



30th
1990
2020
anniversary

**Cooperation between EC-JRC and JAEA
in Nuclear Nonproliferation and Nuclear Security**

**Achievements
and Future Direction**

Greetings

Stephen Quest

Director General, European Commission, Joint Research Centre



I would like to express my appreciation of our valuable long-standing research cooperation. In 30 years, the JAEA- Euratom cooperation gradually expanded its scope from research in nuclear safeguards to nuclear security and joint outreach, promoting nuclear non-proliferation world-wide. I would like to express my gratitude to all the colleagues contributing to this fruitful partnership. I look forward to deepening our cooperation in coming years.

Toshio Kodama

President of Japan Atomic Energy Agency

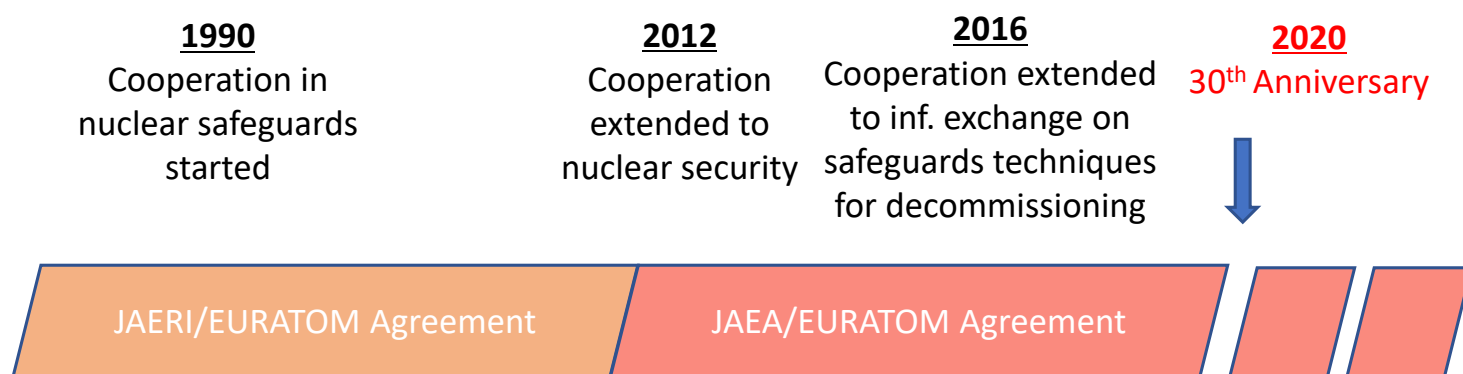


I would like to express my sincere gratitude to everyone who has been involved in the EC/JRC and JAEA cooperation on nuclear nonproliferation and nuclear security as we celebrate its 30th anniversary. I am proud that the results of this cooperation contribute to the safeguards activities and nuclear security activities of the IAEA and are playing a part in strengthening international nuclear nonproliferation and nuclear security. We sincerely wish for the development of this cooperation from now on.

History of cooperation framework

Cooperative activities for nuclear safeguards between EC-JRC and JAEA started more than 30 years ago and the agreement was signed in 1990 in order to foster closer cooperation. The agreement was extended 5 times. The scope of the cooperation was specified as nuclear material Safeguards research and development in the original agreement. The cooperative activities have played a important role to support reliable IAEA Safeguards systems, improving their efficiency and effectiveness. Currently, the scope of the cooperation is expanded to nuclear nonproliferation and nuclear security.




Agreement was signed in 1990 and extended in 1996, 2000, 2006, 2012 and 2016

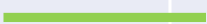
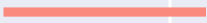
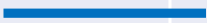


<u>1997</u> IAEA approved Model Additional Protocol	<u>2005</u> Organizational integration of JAERI/JNC	<u>2010</u> ISCN establishment; Official launch of EU CBRN CoE initiative	<u>2012</u> EUSECTRA establishment; JRC inauguration of LG-SIMS
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EURATOM	European Atomic Energy Community
JRC	Joint Research Centre
JAEA	Japan Atomic Energy Agency formed in 2005 by merger of JAERI and JNC
JAERI	Japan Atomic Energy Research Institute established in 1956
JNC	Japan Nuclear Cycle Development Institute formed in 1998 as the successor of PNC
PNC	Power reactor and Nuclear Fuel Development Corporation established in 1967
ISCN	Integrated Support Center for Nuclear Nonproliferation and Nuclear Security, JAEA
EUSECTRA	European Nuclear Security Training Centre

Trend of cooperation

1990-	1996-	2000-
Study and Analyze complex facility <ul style="list-style-type: none"> - Near real time Accountancy - Information system for bulk handling system - Error modeling and data processing for accountancy 	 <ul style="list-style-type: none"> - System design for complex facility - Information system for bulk handling system - Error modeling and data processing for accountancy 	<ul style="list-style-type: none"> - System design for complex facility
Containment and Surveillance (C/S) <ul style="list-style-type: none"> - COSMOS - Optical Fiber Seal verifier for COBRA - Multisensor Monitoring 	 <ul style="list-style-type: none"> - Image processing system - Remote monitoring system in the framework of the International Remote Monitoring Project 	<ul style="list-style-type: none"> - Remote monitoring system in the framework of the International Remote Monitoring Project
Measurement Methods and Techniques	 <ul style="list-style-type: none"> - Volume and mass determination techniques 	<ul style="list-style-type: none"> - Volume and mass determination techniques - High performance trace analysis (HPTA) techniques

-  Nuclear Safeguards
-  Nuclear Security
-  Nuclear Nonproliferation policy and capacity building

Areas and Topics

2006-	2012-	2016-
<ul style="list-style-type: none"> - System design for complex facility 		
<p>C/S and Remote Monitoring</p>		
<ul style="list-style-type: none"> - HPTA - Environmental sample analysis - SIMS/TIMS analysis - Nuclear Forensics - Alternative Nuclear Material (ANM) analysis - Reference Material - Nuclear Material in waste and scrap 	<p>Nuclear safeguards and non-proliferation R & D</p> <ul style="list-style-type: none"> - Safeguards by design - Measurement using Laser - Process monitoring - Environmental sample analysis 	<p>Nuclear safeguards and non-proliferation R & D and Security</p> <ul style="list-style-type: none"> - Detection with neutron interrogation - Nuclear Forensics - Environmental sample analysis - Characterization technique for decontamination of reactors - C/S - Process monitoring
<p>Nuclear nonproliferation policy</p> <ul style="list-style-type: none"> - Information exchange 	<p>Capacity building, for safeguards, security and non-proliferation</p> <ul style="list-style-type: none"> - Curriculum development - Exchange of lecturer - Co-sponsor training - Technical support to third countries 	

Achievement for establishing effective and



Near Real Time Accountancy (NRTA)

- Conceptual Design by JAERI
- Statistical approach was established by EURATOM
- A joint seminar on NRTA

TAME Project

- Tank monitoring project at JRC Ispra (1996-1997)

Support for improving nuclear material accountancy system

Support for improving capability to detect undeclared facility and activity

Support on environmental sample analysis

Network of Analytical Laboratories



JRC Clean Laboratory
Established in 1996;
Measurements at JRC using Cameca 4F-6F SIMS

Joint in 1998
sample



IAEA Safeguards Analytical laboratory (Seibersdorf)
The IAEA began its environmental sampling programme in the mid-1990s.

Joint in 2004
sample



JAEA CLEAR: Clean Laboratory for Environmental Analysis and Research; Established in 2001

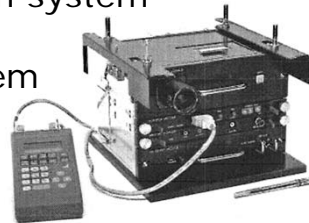
- JRC and JAEA are members of the IAEA Network of Analytical laboratories
- JRC developed Reference Materials for Environmental Sampling (1998-2001)
- Nuclear Signatures Interlaboratory Measurement Evaluation Programme (NUSIMEP@JRC, 1996-present)

Safeguards System

Contribution for advanced Containment and Surveillance (C/S) system

Compact Surveillance and Monitoring System (COSMOS)

- Authorized for inspection use by IAEA in 1993 and 90 systems were procured by IAEA at that time.
- Developed by JAERI under JASPAS (Japan Support Programme for Agency Inspection)
- Built-in battery, recordable for 30000 scenes with SONY 8mm system
- Field Test at JRC Ispra
- Automatic review system



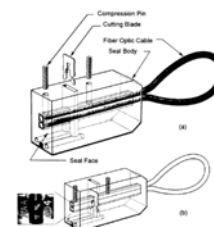
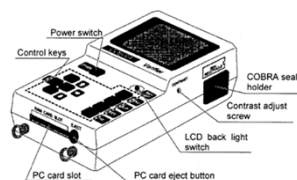
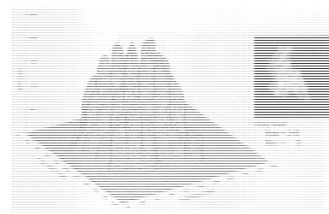
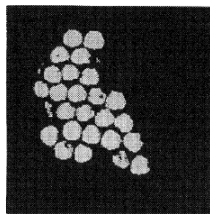
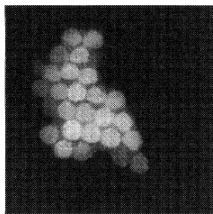
Appendix - The Copy of the Letter from D.E. Roudsquin, Acting Director of SCTSS/IAEA, to M. Hayashi of JNSB concerning the Authorization of Inspection Use for the Compact Surveillance and Monitoring System (COSMOS)



Authorization letter from IAEA

Auto-identified Fiber optical Seal verifier

- Developed under JASPAS
- Digitizing COBRA image
- Pattern recognition and seal integrity judgement



Outcome and recent activities

Neutron Resonance Densitometry

The objective of the project was to develop a non-destructive analysis technique to characterize melted fuel formed in a severe nuclear accident such as the one at Fukushima. The proposed technique - Neutron Resonance Densitometry is a combination of Neutron Resonance Transmission Analysis (NRTA), Neutron Resonance Capture Analysis (NRCA) and/or Prompt Gamma-ray Analysis (PGA). The former two are developed at the GELINA facility of the JRC Geel. A gamma ray spectrometer for NRCA/PGA was developed by the Nuclear Science and Engineering Center of the JAEA. This project (2012-2015), demonstrated the potential of the technique to characterize complex nuclear materials and triggered a new project on development of innovative Non-Destructive Analysis techniques for a broader application field, i.e. security, safeguards and nuclear safety applications. Moreover, the project received one of the most important Atomic Energy Society of Japan awards – 2016 'Award for Distinguished Technology Development'.



Reports on Neutron Resonance Densitometry



Demonstration of NRD performance, Euratom/JAEA Workshop, March 2015



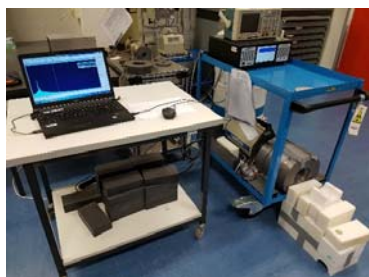
Atomic Energy Society of Japan 2016 Award for Distinguished Technology Development

Other Non-Destructive Assay (NDA) techniques

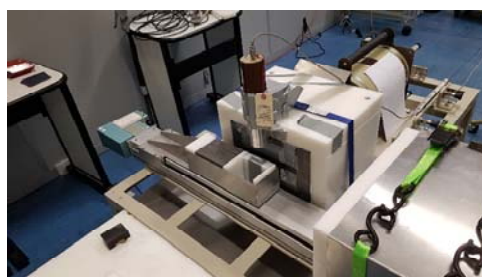
The JAEA and the JRC develop an innovative nuclear instrument that integrates four active NDA techniques to make optimum use of the complementarity between them, taking into account their advantages and limitations.

These active NDA techniques are:

- DDA: Differential Die-Away Analysis
- DGA: Delayed Gamma-ray Analysis
- NRTA: Neutron Resonance Transmission Analysis
- PGA/NRCA: Prompt Gamma-Ray Analysis and Neutron Resonance Capture Analysis.



Optimisation of a HPGe detection set-up in PERLA.



A combination of high and medium gamma-ray energy resolution detector in DGA technique development.



JRC Ispra - Pulsed Neutron Interrogation Test Assembly – PUNITA lab.



JRC Geel – Neutron time-of-flight facility for high-resolution neutron data measurements - GELINA

Experiments on DDA and DGA are being carried out in PERLA and PUNITA labs in JRC Ispra, while the work on NRTA and PGA/NRCA is about to start in JRC Geel using GELINA and MONNET particle accelerators.

Outcome and recent activities

Nuclear Forensics

Nuclear Forensics cooperation was triggered by JRC's long-standing experience in this field. It focusses on the exchange of information on e.g.: national response frameworks, evidence collection and handling, analysis and interpretation, isotopic fingerprinting, and characterization of radioactive material after a dispersion event. Moreover, the 'In-situ Uranium Age Dating Method', developed by the JAEA, was successfully validated by a bi-lateral inter-laboratory analysis. A joint workshop on nuclear forensics signatures was organized and JRC provided support to JAEA in the conception and implementation of a regional training course on nuclear forensics and JRC contributed to the '*International Symposium on Technology Development for Nuclear Security - Focus on Nuclear Forensics and Regional Collaboration*' held in Tokyo. In summary, the cooperation in the nuclear forensics area comprises research topics, training activities and visibility events.



International Symposium on Nuclear Forensics, Tokyo, June 2017



JAEA Regional Training Course on Nuclear Forensics with support of JRC and NSDD, January 2019

Environmental Sample Analysis

Cooperation in environmental sample analysis aims at information exchange in particle analysis and mutual experts' visits to LG-SIMS laboratories at JAEA/CLEAR and JRC/Karlsruhe. In particular, the cooperation includes the comparison of the overall performance of the instruments and improvement of the sample preparation procedures.



CAMECA IMS1300HR3 installed at JAEA/CLEAR



JRC Karlsruhe – LG SIMS

Outcome and recent activities

Capacity Building

JAEA and JRC jointly promote nuclear security and support each other's initiatives in nuclear safeguards, including education and training activities by exchanging experts. For example, JRC repeatedly supported '*International Forum on Peaceful Use of Nuclear Energy, Nuclear Non-Proliferation and Nuclear Security*' organized by the ISCN/JAEA. JRC supports the training course on '*State systems of accounting for and control of nuclear material*' (SSAC), which is organised yearly in Tokai by both JAEA and IAEA and it provides NDA follow up training to SSAC in JRC Ispra for selected trainees. And vice-versa, the JAEA regularly supports the '*ESARDA course on nuclear safeguards and non-proliferation*' held annually in Ispra, Italy.



18th ESARDA Course, April 2019, JRC Ispra



NDA follow up training to SSAC course, JRC Ispra (2016-2020)



ISCN Regional Training Course on Nuclear Forensics, January 2019, JAEA

Future Direction

In the future, the focus will be on the consolidation of the cooperation in nuclear safeguards and security with more innovative projects taking into account the age of digital transformation with aspects such as machine learning and artificial intelligence.

Our cooperation in joint outreach, should be more effective and we are looking together into possibilities to apply the technical developments in safeguards into other areas as e.g. decommissioning.

As shown in the previous pages, we have obtained useful results through our co-operation in the fields of nuclear safeguards and security and thus contributed to the international security and global use of nuclear energy. In the future, it is hoped that we will expand our co-operation to other areas of common interest to be identified through our bilateral discussion.



Mr Yosuke Naoi and Mr Said Abousahl, June 2015, Brussels, Belgium



JAEA-Euratom Steering Committee Meeting, May 2019, Stresa, Italy

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European Commission, Joint Research Centre

Mission:

Provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle



Japan Atomic Energy Agency

Mission:

Contribute to welfare and prosperity of human society through nuclear science and technology