Activities and Achievements of ISCN in the Past Decade

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Commitment at Nuclear Security Summit and Establishment of ISCN

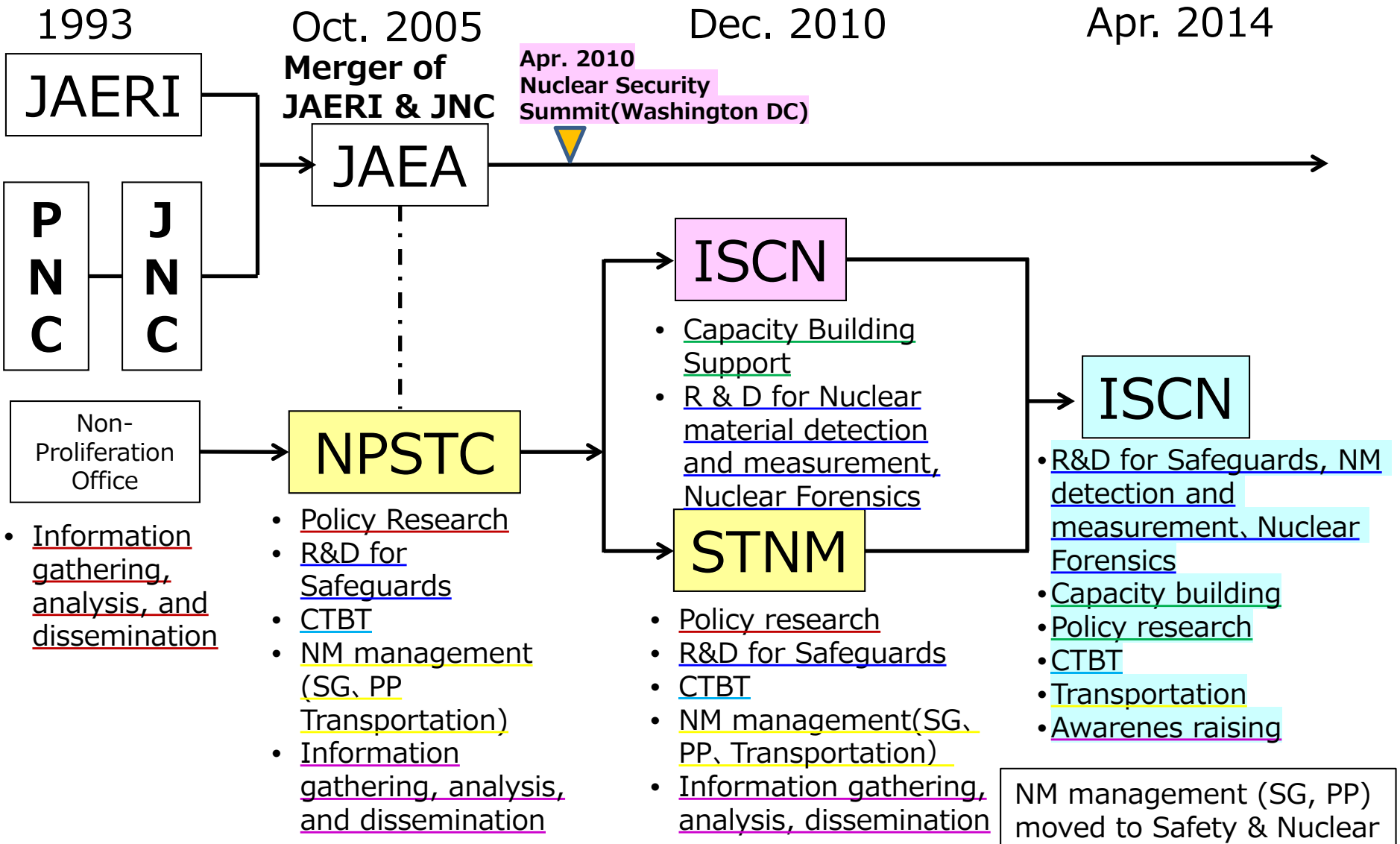
As the commitment of Japan's National Statement at 2010 Nuclear Security Summit

- Japan will contribute to;
  - strengthening nuclear security in Asia and other regions
  - Improvement of global nuclear security by implementing human recourse development programs
  - development of technology related to measurement and detection of nuclear material
  - nuclear forensics
  - based on international cooperation ※

Establishment of ISCN in December 2010

※https://www.mofa.go.jp/policy/un/disarmament/arms/nuclear_security/2010/national_statement.html

History and Activities of ISCN



NM management (SG, PP) moved to Safety & Nuclear Security Administration Department

NPSTC : Nuclear Nonproliferation Science and Technology Center
ISCN : Integrated Support Center for Nuclear Nonproliferation and Nuclear Security
STNM : Department of Science and Technology for Nuclear Material Management

Achievements of ISCN in the Past Decade

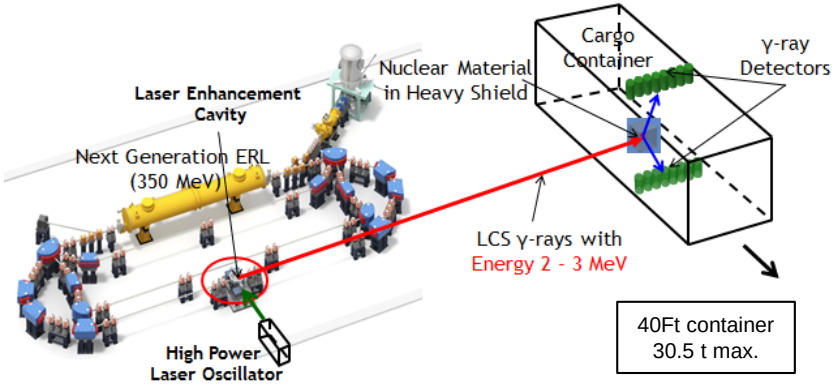
- Development of nuclear resonance fluorescence (NRF) technique for detection of hidden shielded nuclear material
- Development of active neutron NDA
- Advancement of nuclear forensic technologies
- Contribution to CTBT International Verification Regime
- Capacity Building Support Activities
- Policy Research
- Awareness Raising and International Contribution

Development of nuclear resonance fluorescence (NRF) technique for detection of hidden shielded nuclear material

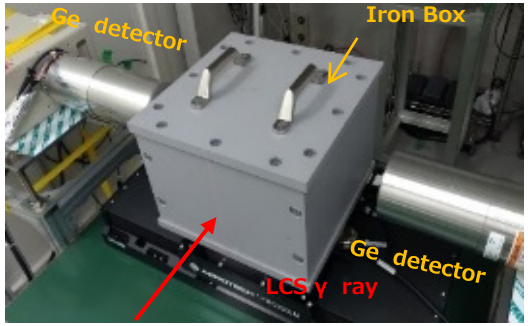
Abstract : R&D to detect nuclear material hidden in a shield box in a transportation container at a port by using nuclear resonance fluorescence（2011～2019JFY）

Achievements : ①In collaboration with the High Energy Accelerator Research Organization (KEK) and the JAEA Quantum Beam Application Research Center, laser Compton scattering (LCS) is used to generate successfully the world's highest intensity gamma rays with excellent monochromaticity from energy recovery Linacs and laser storage devices.（2011～2014）

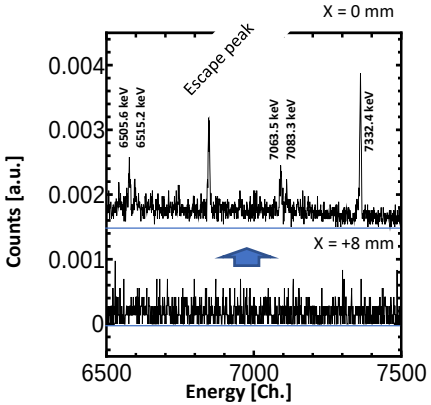
②In a joint research with the National Institutes for Quantum and Radiological Science and Technology and the University of Hyogo, a demonstration test was conducted at the New SUBARU facility to detect nuclear material (simulation) in an actual shielded container us[illegible] LCS gamma rays.（2015～2019）



Detection of concealed nuclear material (conceptual diagram)



A simulated sample (Pb-208) is placed in an iron box that simulates a shield container, irradiated with LCS gamma rays, and NRF scattered gamma rays are measured with a Ge detector on the side of the container.

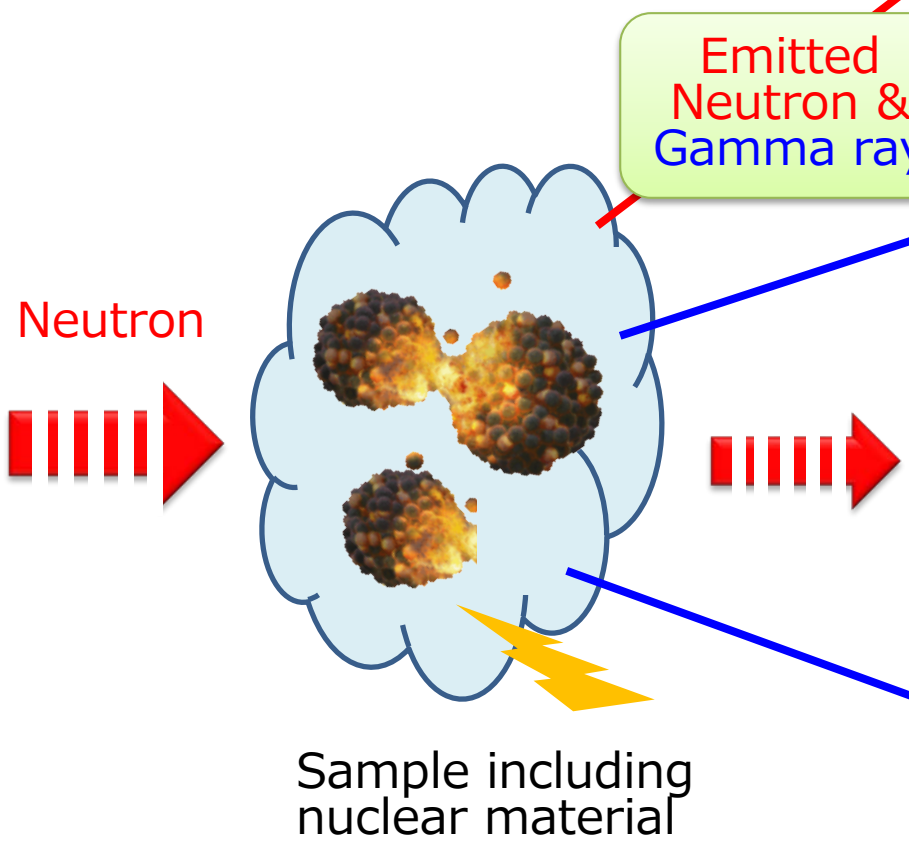


Detects peaks of NRF-scattered γ-rays (7332.4 keV, etc.) from simulated nuclear material (Pb-208) measured by a Ge detector.

Demonstration test for detection of nuclear material (January 2020)

Development of non-destructive nuclear material measurement / detection technology using four active neutron methods

Neutron irradiation to cause a nuclear reaction, and measures the neutron and gamma rays emitted accordingly



DDA (differential die-away analysis)
Measurement of neutron emission associated with fission reaction
(total amount of fissile nuclides)

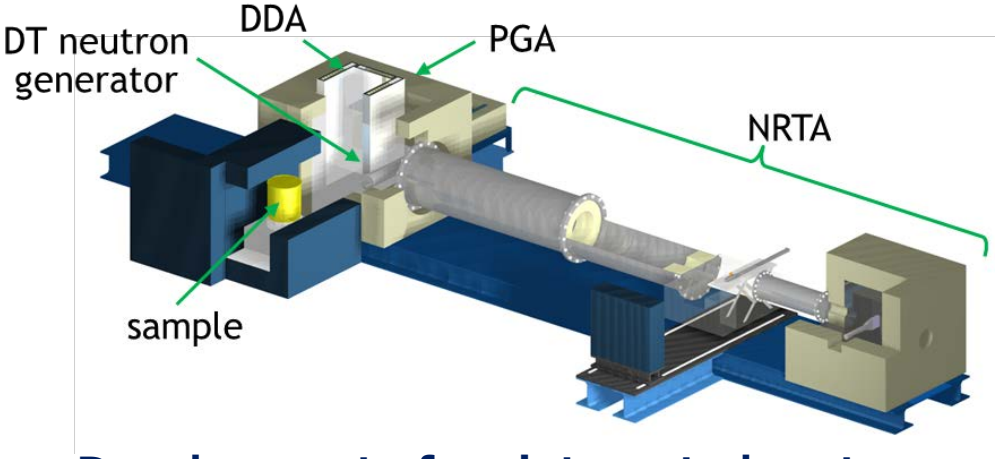
PGA(prompt γ-ray analysis)
Measurement of prompt gamma rays associated with neutron capture reaction
(explosives, neutron absorbers, poisons, etc.)

NRTA (neutron resonance transmission analysis)
Measurement of transmission neutron
(quantity of each nuclear material)

DGA(delayed gamma analysis)
Measurement of decay gamma-rays from fission products
(ratio of each fissionable nuclear material)

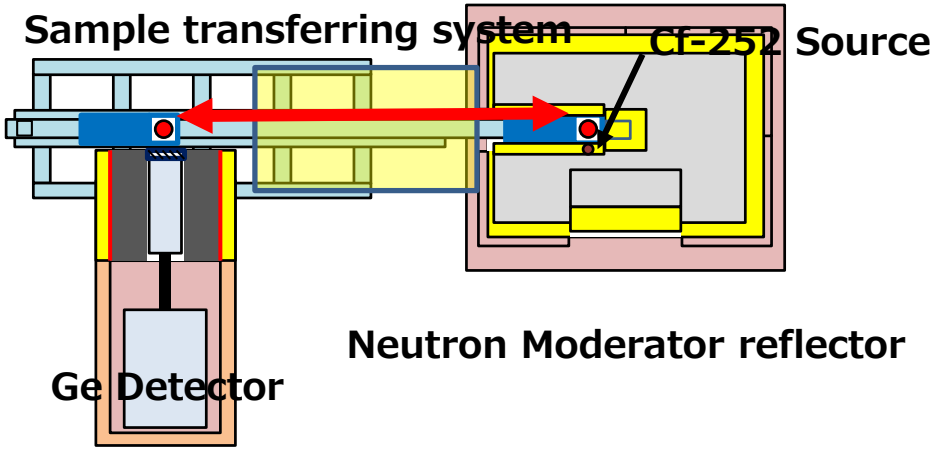
Development of Active Neutron NDA technique at JAEA

Achievement : JAEA Nuclear Science and Engineering Center is developing a test device that integrates the three technologies of DDA, NRTA, and PGA using a DT neutron generator tube. We confirmed so far that 20 mg of Pu-239 can be measured even in a sample containing Cm-244 (equivalent to 30 GBq).



Development of an integrated system

Achievement: Joint experiments were carried out at the Ispra Research Center (Italy) of EC / JRC using a device developed by ISCN that uses Cf-252 as a neutron source. As a result, delayed gamma rays were obtained with a test device using a Cf-252 source, confirming the possibility of application to reprocessing facilities .

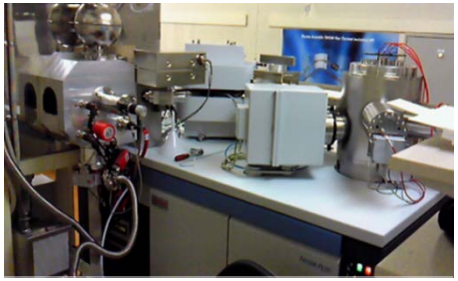


Development a practical DGA system

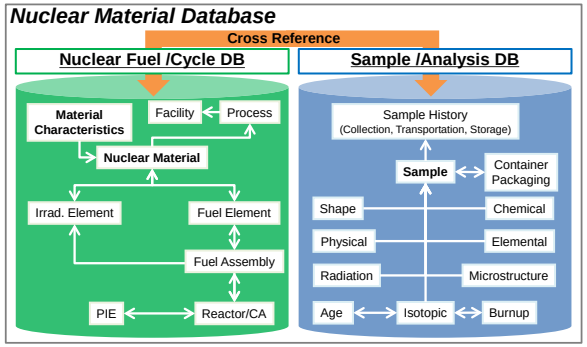
R&D on Nuclear Forensics

Phase I
(2011JFY-2014JFY)

Establishment of Fundamental technology



Measurement of uranium isotope ratio by TIMS

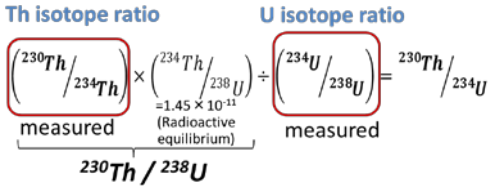


Nuclear material database for collating analytical data (development of prototype nuclear forensics library)

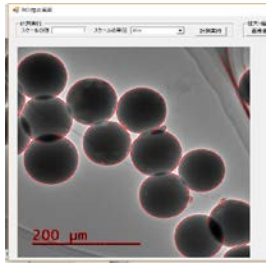
Phase-II
(2015JFY-2018JFY)

Advanced technology Development

More advanced technology development based on the knowledge of Phase-I



In-situ Uranium age determination (development of new technic)

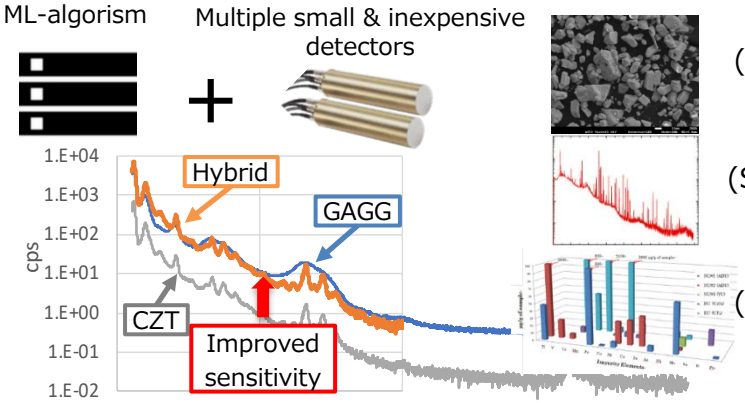


Electron microscope image analysis software (R&D on particle shape analysis)

Phase-III
(2018JFY～)

R&D for Practical application

R&Ds to overcome technical issues for future practical implementation of NF



(image data)

(Signal data)

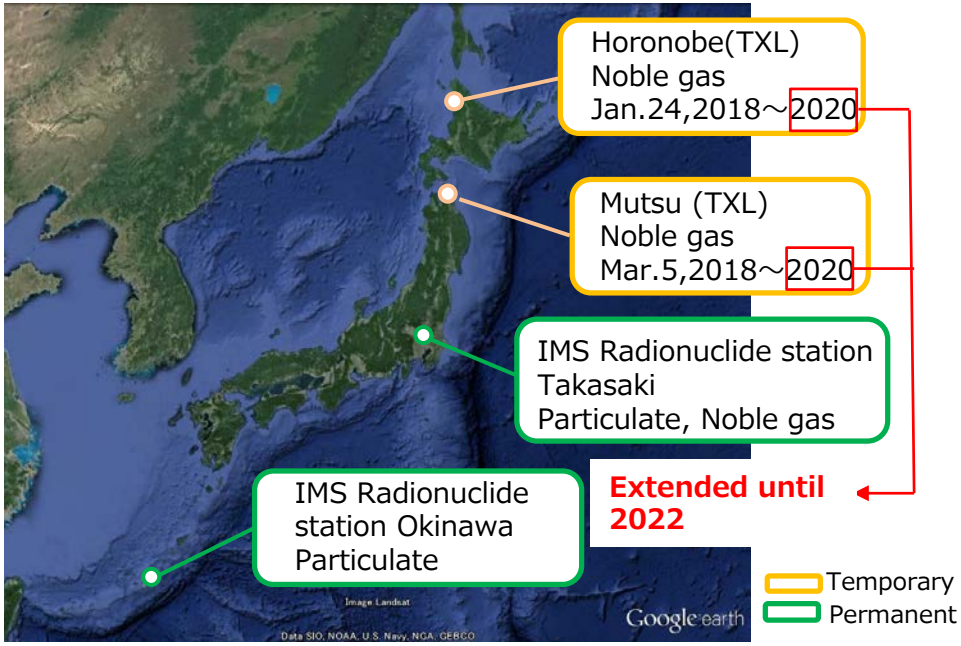
(Numerical data)

Objective & quick data analysis by AI (ML) for identification of the origins of MORC

AI-based nuclear forensics interpretation (R&D for application of new technology)

Contribution to CTBT International Verification Regime

JAEA operates the CTBT international monitoring stations (IMS) in Okinawa and Takasaki and national data center (NDC) for monitoring of nuclear test. In the past six nuclear tests in North Korea, radioactive noble gas released from those tests was detected at Takasaki station in 2013. In the case of an underground nuclear test, noble gas is contained underground and difficult to detect. In order to enhance the nuclear test verification capability with the CTBT organization, two joint observation projects were conducted in the past in Mutsu, Aomori Prefecture, to investigate the BG behavior of radioactive noble gases. From 2018, transportable radoxenon monitoring equipment (TXL) were installed Mutsu, Aomori and Horonobe, Hokkaido, and are continuing BG measurement. This observation has been extended for another two years and will continue until March 2022.



IMSs and TXLs operated by JAEA

Exterior and interior of TXL

Purpose and Outline of Capacity Building Support Activities

- While considering the international common framework and the IAEA guidelines for nuclear nonproliferation, ISCN has been working for Capacity Building Support activities by making use of the experience that Japan has accumulated while promoting the peaceful use of nuclear energy.
- ISCN has been implementing training focusing on the development of senior officials and instructors in the target countries to improve their capabilities in this field, and will lead to the construction of a mechanism for maintaining and improving their own capabilities in the Asian region.
- In response to the various needs of the target states, priority items common to the region were prioritized and implemented efficiently, and in order to meet individual needs, training was also conducted bilaterally at the targeted states with their needs.
  1. **Nuclear security course**
  2. **Safeguards and SSAC course**
  3. **International nuclear nonproliferation framework course (Bilateral)**

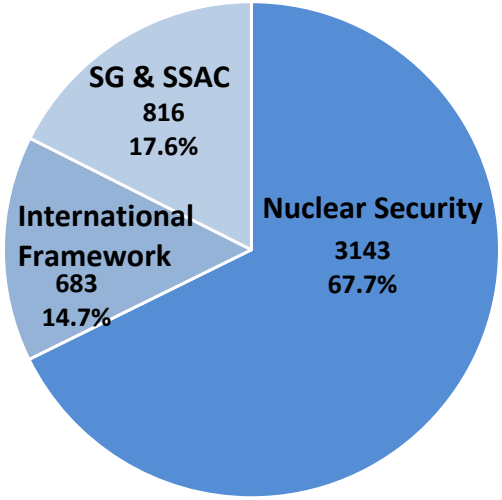
Initial target	2010	2015	2020
Short term : International joint implementation of training based on curriculums of IAEA, US, EU, etc.	→		
Mid term : Implementation of ISCN developed training that takes into account the characteristics of Japan		→	
Long term : Development and implementation of training unique to Japan that incorporates domestic and foreign best practices and the latest technology			→

Track Record on Capacity Building Support

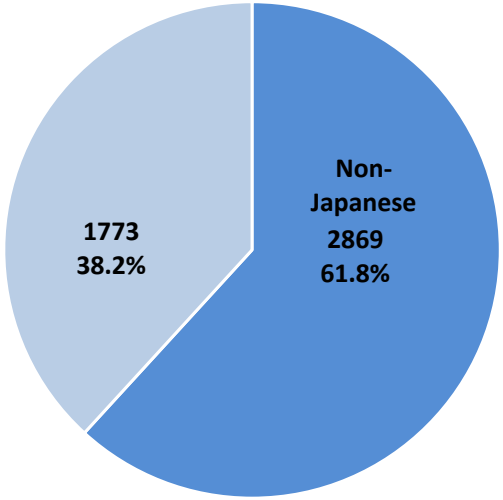
Activity record（From 2011 to November. 2020）

- Total 4,693 participants in 187 courses (99 countries, 6 international organizations)
- Confirm the effect of training by conducting a follow-up survey several years after the course

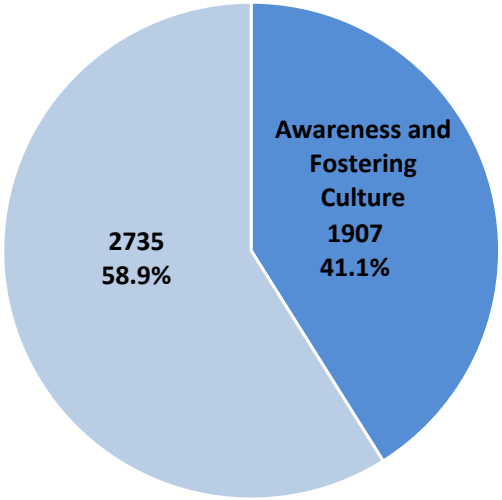
Course topic



Nationality



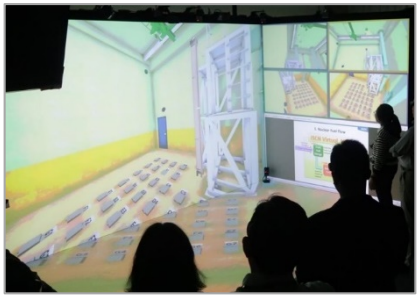
Course style



Lecture

Group exercise

VR system



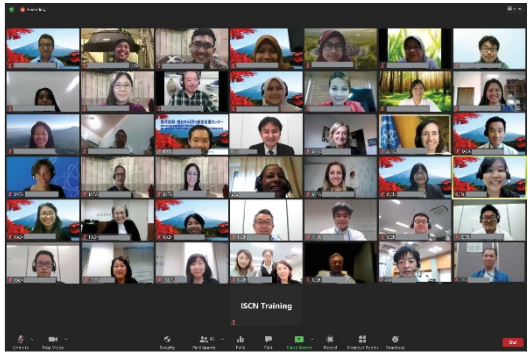
PP exercise field

Development of Online Training

Capacity Building Support Activity under COVID-19 Pandemic

- All international trainings after March 2020 were postponed.
- Domestic courses were conducted with appropriate measures after September 2020.

- **Development of international online course (Apr. 2020~) and world's first implementation in 2020**
  - **October : RTC on PP developed by ISCN & SNL**
  - **November : RTC on Safeguards and SSAC developed by ISCN and IAEA**
- **Using e-learning and Zoom meeting with bidirectional**
- **Development of Virtual Tour (VT)**
  - **Exercise on Design Information Questionnaire using VT on research reactor**
  - **VT of Physical Protection exercise field**

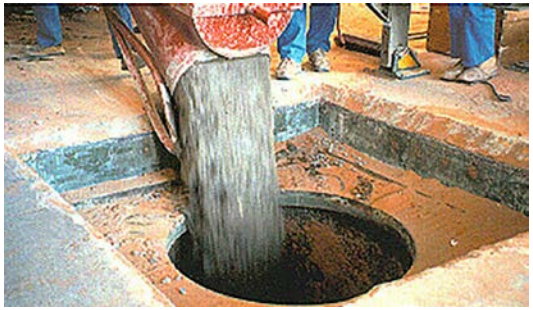


- **Possibility to provide more effective training by taking advantage of online characteristics and combining with in-person training**

Policy Research with Technical Knowledge and Experience

ISCN

- Conducting policy research based on technical knowledge to support national policy making on nuclear non-proliferation and nuclear security issues
- From 2018, started “study on factor analysis and technical processes for achievement of denuclearization
  - ✓ Analyzed various factors for achieving denuclearization through a case study of countries which achieved or are on the way to address denuclearization, such as South Africa, Libya, Iran, Iraq, Ukraine, Kazakhstan, Belarus, North Korea and Syria, based on public information.
  - ✓ Conducted analysis on motives for acquiring nuclear weapons, internal and external situations at the time of decision to denuclearize, effects of economic sanctions, denuclearization methods, verification methods / verifiers, etc.
  - ✓ In the future, we plan to examine the technical procedures for denuclearization including dismantlement and disposal of nuclear weapon, and development and production processes, together with their verification scheme.



Kalahari Nuclear Test Sit, South Africa
Source: IAEA, Against the Spread of Nuclear Weapons: IAEA Safeguards in the 1990s

P1 gas centrifuges stored at Oak Ridge National Laboratory which were transferred from Libya
http://www.nti.org/media/images/1540_libya.jpg?_=1330127318

Awareness Raising and International Contribution

In promoting the peaceful use of nuclear energy, it is important for people to understand the importance of ensuring nuclear non-proliferation and nuclear security. ISCN has been promoting awareness raising to obtain this understanding.

- Monthly issue of "ISCN Newsletter" that analyzes and explains the latest trends related to nuclear non-proliferation and nuclear security, and introduces ISCN's activities (Distribution vis e-mail then uploading to ISCN homepage
- International forum once per year in Tokyo for Japanese audience
- Side events and booth exhibitions utilizing the IAEA General Assembly and the International Conference on Nuclear Security

Dispatched ISCN experts to IAEA consultancy meetings, etc., and chaired technical sessions at international conferences to contribute internationally.

International Forum in Tokyo, Dec. 2019

Side event at IAEA ICONS 2020

Goals for the next decade

- While there are movements to expand the use of nuclear energy in India and China, and other place, there are growing concerns about the proliferation of nuclear technology and weapons-grade nuclear material, concerns about nuclear development in Iran and North Korea, and concerns about nuclear terrorism. An era when integrated promotion of safety and nuclear non-proliferation / nuclear security is required.

- ISCN is working towards a world without the threat of nuclear proliferation or terrorism through the development nuclear forensics, new nuclear material detection technology, etc., and supporting capacity building mainly for emerging nuclear countries. ISCN contributes to further strengthening of nuclear non-proliferation and improvement of nuclear security.

- In addition, ISCN will contribute to denuclearization by effectively utilizing the technology and knowledge JAEA has cultivated so far.

Thank you for your kind attention.

We look forward to your continued support and cooperation.

ISCN staff stationed at JAEA HQ (November 2020)

ISCN staff stationed at Nuclear Science Research Institute (November 2020)