

# JAEA's Activities and International Contributions to Nuclear Non-Proliferation and Nuclear Security

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**Keynote Report**

**The International Forum on Peaceful Use of Nuclear Energy,  
Nuclear Nonproliferation and Security**

**13 December 2018**

- 1. Activity Summary**
2. Activities of the Integrated Support Center for Nuclear non-proliferation and Nuclear Security (ISCN)
3. Introduction to the Panel Discussions

# Missions and Visions of Activities for Nuclear Non-Proliferation and Nuclear Security

## Missions for Nuclear Non-Proliferation and Nuclear Security Activities

Combine technological efforts built on the accumulated knowledge and experience on nuclear energy R&D

Fully cooperate with relevant organizations national and international

Contribute to harmony of the peaceful use of nuclear energy with nuclear non-proliferation and nuclear security

## Three Visions of Nuclear Non-Proliferation and Nuclear Security Activities

- **Promoter and facilitator of the peaceful use of nuclear energy**  
Support Japan in ensuring transparency in nuclear material management and use
- **Engineers and scientists trusted by the international community**  
Develop technologies in the field of nuclear non-proliferation and nuclear security in support to international organizations (IAEA, etc.) and other countries
- **International center of excellence (COE) to support capacity building**  
Provide human resource development support activities for capacity building in the field of nuclear non-proliferation and nuclear security, mainly for Asian countries

# Activity Summary

## ○ Activities for Nuclear Non-Proliferation and

## Nuclear Security at JAEA

### Nuclear Security: Physical Protection (PP)

#### Protection of NM & nuclear facilities from adversaries

Facilities handling nuclear fuel materials (protective facilities): NSRI<sup>1</sup>, NCL<sup>2</sup>, Oarai<sup>3</sup>, Monju, Fugen, Ningyo-toge<sup>4</sup>

- Formulate basic policies of PP
- Foster nuclear security culture
- Respond to physical protection inspection
- Respond to act amendments and administrative directions
- Secure transportation, and so on...

### Nuclear Non-Proliferation: Safeguards (SG):

#### Verification activities to ensure no diversion of NM into nuclear explosive device

Main facilities for safeguards:  
NSRI<sup>1</sup>, NCL<sup>2</sup>, Oarai<sup>3</sup>, Monju, Fugen, Ningyo-toge<sup>4</sup>, etc.

- Perform SG inspections and material accountancy operations for internationally regulated materials.
- Maintain and enhance SG and material accountancy operations.
- Respond to act amendments and administrative directions, and so on...



- 1: Nuclear Science Research Institute
- 2: Nuclear Fuel Cycle Engineering Laboratories
- 3: Oarai Research and Development Center
- 4: Ningyo-toge Environmental Engineering Center

# Activity Summary

## ○ Domestic and international contributions

### Technical Development for Nuclear Non-Proliferation and Nuclear Security

- Nuclear non-proliferation and safeguards technologies (e.g.)
  - Safeguards and material accountancy techniques for melted fuel in Fukushima
  - Advanced Pu monitoring technology
- Nuclear security technologies
  - Nuclear forensics techniques
  - Non-destructive detection techniques for nuclear material

### Contributions to the CTBT International Verification Regime

- Operate CTBT radionuclide stations, an official laboratory, and a national data center.
- Develop CTBT verification techniques

CTBT: Comprehensive Nuclear-Test-Ban Treaty  
 EC/JRC: European Commission/Joint Research Center

### Nuclear Non-Proliferation Policy Research

- Conduct policy research on nuclear non-proliferation and nuclear security based on technological knowledge
- Collect, analyze, and transmit information on international trends

### Support in Capacity Building, Mainly in Asia

- Established ISCN in JAEA, following the government's statement in the Nuclear Security Summit in April, 2010
- Provide training to strengthen nuclear security

### Awareness and International Contributions

- Organize international forums and symposiums and publish ISCN newsletters
- Cooperate internationally with U.S. and EC/JRC.
- Support IAEA in technology development

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# Technology Development for Nuclear Non-Proliferation and Nuclear Security

## Nuclear Forensics (NF) R&D

~Development toward the practical use for contribution to law enforcement operation~

Nuclear Forensics is a technical measure to elucidate the origin and history of seized nuclear materials by chemical/physical analysis.

R&D for innovative NF technology as worldwide pioneer

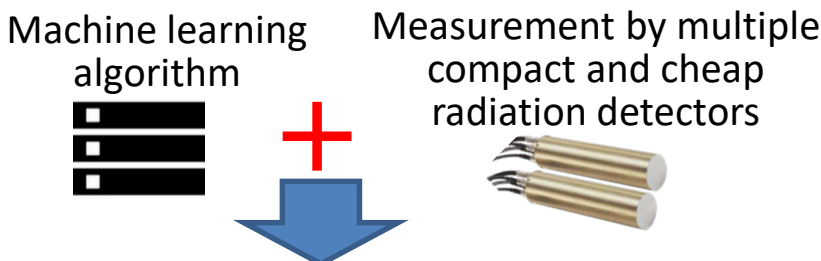


Establishment of fundamental NF technique

Development of advanced and rapid NF technique

R&D for NF in post-dispersion events

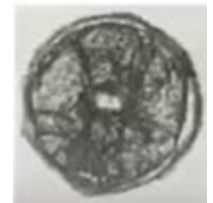
### Detection and sampling technique for residue nuclear material or radioactive debris in crime scene



Development of radiation detector for autonomous detection & determination and getting dispersion map of radionuclide to assist a first responder

### Analytical technique for materials sampled in crime scene and signature analysis

- Technology of nuclide separation from Environmental sample (e.g. soil, rain water) and analysis, impact evaluation of nuclide existed in environment
- Research on key signature of post-dispersion samples, e.g. identify original (pre-use) material
- Research on unraveling signature denaturation characteristics by explosion



Electron micrograph of fallout

Reference : ORNL : Post detonation Nuclear Forensics

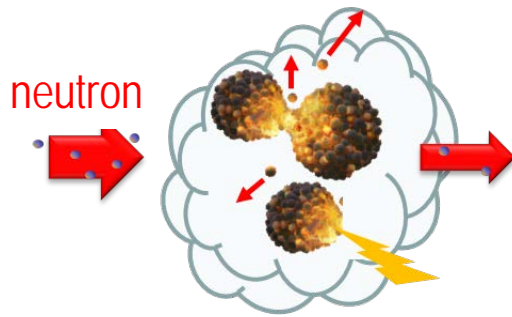
# Technology Development for Nuclear Non-Proliferation and Nuclear Security

## ○ A challenge of development of new active NDA methods

Development of active neutron Nondestructive Assay (NDA) methods for a high-level radioactive nuclear material (NM) sample, such as spent fuel, is in progress under a collaboration with EC/JRC

### Active neutron NDA

"Active method" utilizes elemental particles (n,  $\gamma$ -ray, etc.). Potentially it can overcome the background problems that passive methods encounter.

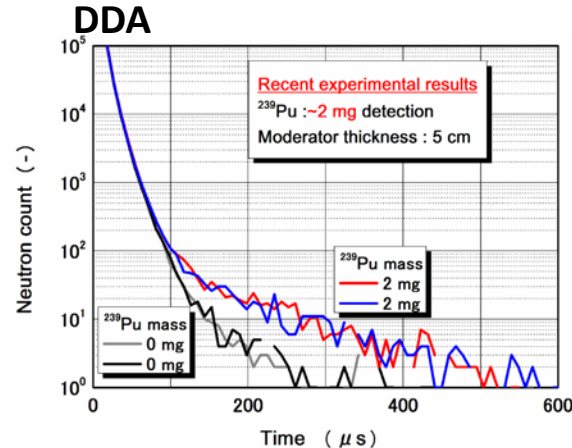


Neutron active interrogation method (conceptual view)

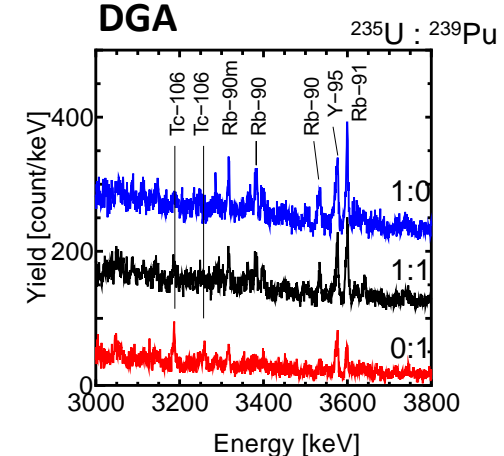
### Development of DDA and DGA with EC/JRC

DDA measures neutrons produced in neutron induced fission reactions to deduce the fissile mass. DGA measures delayed  $\gamma$  rays from disintegration of fission products to determine the mass ratio of fissile nuclide.

(DDA: Differential die-away analysis, DGA: Delayed gamma-ray analysis)



Time dependent neutron counts of DDA system. The developed system can detect 2 mg  $^{239}\text{Pu}$ . (NUCEF, JAEA)



Delayed  $\gamma$ -ray spectra. Change of the peak intensity ratio owing to the  $^{235}\text{U}/^{239}\text{Pu}$  were observed. (PUNITA of EC/JRC Ispra)

These techniques would be useful to analyze a sample for NM accountability, complementing Destructive Analysis (DA)



# Technology Development for Nuclear Non-Proliferation and Nuclear Security

## ○“Workshop on Technological Development for Nuclear Non-Proliferation and Security”

This workshop was held to share the results of the projects, “Development of Active Neutron NDA Techniques” and “Advanced Pu Monitoring Technical Development”, with domestic and international organizations, and to perform evaluations, seek advice and feedback from invited Evaluators.

**Date** : 12 – 15, March, 2018

**Venue** : JAEA, Tokai-mura Japan

**Evaluators** : IAEA/SGTS, DOE/NNSA (US), IRSN (F), EC/JRC, ORNL (US) (5 representatives)

**Attendees** (by invitation : 13 representatives)

MEXT, JNFL, CRIEPI, Universities, manufacturing company,

IAEA/SGOA, LANL

JNFL: Japan Nuclear Fuel Limited

CRIEPI: Central research institute of electric power industry

## Evaluation Results

Both projects were completed successfully

The following points were evaluated:

- The projects were implemented under international collaborations
- Young scientists were mentored
- Technical achievements were published
- Simulations were used to drive the experiments

Discussed topics on “Advanced Pu Monitoring Technical Development” were: application on safeguards, monitoring of the movement and sludge precipitate, usage for safety purposes, ...

Discussed topics on “Development of Active Neutron NDA Techniques” were: importance of nuclear data, future challenges, development of optimized measurement system, ...



# Contributions to the CTBT International Verification Regime

## ○ Noble gas joint measurement project with CTBT Organization

### 【Outline of the project】

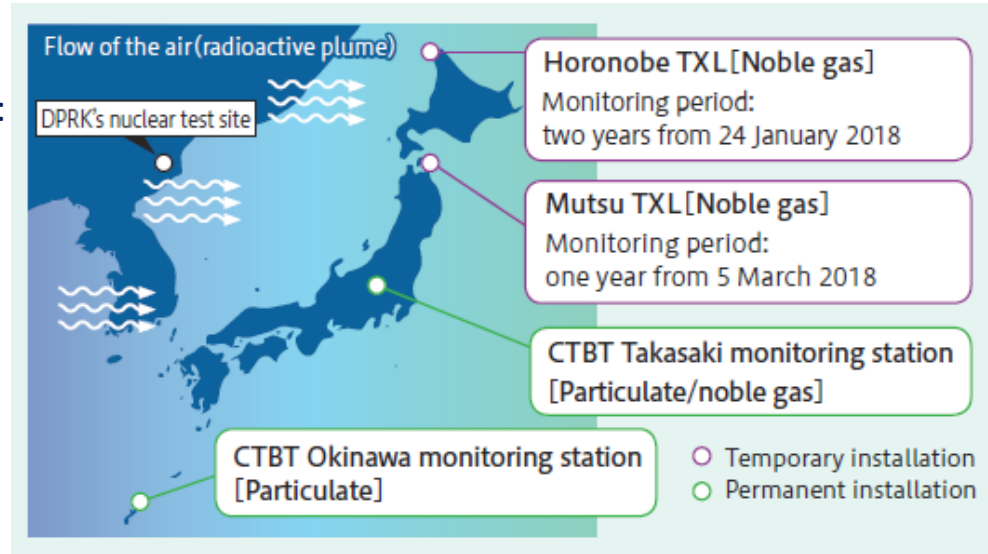
The mobile noble gas measurement systems (TXLs) are installed at two sites, and JAEA carries out measurements:

1. A public land owned by the municipality of Horonobe in Hokkaido, and
2. JAEA Ohminato site in Mutsu city

The improvement in the detection capability for nuclear tests with simultaneous measurements of radioxenon are expected.



A Mobile noble gas measurement system (TXL : Transportable Xenon Laboratory)



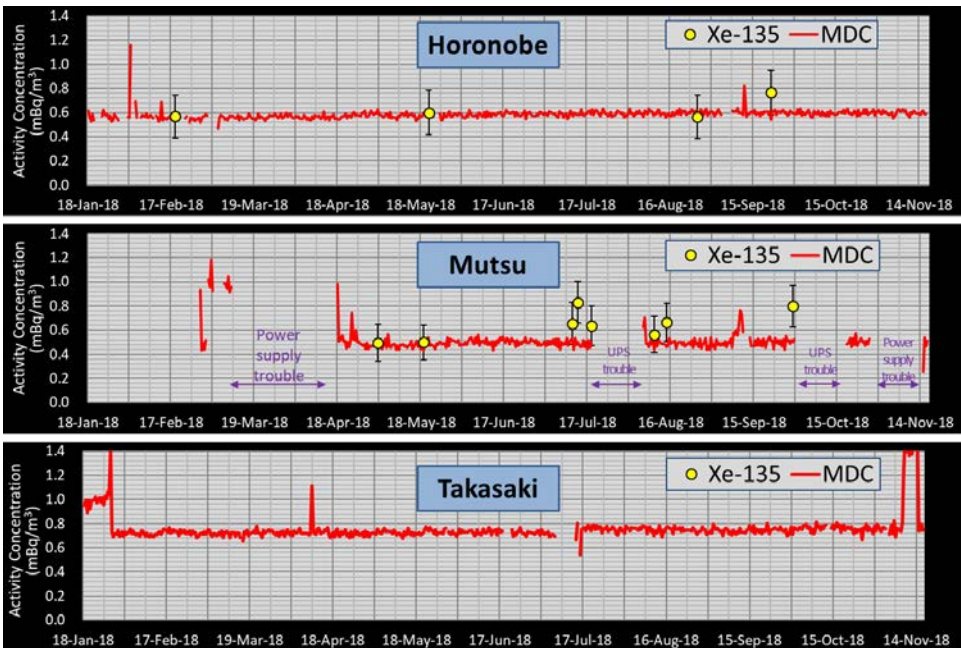
Installed maps of CTBT radionuclide monitoring stations and mobile noble gas measurement systems operated by JAEA

### 【Measurement results】

- $^{135}\text{Xe}$  isotopes with activity concentration above MDC\* were detected several times at Horonobe and Mutsu, but not detected at Takasaki.
- $^{133}\text{Xe}$  isotopes with activity concentration above MDC were detected at Horonobe, Mutsu and Takasaki frequently.

Measurement results of Xe-135 at 3 measuring points

\*MDC: Minimum detectable concentration



# Nuclear Non-Proliferation Policy Research

## ○ Research on promoting nuclear non-proliferation (safeguards) and nuclear security (2015-2017)

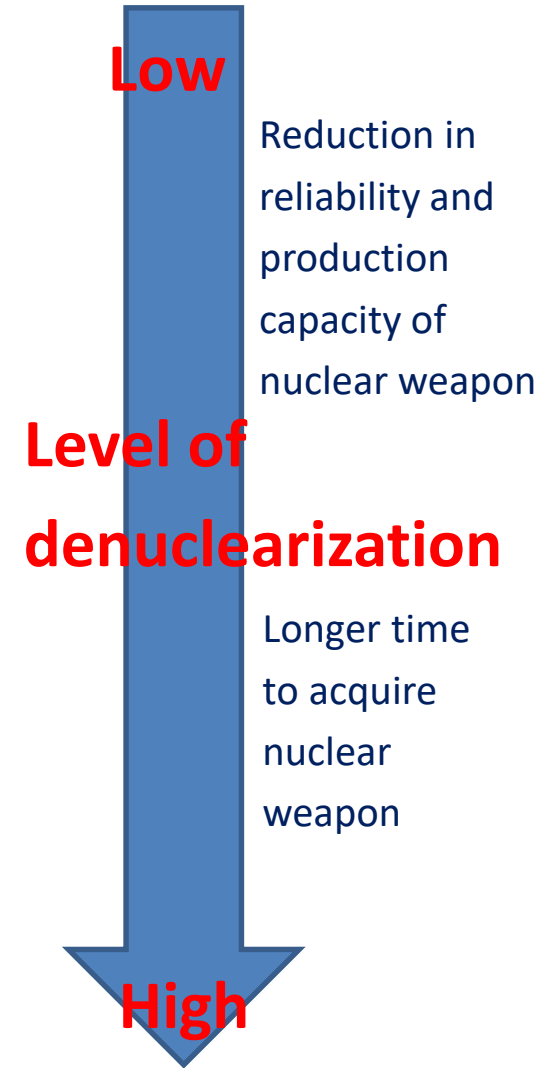
- Investigated potential synergistic effects between safeguards and nuclear security (2S) measures
- Analyzed challenges and possible solutions in maximizing such synergistic effects
- Clarified that joint use of measurement and surveillance equipment / data among 2S could be effective. Proposed “2S by design” is one of possible solutions to such challenges

## ○ Research on critical factors and technical processes for achieving denuclearization (2018-)

- Based on past denuclearization experiences, broader denuclearization scope, issues implemented, as well as critical factors which made successful denuclearization possible are to be clarified
- In reference to above clarification, applicable technical denuclearization process will be analyzed

# Technical Processes of Denuclearization

- ① Disablement of nuclear test site
- ② Disposal/removal of nuclear weapon
- ③ Dismantlement/disablement of nuclear weapon fabrication facility
- ④ Disposal/removal of weapon usable material (Pu, HEU)
- ⑤ Dismantlement/disablement of facilities to produce weapon usable material (uranium enrichment, reprocessing, nuclear reactor)
- ⑥ Disposal/removal of nuclear material



Human resources, technical know-hows, procurement routes

# Capacity Building Support Activities

## Bilateral Cooperation:

### ① Training Course covering the Additional Protocols (AP) and Commodity Identification, Thailand (Jan. 16-18, 2018)

- Thailand ratified AP in Nov. 2017: raising awareness among senior government officials and stakeholders by emphasizing the significance of AP and non-proliferation
- Lecturers from MOFA and METI of Japan joined the Course
- The first jointly conducted training with participation of the Korean COE (INSA)

### ② Seminar on Peaceful Use of Nuclear Energy and Nuclear Non-Proliferation and Nuclear Security in Lao PDR (Feb. 21-22, 2018)

- All the stakeholders - 9 government agencies and a university- joined the seminar
- Lecturer from MOFA of Japan joined the Seminar
- Identify the current status of the national infrastructure development and the needs for raising awareness as well as capacity building

### ③ Safeguards Implementation Training for Iran (Jul. 5-9, 2018)

- Built upon the Japan-Iran Joint Statement of Oct. 2016: ISCN hosted the IAEA training course with the support from the government of Japan in Sept. 2017
- Strong request from Iran and IAEA conducted the 2<sup>nd</sup> course: Jul. 2018
- 24 participants from the government, nuclear facilities and related manufacturer
- Sharing Japan's experiences and providing practical exercises using JAEA facilities

### Hosting IAEA Training Course on Small Quantity Protocol (SQP) (Jun. 4-8, 2018)

- First conducted in Asia based on the identified needs: 24 participants from 19 States
- Practical exercise using JAEA facility → highly valued by IAEA, 2<sup>nd</sup> course in 2019

# Collaboration with Other COEs

## ◆ Contribution to the NSSC\* Network

\*NSSC : Nuclear Security Training and Support Centres

Membership: 60 NSSC member states, 66 institutions, 5 observers (WINS, NTI, CSIS, EC/JRC, UNODA) as of Nov. 2017  
 WGs: A: Coordination & Collaboration  
 B: Best Practices  
 C: Information Management and other Emerging Issues

- Sharing ISCN experiences of establishing, implementing and maintaining a COE
- Active participation to Working Group (WG)
- Network Chair from ISCN (2016-18)
- Hosted 2018 Annual Network Meeting

## ◆ Collaboration with Regional COEs through Asia Regional Network

- Information exchange on each training course topics and schedule
- Exchange of observers and participants to each other's training courses
- Technical visit to each center
- Joint training and outreach (2018~)

### 3 COEs

#### ISCN (JAPAN)

Integrated Support Center for Nuclear Nonproliferation and Nuclear Security

#### SNSTC (China)

State Nuclear Security Technology Center

#### INSA (ROK)

International Nuclear Security Academy

## Transmitting Information on ISCN Activities

### Side Event to Commemorate the 30th Anniversary of DOE/NNSA and JAEA Cooperation in Nuclear Non-Proliferation

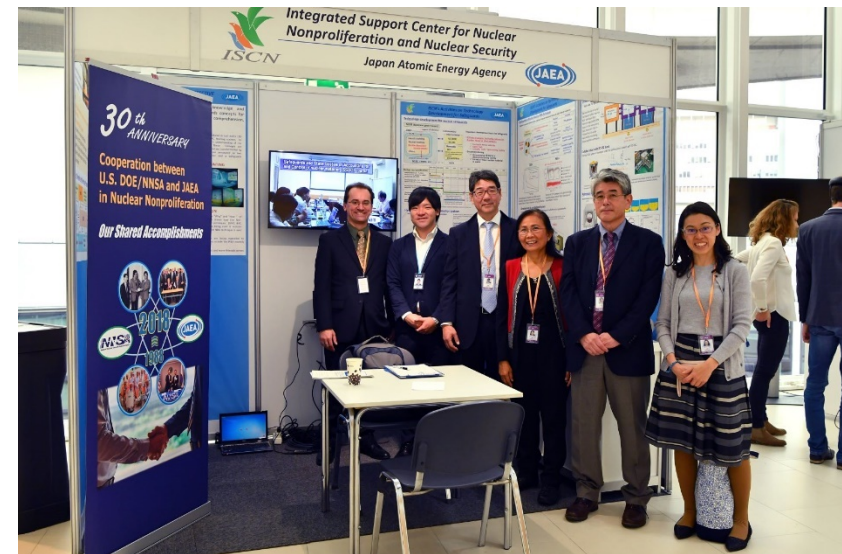
- The event was held on 18 September 2018 as side event of the 62<sup>nd</sup> General Conference of IAEA
- Around 80 participants, GC participants and IAEA staffs
- Introduction of US-Japan collaborative activities.
- Remarks by Mr. Toshio Kodama, President of JAEA, Ms. Lisa Gordon-Hagerty, Under Secretary DOE and Administrator NNSA, Ambassador Mitsuru Kitano, Permanent Mission of Japan
- Shared history and achievements in nuclear non-proliferation and nuclear security regimes and contribution to IAEA, recognized importance of US-Japan cooperation in these areas



# Transmitting Information on ISCN Activities

## Active Participation to the IAEA Safeguards Symposium

- The IAEA Safeguards Symposium was held from 5 to 8 November, ISCN/JAEA actively participate in the symposium
  - 11 papers for panel discussions and poster presentations of the symposium to share the results of R&D and capacity building activities of ISCN/JAEA
  - Setup exhibition booth for information sharing of ISCN's activities and demonstration of virtual reality (VR) for safeguards training





# Transmitting Information on ISCN Activities

## Website

- ISCN Newsletter (monthly)



- Nuclear Non-Proliferation Trends (2-3 times a year)
- ISCN Website (<http://www.jaea.go.jp/04/iscn/>)



## Info-service of “Nuclear Non-Proliferation Pocketbook”

- The Pocketbook (in Japanese) accumulates various nuclear non-proliferation related information to enhance the public's understanding of nuclear non-proliferation issues.
- For more effective utilization of the Pocketbook, it was also simultaneously released on ISCN Website



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# Panel Discussion 1: Strengthening Nuclear Non-Proliferation

## Moderator :

- **Prof. Masahiko Asada**, Graduate School of Law, Kyoto University, Japan

## Panelists :

- **Mr. Frédéric Claude**, Section Head, Section for Safeguards Programme and Coordination, IAEA
- **Mr. Stephen LaMontagne**, Advisor, Bureau of International Security and Nonproliferation, Department of State, USA
- **H.E. Mr. Takeshi Nakane**, Ambassador for Science and Technology Cooperation, Special Assistant to the Minister for Foreign Affairs, Ministry of Foreign Affairs, Japan
- **Mr. Yosuke Naoi**, Director, ISCN, JAEA

# Panel Discussion 1: Strengthening Nuclear Non-Proliferation

## Points for Discussion:

- Effectiveness and efficiency of the IAEA safeguards
- Challenges in the denuclearization process
- Expectations for denuclearization, technical contributions from stakeholders, and the role of IAEA and States in the process

## Panel Discussion 2

# Technologies Supporting Nuclear Non-Proliferation and Denuclearization

### Moderator:

- **Mr. Naohito Kimura**, Director, Research and Development Policy Division, Research and Development Bureau, Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan

### Panelists:

- **Dr. Kamel Abbas**, Project Leader, Department of Nuclear Security and Safeguards, Directorate Nuclear Safety and Security, Joint Research Centre - European Commission (EC-JRC)
- **Mr. Frédéric Claude**, Section Head, Section for Safeguards Programme and Coordination, IAEA
- **Mr. Stephen LaMontagne**, Advisor, Bureau of International Security and Nonproliferation, Department of State, USA
- **Dr. Masato Hori**, Deputy Director, ISCN/JAEA

## Panel Discussion 2

# Technologies Supporting Nuclear Non-Proliferation and Denuclearization

### Discussion Points

- Research and development supporting nuclear non-proliferation and nuclear security
- Technical challenges facing international safeguards and R&D needs
- Technical challenges for denuclearization and R&D needs
- Contribution of Japan and international cooperation in nuclear non-proliferation and denuclearization