



EU CONTRIBUTIONS TO SAFEGUARDS

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Nuclear safeguards are measures to verify that states do not use nuclear materials to develop weapons and that they respect their obligations under international non-proliferation treaties. The development and implementation of safeguards and other nuclear security technologies is a priority of EU policy.

The European Union, through the European Commission's (EC) science and knowledge service Joint Research Centre (JRC), provides operational analyses to safeguards authorities, carries out research and develops technologies, methodologies and standards for more effective and efficient safeguards addressing different parts of nuclear fuel cycle from enrichment to final disposal.

*The R&D results are transferred to and made operational by both **Euratom Safeguards** and the **International Atomic Energy Agency (IAEA)**.*



SUPPORTING EURATOM SAFEGUARDS

JRC scientific, technical and operational support for Euratom Safeguards is crucial for its ability to draw **annual safeguards conclusions**. The EC's science and knowledge service support activities for Euratom Safeguards include:

- Operating an **on-site laboratory** at the Reprocessing Plant in La Hague (France) **on behalf of Euratom Safeguards**
- Providing analysis of **nuclear inspection samples**
- Metrological quality control tools such as **Certified Reference Materials**
- Tools for **containment and surveillance**
- Tools for **process monitoring**
- Developing equipment for **Non-Destructive Analysis**
- Providing **trainings to Euratom inspectors and test newly developed Operational Technology**, thanks to the JRC unique infrastructure and availability of nuclear material



SUPPORTING THE INTERNATIONAL ATOMIC ENERGY AGENCY

For more than 40 years, the **European Commission Support Programme (EC SP)** provides the technical support to the IAEA in nuclear safeguards. The EC SP activities focus on multiple fields:

- Analysis of **nuclear material and environmental particle samples**
- Development and provision of **reference materials and particles**
- Development of **measurement techniques**
- **Containment, surveillance and sealing/identification** techniques
- Information technologies for **non-proliferation studies**
- **Process monitoring** techniques
- Development of **concepts and approaches**
- **Training of inspectors**



FOSTERING R&D COOPERATION ACROSS THE GLOBE

The JRC has developed an important international network in the field of nuclear safeguards. **R&D cooperation agreements** have been established between Euratom and other partners including:

- **IAEA**
- **Non-EU countries:** US, Japan, China, Canada, Argentina, Australia, South Africa
- **Regional associations worldwide:** Brazilian–Argentine Agency for Accounting and Control of Nuclear Materials, Asia-Pacific Safeguards Network, Australian Safeguards and Non-Proliferation Office, and the European Safeguards Research and Development Association (ESARDA)



CONTRIBUTING TO KNOWLEDGE AND EXPERTISE DISSEMINATION

EU outreach: In specific cases, **JRC safeguards expertise and R&D results** are part of EU outreach activities, funded by the European Commission.

Education: The JRC further contributes with the **delivery of modules and lectures** to the ESARDA course on safeguards and non-proliferation, to the first level specializing Master on Nuclear Safeguards, and directly engages with pupils at schools.



STRENGTHENING INTERNATIONAL NUCLEAR DISARMAMENT VERIFICATION

Participation in International Partnership for Nuclear Disarmament Verification: The JRC, through its participation in the International Partnership for Nuclear Disarmament Verification (IPNDV), **supports international efforts to develop potential procedures and technologies for disarmament verification.**

Sound verification technologies: JRC research addresses potential verification technologies such as Passive Neutron Counting; Pulsed Neutron Interrogation; Calorimetry; 3D Lasers for Design Information Verification; 3D Lasers for identification, authentication, and containment; 3D surveillance; Tamper indicating seals and enclosures.

For **analysis of nuclear material and environmental particle samples**, the JRC uses a number of Analytical Techniques accredited by ISO 17025 e.g.: Hybrid K-Edge Assay; Calorimetry; High Resolution Gamma Spectrometry; Mass spectrometric methods (thermal ionisation, secondary ion, Inductively Coupled Plasma).

The **on-site laboratory at La Hague Reprocessing Plant** provides independent verification of the nuclear material accountancy by analytical measurement of samples taken at key measurement points using radiometric assay, chemistry, and mass spectrometry to the highest quality standards.

The JRC is one of the major developers and accredited (ISO17034) producers of **reference materials** in the world. Reference materials are reliable quality assurance tools that provide confidence in measurement results. They play a key role in the calibration of laboratory instruments, for validation of analytical methods and in quality control.

Inter-laboratory Comparisons, so called **proficiency testing**, is organized to check the ability of a laboratory to deliver accurate testing results. The JRC, as accredited proficiency testing provider (ISO17043), plays a central role in organising nuclear inter-laboratory comparison programmes in support to European and international non-proliferation.

JRC operates **Pulsed neutron facility (PUNITA)** for research in Non-Destructive Analysis methods and instrumentation for applications in nuclear safeguards and security.

PUNITA can be used e.g. for mass determination of small fissile quantities through detection of prompt fission neutrons and for the U / Pu ratio through detection of delayed neutrons.

JRC develops **IT tools for safeguards applications** as e.g. VideoZoom for surveillance stream reviews. VideoZoom uses image summaries and a zooming interface to enable the inspector's ability to detect safeguards-relevant events, whether typical or anomalies. Inspectors see image details or context information on-demand.

Mobile Laser Scanning Platform (MLSP) is one of several JRC laser developments. It is used for fast and accurate 3D mapping and indoor localization. When a historical scan is available, the MLSP allows automatic change analysis/progress monitoring. MLSP works in outdoor and indoor environments. In addition, it can be used for material volume measurement in support of Physical Inventory Verification activities.

JRC develops a variety of **sealing technologies and delivers related trainings to safeguards inspectors**. One of more recent developments, Operator Applied and Removed Seal (OARS) for transport casks (Encapsulation Plant & Geological Repository), uses sealing bolt spring equipped with an internal optical fiber connected to an electronic active monitoring device. It senses when the bolt is correctly torqued and monitors all the closing and opening parameters.