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# THE EURATOM SAFEGUARDS SYSTEM

In 1957, six European countries had established the European Atomic Energy Community (EURATOM). The task of the Community, in accordance with art. 1 of the Euratom Treaty, is "to contribute to the raising of the standard of living in the Member States and to the development of relations with the other countries by creating the conditions necessary for the speedy establishment and growth of nuclear industries".

The Treaty contains Chapter VII, Safeguards, by which the first multinational nuclear safeguards system was established. Thus, the signatory states handed over the controls for nuclear safeguards within its own territory to the Community executive body, the Commission. The Commission, therefore, has the right to control stocks and flow of fissile material within the territory of the Member States. However, if an infraction of safeguards is detected law enforcement measures remain the task of the individual member countries. On January 1st 1973 the Community was enlarged by three New Member States, all of whom accepted these safeguard measures as full members of Euratom.

## Application of Safeguards in the Fuel Cycle within the Community

The Euratom safeguard system has been in operation for almost twenty years during which time it has proved its effectiveness. Its task is to verify non-diversion, and to maintain control over the use to which nuclear material is put for all non-military purposes.

Euratom safeguards apply not only to all civil nuclear materials in the Member States of the European Community but also to equipment and non nuclear materials for use in nuclear installations supplied by separate agreements with third countries, if such agreement so require.

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In contrast with the situation in almost all other parts of the world, the Community has nuclear installations of practically all types, gas graphite reactors, light-water reactors, research and experimental reactors, high-temperature gas reactors, fast reactors and the related enrichment, fabrication and reprocessing facilities. They use natural, slightly-enriched and highly enriched uranium and plutonium. In terms of numbers of installations, in 1976 there were in the Community:

35 preparation and fabrication plants

71 power reactors

117 research reactors

13 reprocessing plants

211 research centres, laboratories, stores, enrichment plants, others.

To give some idea of the extent of nuclear activity within the Community in 1976, the number of movements of fissile material among nuclear plants in the Community were as follows:

5.000 for material less than 1 kg of weight

8.000 for material more than 1 kg of weight.

The number of nuclear packages imported in the same period amounted to 568; the number of exports to 508.

The figures give an idea of the importance and complexity of nuclear activities in the Community to which the Euratom inspectors have been applying a detailed and efficient system of safeguards since 1959.

The Euratom Safeguards Department has 115 staff members of whom about 60 are safeguards inspectors, drawn from all nine Member States of the Community. They are permanent European civil servants and are therefore responsible towards the Commission and not towards their country of origin.

With regard to accountancy, about 20.000 entry lines are processed per month from the 450 installations. Electronic data processing has been adopted and the computerized system has reduced the effort for book-keeping and checking very considerably. Inconsistencies are automatically detected. The controls effected by Euratom are based on declarations made by each operator on the amount and quality (enrichment) of the nuclear material being moved from plan to plan in dynamic flow as well as static (inventory) conditions. Fissile material is measured at the time of entry and exit. Inventories are taken periodically and declared by the operators: the declarations and the measurement systems of the operators are checked one against the other by the Euratom control department.

In order to save as much as possible on inspection effort, full account is taken of the fact that each installation is linked with a preceding and a subsequent installation within the cycle.

In the course of inspection special attention is paid to plutonium and highly enriched uranium at points in the fuel cycle where transformations involve possible losses of material, such as fuel element fabrication plants or where some uncertainty in the amount of material assessed may still exist, such as reprocessing facilities.

To give a better understanding of the way in which safeguards are applied, an example is given of the procedure followed in a generic plant for fuel element fabrication.

## Flow verification

### Receipts:

The verification of the input material is done by non-destructive techniques or by taking samples for analysis at the same time that commercial samples are taken, and by weighing. Quite often the verification of the material has been made at the dispatching installation. In this case the shipping containers are sealed before dispatch and at the receiving plant only checks on seals are carried out.

### Dispatches:

If the plant proceeds to undertake destructive analysis and weight or volume measurements of material before the final stage of the fabrication, a direct check of those measurements is performed by the Safeguards Inspectors.

If the plant proceeds to undertake measurements of material content in the finished fuel by non-destructive assay (NDA) techniques, the precision and accuracy of measurement is verified by use of reference materials relating to the production. Special attention is given to the preparation of these reference materials which must comply with the requirements of the Safeguards Authorities and also be recognized by the plant operators as reference elements representative of the production.

In cases where the plant does not proceed to undertake NDA measurements and the use of these techniques is possible, this verification is carried out by the Safeguard Authorities using their own equipment and their own reference standards.

### Waste:

In this case NDA techniques are used by the plant and checked by the Safeguards Directorate against calibration curves.

## Taking of the inventory

The date and the procedure for taking the inventory, which is done at least once or twice a year depending on the amount and quality of material held, have to be declared by the operators. To give the Safeguards Directorate the possibility of carrying out its verification, a physical inventory list is made available to the Safeguards Directorate. This list serves as a basis for preparing the overall plan of the verification including sampling plans and the use of NDA equipment.

Safeguards Directorate NDA Instruments

In order to increase the efficiency of the verifications, Euratom inspectors are increasingly making use of NDA techniques. To this effect Safeguards Directorate equipment has been installed in several plants and, when appropriate, portable instruments are taken and used by the inspectors. To give some examples:

- Gamma scanners equipped with NaI and Ge (Li) detectors connected to analysers and minicomputers, have been installed in fabrication plants and are used to measure fuel elements and plates of enriched uranium and plutonium pins.
- A "Random Driver" is used for active or passive neutron measurements of uranium and plutonium scraps.
- An instrument, based on neutron interrogation, has been installed in a fabrication plant to measure HTR fuel pebbles.
- Portable 256-channel analysers and Sam 2 equipment are used to measure different material quantities through their emission of gammas and neutrons.
- Neutron coincidence counters for the control of plutonium scraps and mixed U-Pu pins are in some cases installed in the plants, others are brought into the plants by a specially equipped carrier which is also the property of the Safeguards Directorate.
- A minicomputer is used in particular to verify the physical inventory taken by the plant operators.

It is clear that for the application of safeguards, the choice of points in the fuel cycle, the selection of points in the plants, the type of instrumentation most suitable for each application, require thorough analysis of the fuel cycle in general and its components, careful study of the equipment required in each case, selection of techniques to be used, etc.

For every situation, the effectiveness and accuracy of safeguards must be assured, while keeping costs and burdens for the operator to a minimum.
A programme of R and D has been developed by the Commission's Joint Research Centre together with special support activities designed to solve specific cases which may be encountered by the Safeguards Directorate during its normal safeguards activities.

EURATOM - AEA Agreement

In April 1973, the Community, seven of its Member States and the IAEA signed a safeguards agreement pursuant to the Treaty on the Non-Proliferation of Nuclear Weapons. This agreement, meantime is in force and the Euratom and IAEA Safeguards organizations are engaged in an exercise with the aims of harmonizing their activities in such a way that the duties and responsibilities of each can be faithfully carried out.

Under this Agreement the inventory of nuclear materials in the signatory Member States as of the 28th February 1977 has been transmitted to IAEA, which is now regularly informed of all nuclear material stocks and movements into and out of installations in these States. Many inspections by IAEA for verification of the initial inventory and for design information verification have been carried out since then at the same time as Euratom inspections are being performed. Studies are being made based on the knowledge and experience of Euratom in applying safeguards at their facilities to determine the optimum techniques and procedures for future routine application. Confidence exists that an efficient method of working together between the Community and third countries in nuclear safeguards can be achieved.