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

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Japan Atomic Energy Agency

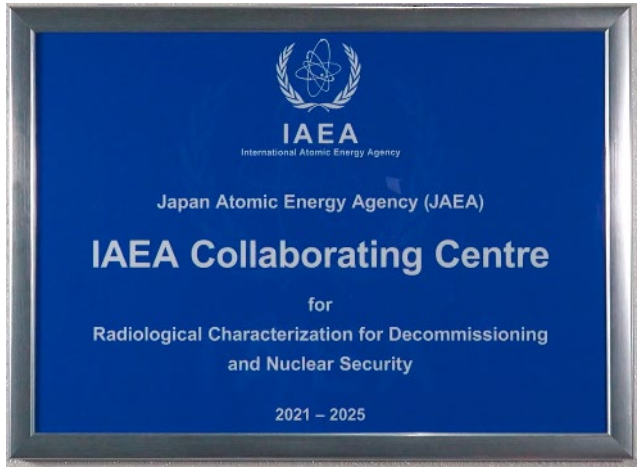
The International Forum on Peaceful Use of Nuclear Energy, Nuclear Non-Proliferation and Security

December 10, 2024

Japan's National Statement at 2010 Nuclear Security Summit and Establishment of ISCN

- Establishment of an integrated support center for nuclear nonproliferation and nuclear security in JAEA
- Development of technology related to measurement and detection of nuclear material and nuclear forensics based on international cooperation.
- Contribute to the improvement of global nuclear security・・・by implementing human resource development programs

December 10, 2010 Establishment of ISCN/JAEA



JAEA was designated as an IAEA Collaborating Centre for nuclear security (and decommissioning and waste management) on October 22, 2021, based its achievement in the international human resource development and technology development in the field of nuclear security in collaboration with the IAEA .

October 22, 2021 Designated as IAEA Collaboration Centre for Nuclear Security

ISCN overview

Obligation for JAEA to contribute to strengthening international nuclear nonproliferation and nuclear security, as a global promoter of the peaceful use of nuclear energy, which has a dual nature.

⇒ Aiming to realize a "world without nuclear weapons and nuclear terrorism x sustainable peaceful use of nuclear energy"

◆Implementation of national policies and support for Initiatives of the international organizations to realize a world without nuclear weapons and nuclear terrorism and to make nuclear energy sustainable

◆Addressing the challenges and changes in the circumstances surrounding nonproliferation and nuclear security

Client

MOFA
Atomic Energy Commission

NRA

Security authorities (police, etc.)

University

Electric utility companies, security vendors, etc.

Asian countries and other international partner countries

JAEA Related department

- **IAEA**
- **CTBTO**
- **U.S. DOE/NNSA**
- **European Commission**

Cooperation

Collaboration

Support

- Establishment of International Rules and Norms
- Strengthen 2S in Japan
- Establishment and maintenance of overseas 2S system in Asian emerging countries, etc.

Integrated Support Center for Nuclear Nonproliferation and Nuclear Security (ISCN)

Technology Development	Capacity Building Support
Policy Research	CTBT Technical Cooperation

Activities to Promote Understanding

Research and Development Activities for Nuclear Nonproliferation and Nuclear Security

ISCN

Nuclear Security

- Nuclear Forensics
- Material Attractiveness evaluation study
  - Methodology to evaluate attractiveness of materials in fuel cycle process for theft and sabotage in nuclear and radiological malicious acts under Japan-US cooperation
- Rapid nuclear and radioactive material detection technologies covering Broad-area

Nuclear Nonproliferation

- Active neutron Non-destructive Assay (NDA) techniques

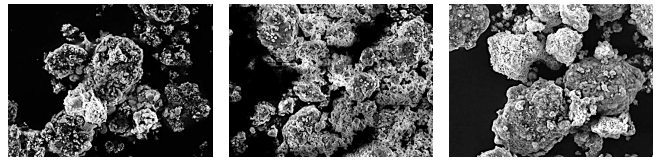
Recent Achievements（Nuclear Forensics）

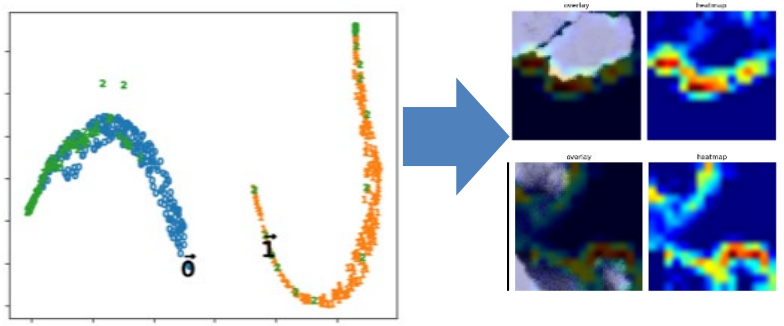
1. **“Signature” analysis techniques using Artificial Intelligence (AI)**
   - Publication of the development of UOC identification by microscope image analysis using deep neural network model
   - Visualization technology development of microscopic image analysis basis by deep neural network model

2. **Study of Uranium ore Signature and it’s analytical techniques**
   - UOC joint sample analysis campaign with US national laboratories and Ningyo-toge center
   - Joint study with DOE/NNSA

3. **Uranium age dating using α spectrometry**
   To develop uranium age dating techniques using low cost equipment for improvement of analytical capability for Newcomer countries and universities
   - Basic analytical protocol development (joint study with Kanazawa Univ.)

4. **Nuclear and other radioactive materials detection and imaging techniques for dispersed those materials at crime scene**
   - Publication of hybrid detector system development
   - Experiments for the direction sensitive gamma-detector development





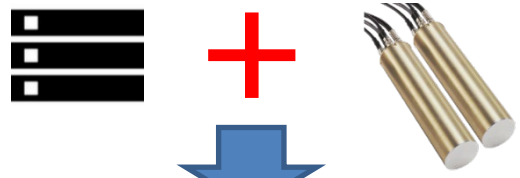
Material Classification & Unknown Material Detection

Interpretation of image analysis results

Microscope Image analysis by deep neural network model

Machine learning algorism

Hybrid system using low cost detectors



Autonomous detection and classification of radionuclides to support crime scene investigator

Recent Achievements（Nuclear Detection and Measurement）

1. Development of active neutron NDA

(1) Delayed Gamma-ray Spectrometry

・Irradiate nuclear materials using a strong DD neutron source

(2) Neutron Resonance Analysis

・Analytical method integrating Neutron Resonance Transmission Analysis, Neutron Resonance Capture Analysis and Neutron Resonance Fission Neutron Analysis

Fission Signature Assay Instrument

2. Broad-area nuclear and radioactive material detection

Counterterrorism at soft target, like sports event, shopping complex, etc.

・Radioactive material detection test

・Development of detectors

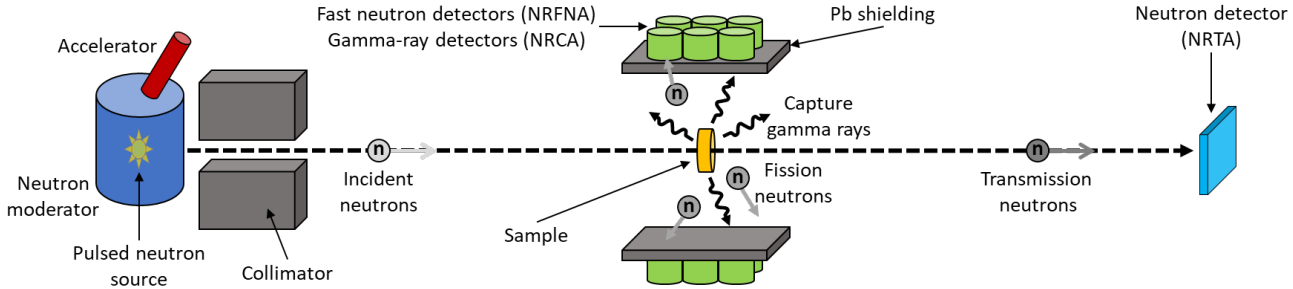
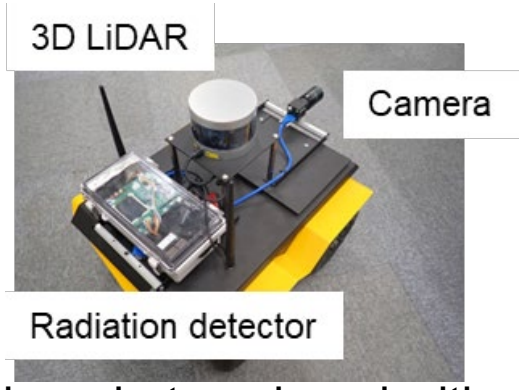
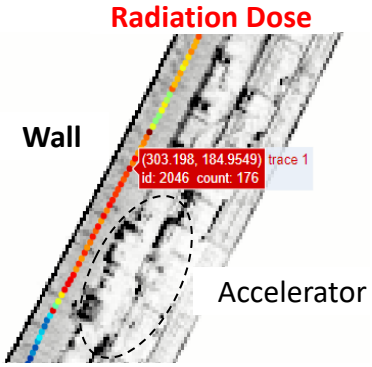


Diagram of the NRA measuring system

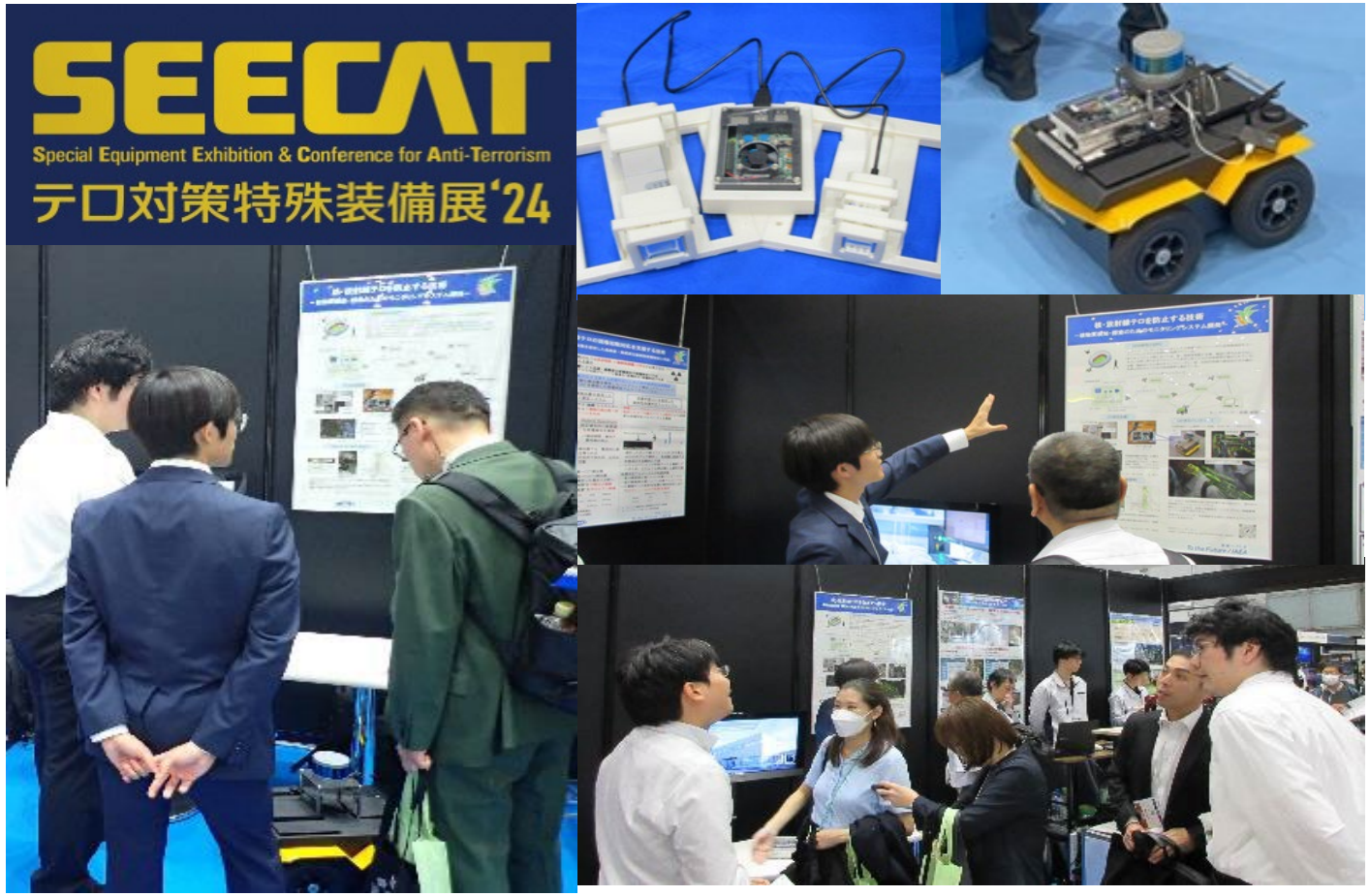


Crawler robot equipped with a radiation detector



Indoor Dose Mapping Test at Accelerator Facility

Efforts toward Social Implementation



SEECAT (Special Equipment Exhibition & Conference for Anti-Terrorism) '24, October 2024, Tokyo Big Sight
https://www.seecat.biz/

Participating SEECAT (Special Equipment Exhibition & Conference for Anti-Terrorism), 9-11 Oct. 2024, Tokyo Big Sight

1. **Hybrid gamma ray detector (prototype)**
2. **Unmanned patrol device**

- **155 visitors in total.**

Capacity Building Support through Human Resource Development for Nuclear Nonproliferation and Nuclear Security

Three courses:

1. Nuclear security course (incl. security of Radiological materials)
2. Safeguards and SSAC* course (* State system of accounting for and control of nuclear material)
3. International non-proliferation framework course: bilateral cooperation

Needs-oriented approach:

Tailored training curriculum to reflect the needs of target audience

For efficient and effective training:

Cooperation with IAEA and DOE/NNSA, combination of the following methods and tools:

Lectures

Group Exercises

Exercise Facility

Virtual Reality (VR) System

ISCN Exercise Field (Exterior)

Equipped with the main security devices (e.g., intrusion detection sensors; camera/video systems) that are in use at actual nuclear facilities, the Exercise Field provides hands-on learning opportunities including the devices' basic functions, the security system designs, and the performance testing techniques.

PTZ Camera
Hybrid Camera
Fix Cameras

Buried E-Field Sensor

Laser Sensor

High-Definition Camera

Infrared Sensor
Microwave Sensor

Thermal Camera

Infrared & microwave Dual Sensor

Free-Standing X-Field Sensor

ISCN Exercise Field (Physical Protection Exercise Bld.)

1F: Server room

2F: Classroom

1F: Mock Central Alarm Station (Mock-CAS)

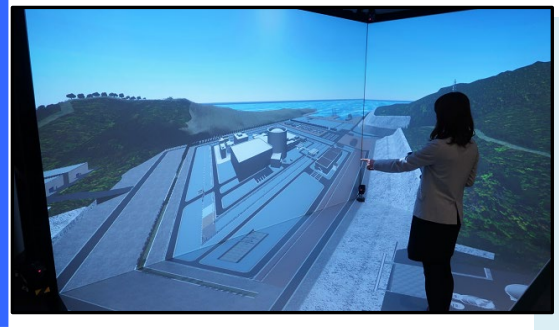
1F: Entry Control equipment room

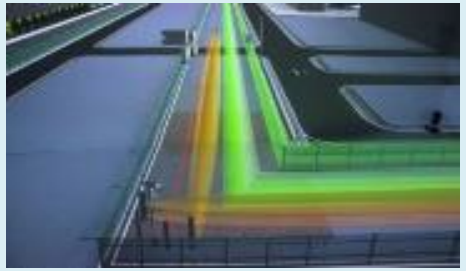
ISCN Exercise Field (Virtual Reality (VR) Exercise Bld.)

VR Exercise Building

Virtual experience of walk/fly-through the inside/ outside of a nuclear facility

- Construct virtual nuclear facilities in the cyberspace
- Display a facility on the three-sided screen in 3-D
- Exercises for nuclear security and safeguards courses





VR enables visualization of sensor detection volume, changing weather or time to observe its impacts on security system

Virtual nuclear facilities for safeguards exercises

Broader tools:

Tools/methods developed for online trainings are incorporated in In-person trainings, E-Learnings, videos, virtual tours and Remote lectures.

E-learnings as pre-requisite

Remote lecture

Workshop with Films

Complementary Access Demo Video

https://elearning.iaea.org/m2/course/view.php?id=1257

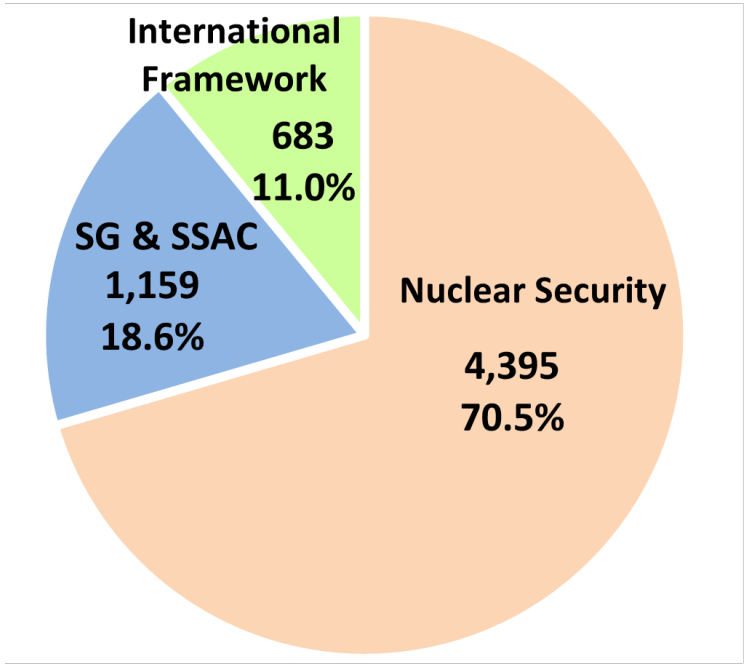
Virtual tour of Research Reactor (JRR-4)

Distribution of Course Participants

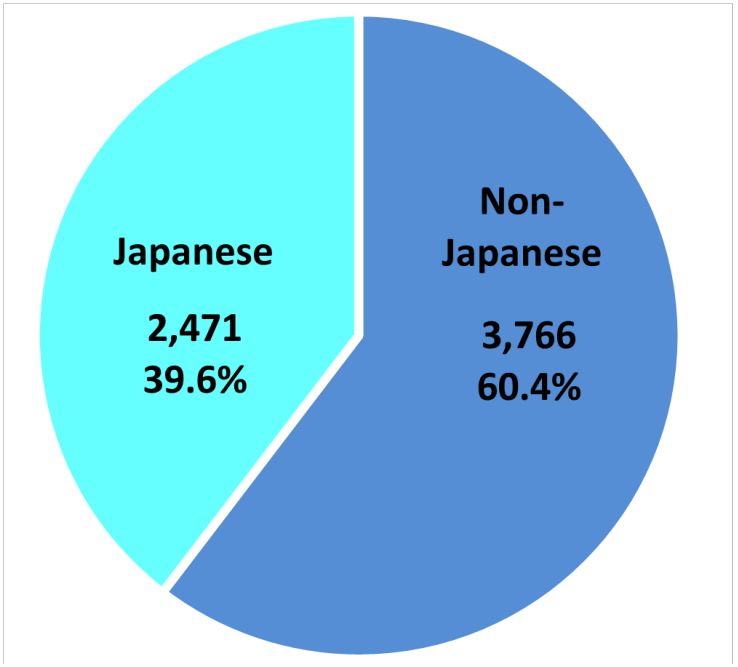
Activity Results of 2011- Nov. 2024

Total 251 courses with 6,262participants
(117 countries, 6 international organizations)

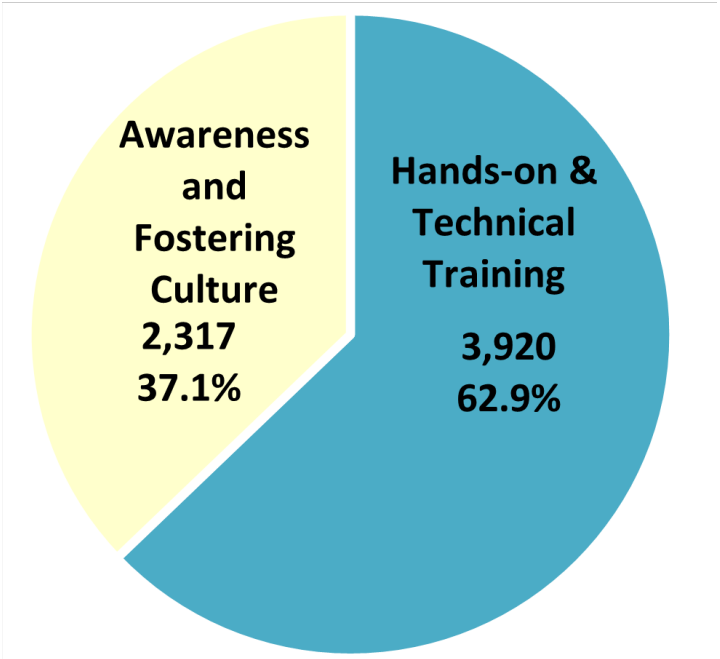
Course Topic



Nationality



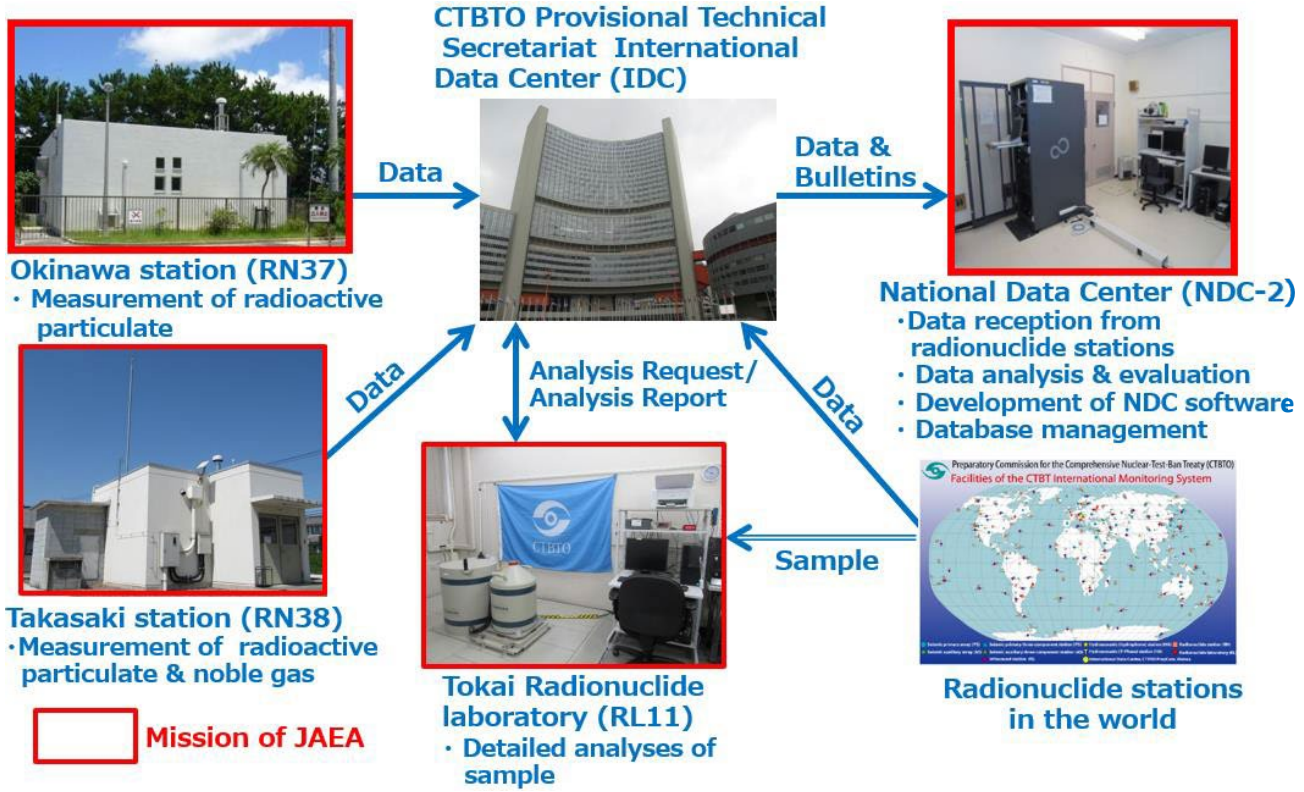
Course Style



Contribution to CTBT International Verification Regime

- Supporting CTBTO International Monitoring Systems (IMS) for nuclear test through operation of;
  - CTBT radionuclide monitoring stations in Okinawa and Takasaki
  - Radionuclide laboratory in Tokai
  - National data center (NDC)

- Supporting CTBTO initiatives for enhancement of detection capability.
  - Radioxenon background measurement using Transportable Xenon Laboratories (TXLs) installed at Horonobe (Hokkaido) and Mutsu (Aomori),



JAEA's activities related to the CTBT

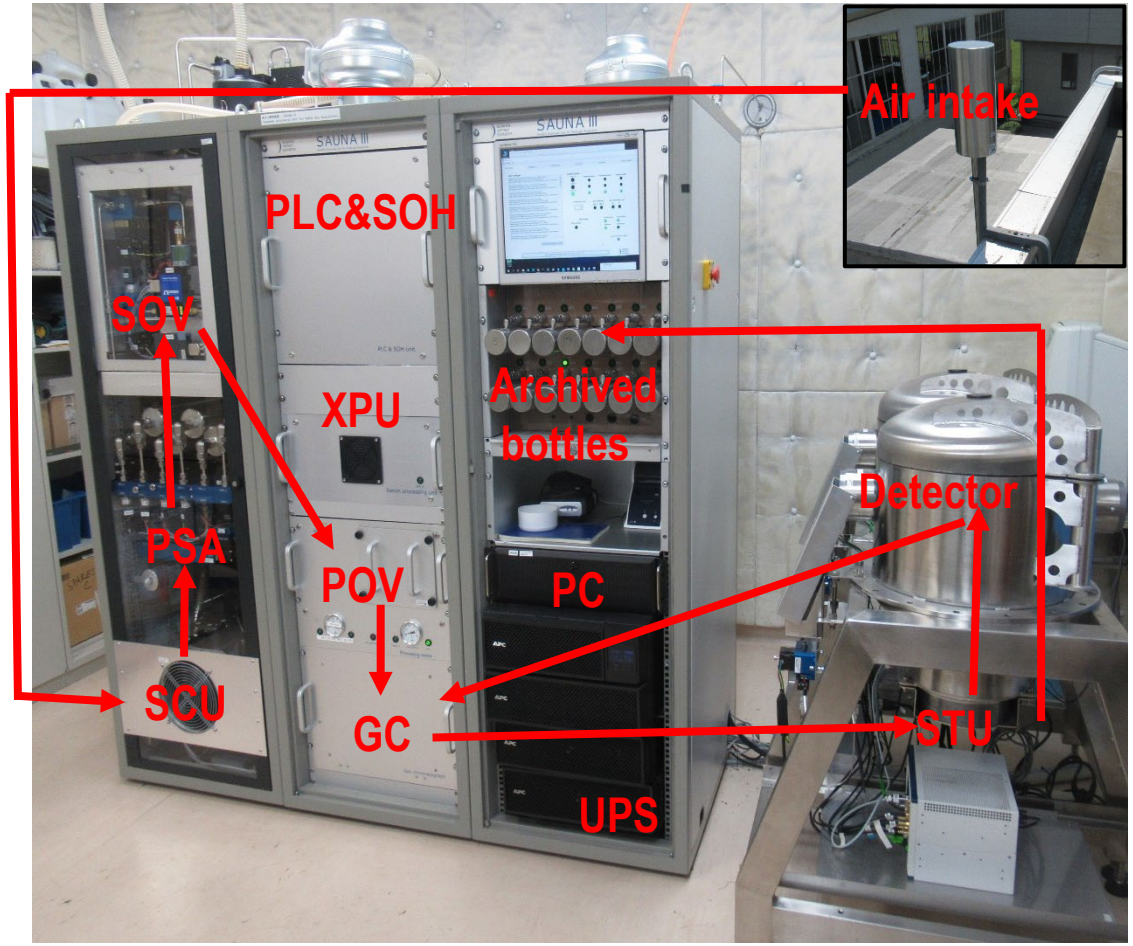
Exterior and interior of TXL installed at Horonobe

Upgrading Noble Gas monitoring System to the Next Generation System, SAUNA III (Takasaki)

Performance comparison of old and new system

	SAUNA Ⅲ ⟸	SAUNA Ⅱ
Collection time	6 hours	12 hours
Samples / day	4	2
Volume of sample	40 m^3	15 m^3
Xenon volume /sample	3.3 ml	1.2 ml
MDC (mBq/m^3)	Xe-133：0.20 Xe-131m：0.20 Xe-133m：0.15 Xe-135：0.40	＜1mBq/m^3
Carrier gas	Nitrogen (N_2)	Helium (He)
Cost of carrier gas/year	JPY 90,000	JPY 2,300,000

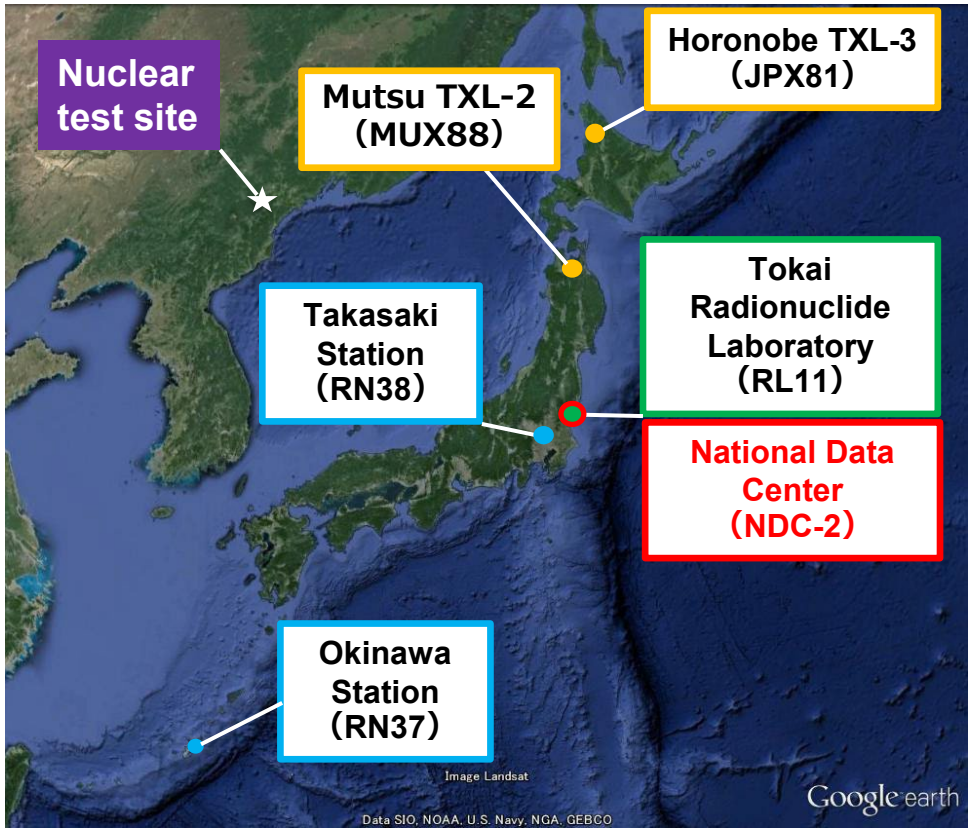
SAUNA Ⅲ



SCU：sample control unit, PSA：pressure-swing adsorption,
SOV：sampling oven, GC：gas chromatograph,
STU： sample transfer unit, XPU: xenon processing unit

Past Results of Radionuclide Detection Relating to DPRK Nuclear Tests at RN38 Takasaki Station

DPRK's nuclear test	Test date	Definitive detection of radionuclides derived from nuclear test
1st	9/Oct/2006	None *(The noble gas measurement system had not been installed yet in RN38 Takasaki station.)*
2nd	25/May/2009	None
3rd	12/Feb/2013	Early in April, Xe-133 and Xe-131m were detected same time far beyond normal background level of the activity concentration at RN 38 Takasaki station (JPX38).
4th	6/Jan/2016	Middle in February, Xe-133 of possible nuclear test origin was detected.
5th	9/Sep/2016	None
6th	3/Sep/2017	Early in October, Xe-133 of possible nuclear test origin was detected.



【Radionuclide Stations】
- Okinawa (RN37)
- Takasaki (RN38)

【Radionuclide Laboratory】
- Tokai (RL11)

【National Data Center】
- Tokai (NDC-2)

【Temporary stations for Joint Project with CTBTO】
Transportable Xenon Laboratory (TXL)
- Mutsu TXL-2 (MUX88)
- Horonobe TXL-3 (JPX81)

Policy Research on Nuclear Nonproliferation and Nuclear Security

ISCN conducts policy research based on technical knowledge reflecting international trends related to nuclear nonproliferation and nuclear security.

- **Study on Impact of Russia‘s invasion of Ukraine on nuclear nonproliferation (NP) and nuclear security (NS)**

  Identify the issues related to NP and NS arising from the Ukraine crisis that are high priority for Japan, and clarify the themes to be addressed, and response policies for them.

Example;

	Assumed scenario	Possible responses	Response polices
1	Accidental external release of radioactive materials due to destruction of nuclear facilities, etc.	Prohibition and suppression of armed attack on nuclear facilities by international rules	Survey trends in rulemaking in the international community
2		Issuance or review of new international guidelines considering military attacks and unjust occupation	Once the IAEA TECDOC or other document is issued, it will be reviewed.
3	Increased safety concerns due to attacks on nuclear power plants and a shift away from energy dependence on Russia	Support for the design of SMRs and other advanced reactors with high intrinsic safety and nuclear security strength	Started as a priority in 2024

Current study: 2S (Nuclear Security and Safeguards) challenges and countermeasures for Advanced reactors including SMRs

Research plan

Identify advantages and challenges

- Extract by features of advanced reactors from overseas previous studies

Selecting prioritized challenges

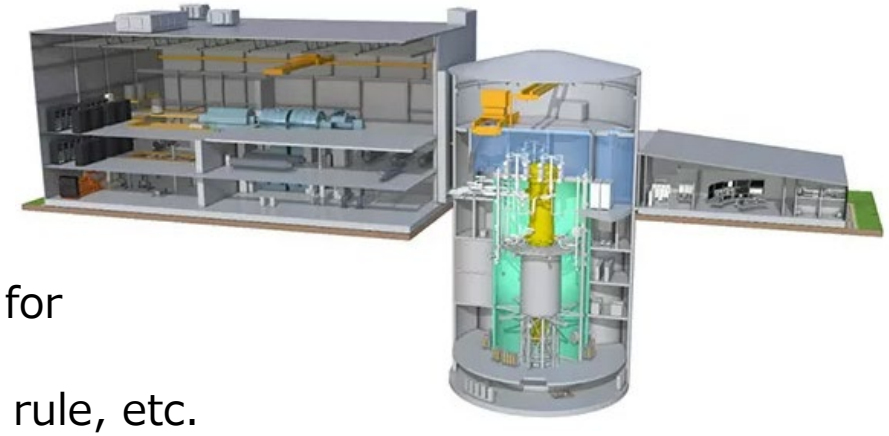
- Large initial and/or running cost for countermeasures
- Required to change international rule, etc.
- Common challenges for 3S

Explore solutions

- Reasonable measures
- Identify new approach, technologies to be developed

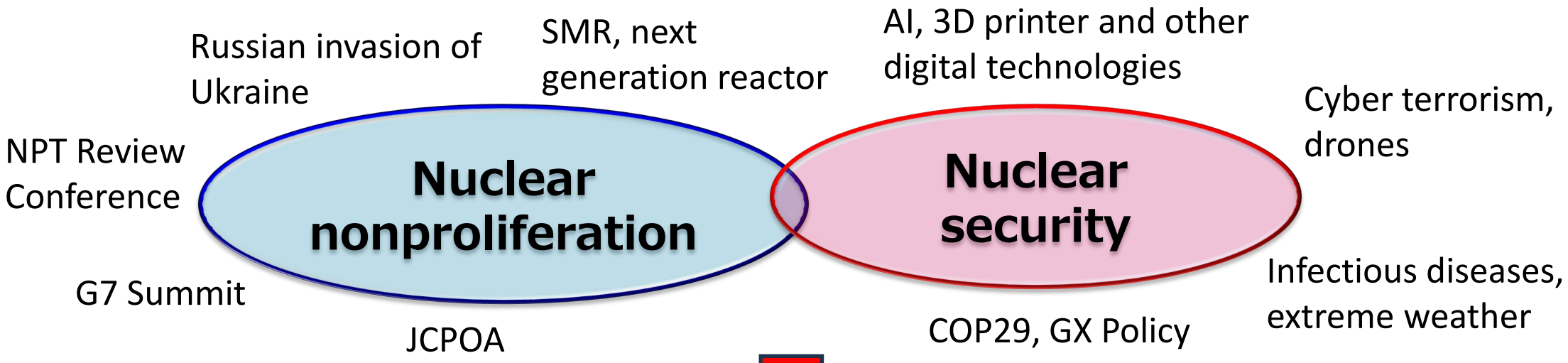
Input to the client

- Addressing common challenges in 2S
- Related to FR and HTGR with hydrogen production plant



BWRX-300

Changes in International Trends Surrounding Nuclear Nonproliferation and Nuclear Security



Information collection and analysis, policy research

Reflect in ISCN's efforts

Support policy maker

Information dissemination

Collaboration with Universities and Academia

◆ Lectures and exercises for universities

- The Univ. of Tokyo (Nuclear Engineering and Management, Nuclear Professional School), Institute of Science Tokyo (former TITAC)
- Hokkaido Univ., Tokai Univ., Fukui Univ. Kagawa Univ. and Nagoya Univ.

◆ "ISCN Summer School" for JAEA Summer Internship Students

- "ISCN Summer School" program is provided to the JAEA internship students in ISCN themes
- As a project, discussing on the topic of International Forum, and the representative student participated as a panelist
- In 2024, one of the students presented a poster on the results of summer internship at INMMJ annual meeting and won the Best Presentation Award.

◆ Collaboration with domestic academia

- Atomic Energy Society of Japan (AESJ), Nuclear Non-proliferation, Safeguards and Nuclear Security Liaison Committee
- Institute of Nuclear Material Management Japan (INMMJ)
  ※A nuclear security webinar co-hosted by the Liaison Conference on Nuclear Non-proliferation and the INMMJ was held (September 2024)
- Japan Society of Nuclear and Radiochemical Sciences

◆ IAEA Nuclear Security Education Network (INSEN)

- Joined as ISCN in May 2024
- Hosting INSEN Annual Meeting 2025 in Japan (planning)
  - ✓ One day will be used for an exchange event with Japanese universities
- A symposium in 2026 inviting INSEN experts for development of education materials
  - ✓ The materials will be distributed in cooperation with ANEC, etc.

Public Engagement (Awareness Raising, Information Sharing)

For deepen understanding of nuclear nonproliferation and nuclear security and peaceful use of nuclear energy, we report and share our achievements at conferences, hold international forums, and disseminate information through the JAEA website and ISCN Newsletter.

ISCN Newsletter

Collect and summarize timely and various information on nuclear non-proliferation and nuclear security, add commentary and deliver as newsletter.

International Forum on Peaceful Use of Nuclear Energy, Nuclear Non-Proliferation and Nuclear Security

"Toward a sustainable society through the peaceful use of nuclear energy and a world without nuclear weapons", Dec. 2023

Thank you for your kind attention.

Please access to our Website

https://www.jaea.go.jp/04/iscn/index_en.html/