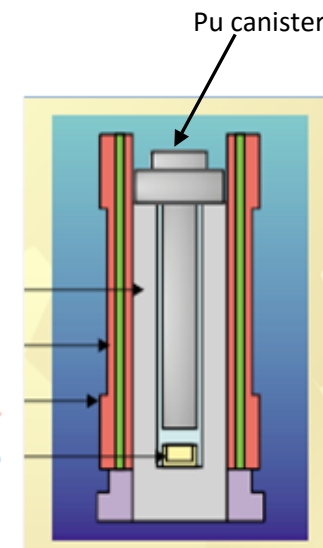
# NDA Technologies

NDA Types	Rough 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 (changes of radiations)</p>	 <p><b>Detecting induced/transmitted radiations</b> <b>(Detecting changes of radiations)</b></p>

# (Example) Passive type NDA

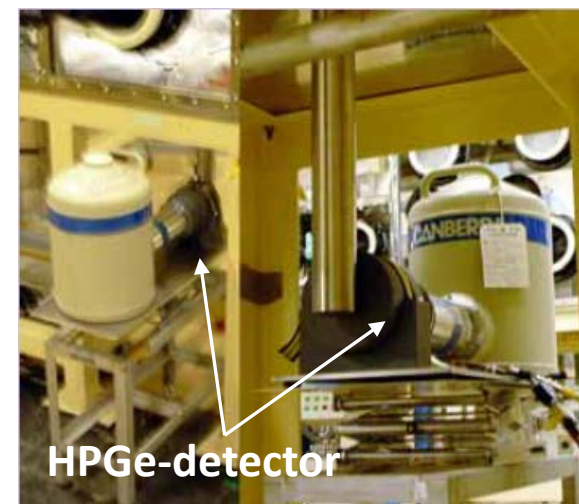
**Pu  
Quantity**  
(<sup>240</sup>Pu-effective)

- PCAS  
[Plutonium Canister Assay System]
- \* Counting of Spontaneous  
Fission Neutrons from <sup>240</sup>Pu etc.



**Pu  
Isotopic  
Compositions**

- HRGS  
[High Resolution Gamma-ray  
Spectrometer]
- \* Counting of Self-emission Gamma-  
rays from Pu isotopes

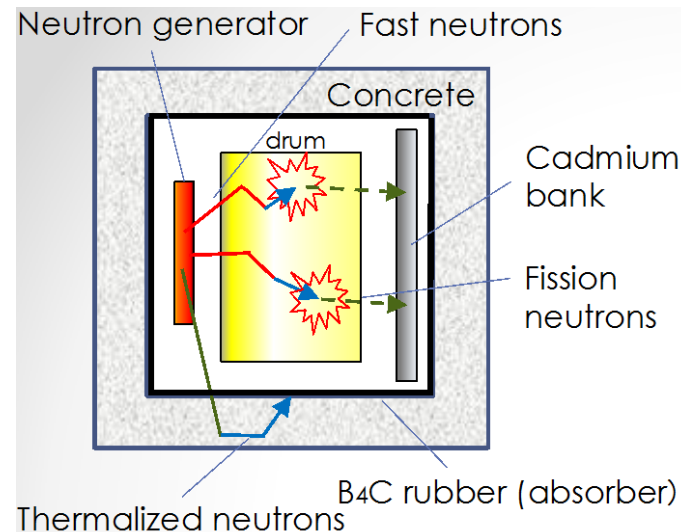
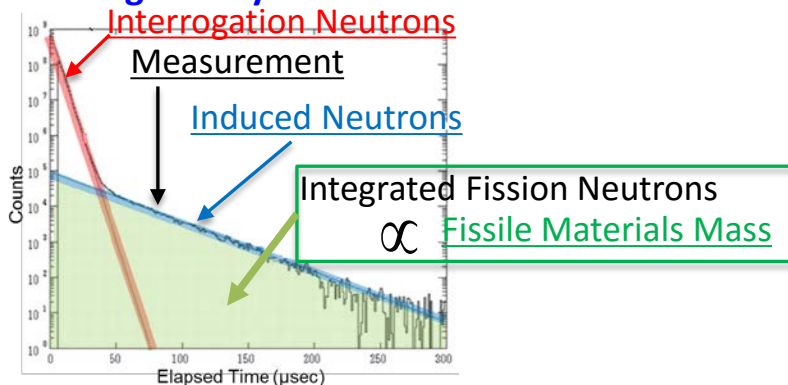


# (Example) Active type NDA

Fissile material Quantity

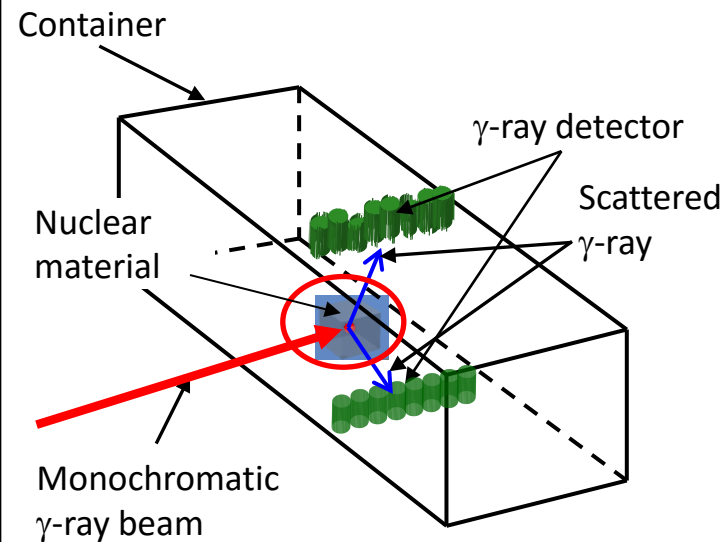
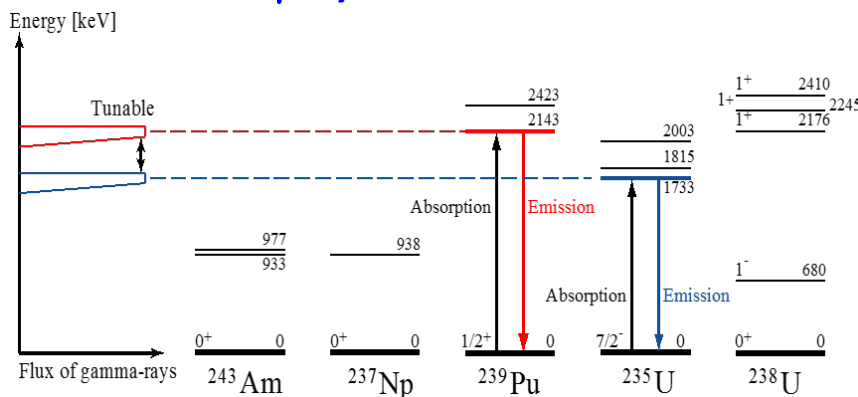
- FNDI  
[Fast Neutron Direct Interrogation method]

\* Counting of Induced neutron interrogated by Pulsed fast neutron



Identify each Isotope

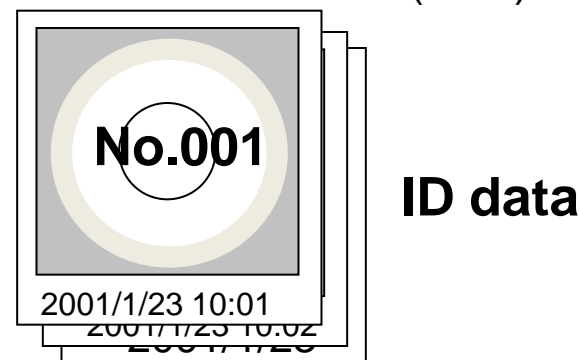
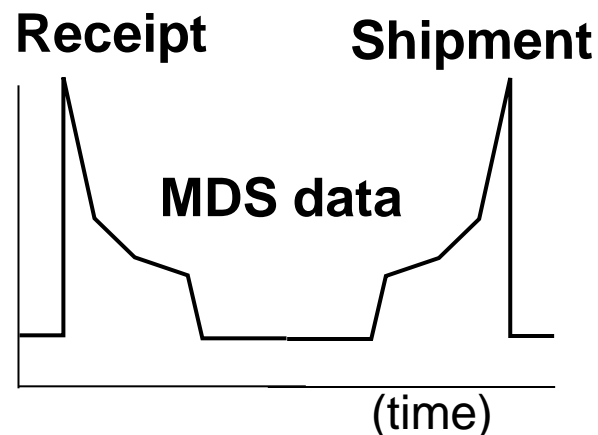
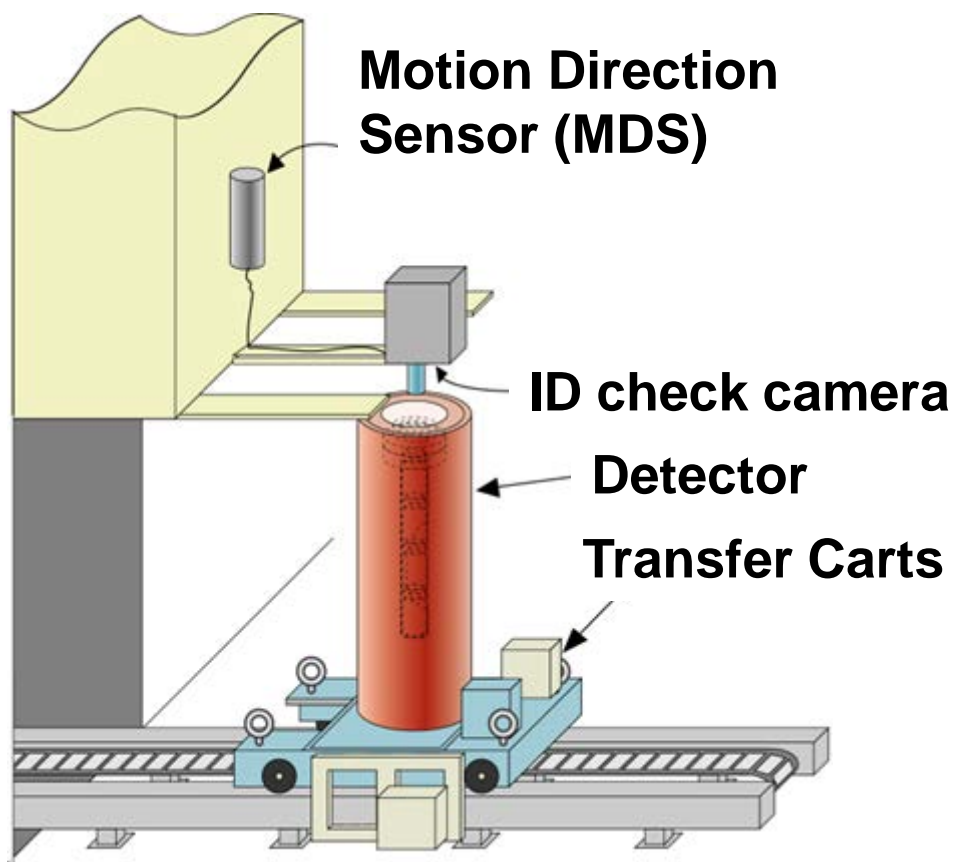
- NRF NDA  
[Nuclear Resonance Fluorescence]  
\* Counting of Induced  $\gamma$ -rays Interrogated by monochromatic  $\gamma$ -ray beam





# Unattended NDA system

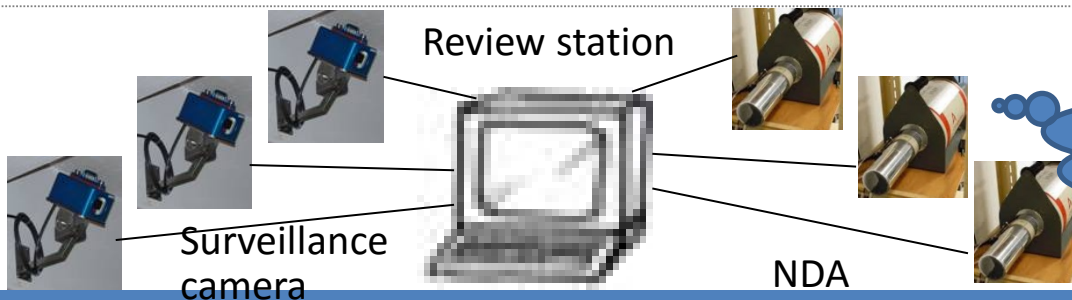
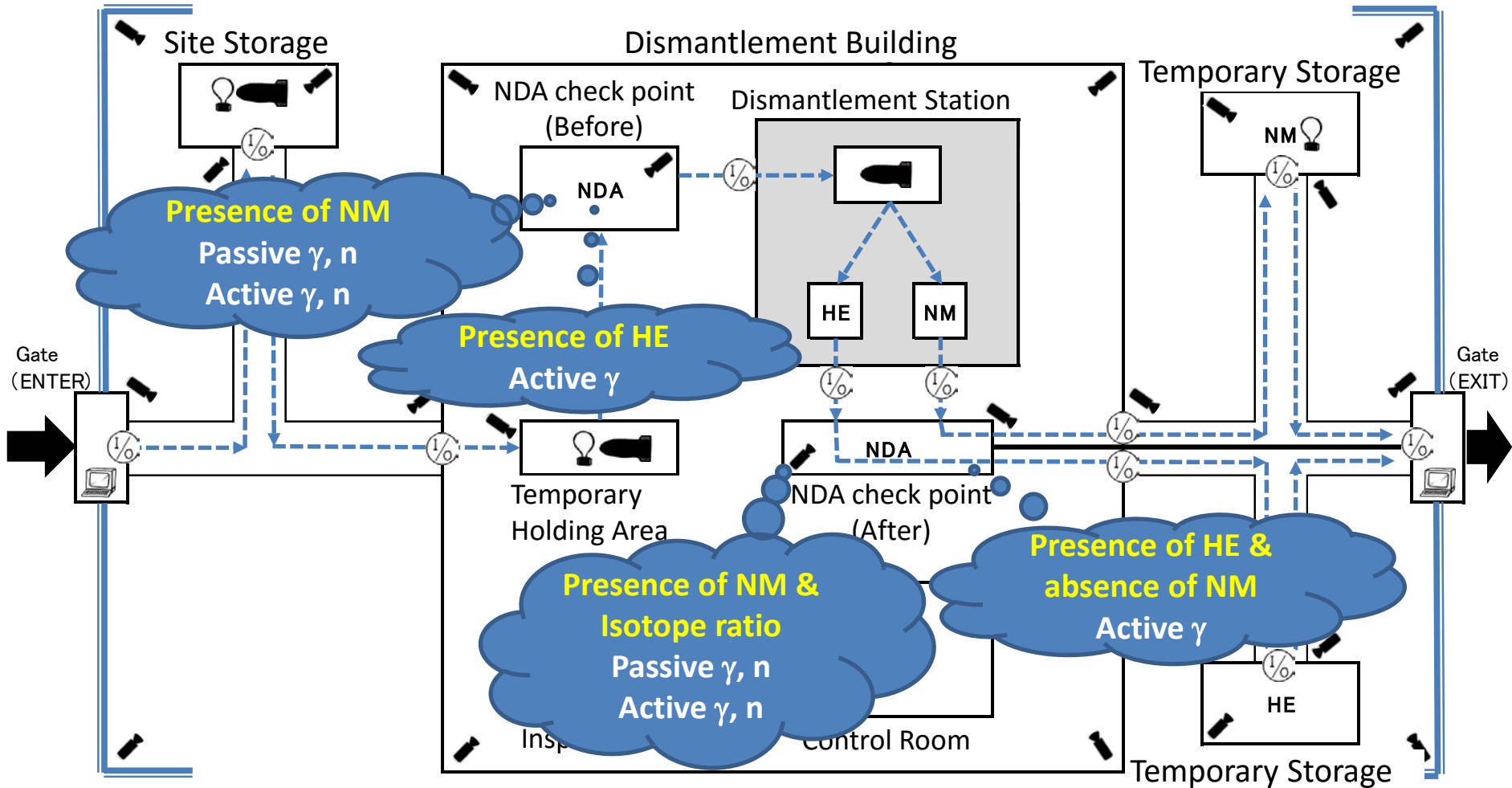
- Once triggered by radiation detector, ID check camera and NDA system automatically activated.
- Acquired data is transferred to data review station.



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**

# (Example) Applicable technologies



**Prevention of information leakage**  
Unattended System

# Conclusion

- JAEA has contributed to CTBT International Verification Regime and cooperated in disposing excess weapon Pu.
- JAEA has long history of development of SG technologies in order to meet IAEA's requirement and contribute effective/efficient SG. These are potentially applicable to nuclear disarmament verification scheme .

## Technical Challenges;

- ◆ Technical features of nuclear disarmament verification, e.g. Information Barrier, have to be taken into account.
- ◆ The detail design information cannot be disclosed to NNWS, and it's difficult to conduct computer simulation and optimize measurement system

***International collaboration including NWS and NNWS might be essential solution to overcome the challenges.***