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COMMISSION OF THE EUROPEAN COMMUNITIES

Brussels, 11.2.2009  
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**COMMISSION RECOMMENDATION**

**of 11.2.2009**

**on the implementation of a Nuclear Material Accountancy and Control system by  
operators of nuclear installations**

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### on the implementation of a Nuclear Material Accountancy and Control system by operators of nuclear installations

THE COMMISSION OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Atomic Energy Community, and in particular Article 77 and Article 124 thereof,

- (1) Whereas Commission Regulation (Euratom) No 302/2005 of 8 February 2005 on the application of Euratom safeguards<sup>1</sup> defined the nature and extent of the requirements provided for in Article 79 of the Euratom Treaty in order to permit accounting for ores, source materials and special fissile materials used or produced.
- (2) Whereas Article 7 of Regulation (Euratom) No 302/2005 requires nuclear operators to maintain a system of accountancy and control for nuclear materials, and sets out some requirements for such a system.
- (3) Whereas the Commission working document entitled “Implementing Euratom Treaty Safeguards” (IETS)<sup>2</sup>, contains the requirement that the Commission draw up a reference framework for high-quality nuclear material accountancy and control (NMAC) systems. It also states that auditing of nuclear operators’ NMAC systems will be one of the Commission’s supervisory activities.
- (4) Whereas the European Safeguards Research and Development Association (ESARDA) presented in 2007 a Guideline for Good Practice in Nuclear Materials Accountancy and Control Systems dealing with the elements of the NMAC system that could be audited and the possible criteria for indicating quality performance in each of these elements.

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<sup>1</sup> OJ L 54 ,28.2.2005,p.1.

<sup>2</sup> SEC (2007) 293

HEREBY RECOMMENDS:

## **Section 1 Purpose and Scope**

This Recommendation describes the reference characteristics of an operator's NMAC system complying with the legal obligations of Regulation (Euratom) No 302/2005. Some characteristics described in this Recommendation are only relevant to facilities with corresponding activities<sup>3</sup>.

## **Section 2 Terms and Definitions**

- (1) “*Containment*” is a structural feature of a facility, container or equipment which is used to establish the physical integrity of an area or item (including safeguards equipment or data) and to maintain the continuity of knowledge of the area or item by preventing undetected access to, or movement of, nuclear or other material, or interference with the contained items. Examples are the walls of a storage room or of a storage pool, transport flasks and storage containers.
- (2) “*Corrective action*” means action to eliminate the cause of a detected NMAC discrepancy, anomaly or other undesirable situation. Corrective action is taken to prevent recurrence. There is a distinction between correction and corrective action.
- (3) “*Data processing*” is the link between the creation of measurement results and material-tracking data and the production of a variety of regulatory reports, documents supporting Euratom verification and internal working documents related to material tracking by the facility itself.
- (4) “*Inventory control*” by the nuclear operator is a quality control programme aimed at ensuring agreement between records and the physical situation in a timely manner. Inventory control should include resolving and reporting on found discrepancies as well as reconciliation with other local accounts and central accounts.
- (5) The “*List of Inventory Items*” (LII) is a complete list of nuclear material (NM) items in a material balance area (MBA) or a specified location within an MBA produced as a result of applying an installation procedure. The list may include material that is handled as a batch. The list should include the identities and locations of the items or batches. The mass values and other characteristics of the items or batches should be traceable.
- (6) “*Material balance test*” means the method for assessing the material balance value; taking into account the justified estimation of measurement uncertainty, the balance test will decide whether the balance is acceptable or not.
- (7) “*Material balance discrepancy*” means a material balance value which is not accepted by the material balance test.
- (8) “*Measurement*” means the activity to determine the quantity and the characterisation of accounted nuclear material.

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<sup>3</sup> The references to measurement and material balance testing will be irrelevant in an item facility which involves no measurement.

- (9) “*Nuclear material accountancy and control*” (NMAC) means all activities in a nuclear installation concerning the accountancy and control of nuclear material, including the determination and processing of data and the reporting to the Commission.
- (10) “*NMAC discrepancy*” means any discrepancy between two or more pieces of NMAC information (e.g. records) where this discrepancy cannot be justified after taking account of legitimate measurement variation or legitimate uncertainty estimation. NMAC discrepancies include measurement discrepancies, material balance discrepancies and nuclear material control discrepancies.
- (11) “*NMAC anomaly*” is an NMAC discrepancy or series of discrepancies that are consistent with the absence or gain of a significant amount of nuclear material. An NMAC anomaly can be detected during an investigation of NMAC discrepancies of whatever kind.
- (12) “*Nuclear material control discrepancy*” means a non-conformance in the identification or location of nuclear material.
- (13) “*Nuclear material tracking*” means the documentation of the identification, the movements, the location and the basic characteristics of every item of nuclear material in the MBA. In particular, tracking includes operating records that are the basis for re-batching, new measurement, shipper-receiver difference and category change declarations.
- (14) “*Nuclear operator*” means a person or undertaking setting up or operating an installation for the production, separation, reprocessing, storage or other use of source material or special fissile material. The term is also used to refer to the organisation ultimately responsible for NMAC compliance with Regulation (Euratom) No 302/2005.
- (15) “*Performance indicator*” means a leading indicator of attainment achieved by an individual, team, organisation or an action.
- (16) “*Physical Inventory Taking*” (PIT) means the process to produce a complete list of the nuclear material items for an MBA as a basis for allowing verification of physical inventory by Commission inspectors.
- (17) “*Physical Inventory Verification*” (PIV) means an inspection activity that verifies the validity of the operator’s physical inventory taking and closes the material balance period. The basis for a PIV is the list of inventory items (LII) drawn up by the operator. The LII data are correlated with the physical inventory listing reports.
- (18) “*Quality Control*” (QC) means a control designed to ensure that the quality requirements are fulfilled.
- (19) “*Quality Management System*” means coordinated activities to direct and control an organisation with regard to quality.
- (20) “*Quality Assurance*” (QA) means the part of the Quality Management System focused on providing confidence regarding fulfilment of the quality requirements.

- (21) “*Traceability*” means the ability to trace the history, application or location of that which is under consideration.

### **Section 3 The Management of an NMAC System**

#### Organisation and Responsibilities

1. Senior management should ensure that responsibilities and authorities are defined and communicated within the organisation. A member of the management should be appointed who, irrespective of other responsibilities, should have responsibility for annually assuring the chief executive officer, in writing, that the entire NMAC system is fit for purpose.
2. Management roles and responsibilities taken together should also comprise organisational procedures and communication patterns that:
  - (a) Transmit information about NMAC performance both hierarchically and across functional responsibility areas.
  - (b) Assign responsibilities for improvement of NMAC as required based on criteria for recognising when improvement is needed.
  - (c) Provide the NMAC Manager with NMAC anomalies information.
  - (d) Ensure staff involved in NMAC activities have the appropriate competences.
  - (e) Ensure appropriate awareness of the legal obligations concerning safeguards.

#### Quality Management and Control

3. The key tasks should incorporate quality assurance and quality control measures. The objectives of these measures should include:
  - (a) Reduction of the intrinsic risk of human errors.
  - (b) Ensuring the correct functioning of instrumentation and software.
  - (c) Provision of a variety of indicators designed to alert management to any sign of inadequate performance (performance indicators).
  - (d) Internal assessment in order to detect poor performance.
  - (e) A corrective action mechanism for cases of poor performance.

## Section 4 Measurement and Measurement Control

### Measurement Programme

1. Where measurements are performed, a programme should be established for providing sufficiently accurate and precise quantification and characterisation of the material that has to be referred to in accounting declarations. The measurement activities should be conducted so as to have traceability in the event of investigation of an anomaly. Measurement activities should include the measurement of material but also the processes whereby measured material is selected as representative of a set of material and all subsequent treatment of this sample material (sampling, sample shipment and preparation) and the required data treatment processes. It also should include measurement activities required for measurement control and quality assurance.

### Accountancy Data Requirements

2. In order to ensure appropriate performance of the measurements, the following should be taken into account:
  - (a) Validation of the applied measurements methods.
  - (b) Traceability of measurement results.
  - (c) Precision and accuracy.
  - (d) That each measurement result is approved by a responsible person.
  - (e) That sampling is representative of the material.
3. In cases where accounting data are based on calculations that are not direct measurements, the values should be validated, traceable and approved. Similar requirements apply to item counting.

### Measurement Control

4. A measurement control programme should be in place in order to ensure the validity of the measurement results and their uncertainties used for accountancy declarations.
5. The measurement control programme should include:
  - (a) Measures to ensure that the instrumentation is performing as required.
  - (b) Assurance that accountancy mass values are free from any significant measurement bias and that the measurement uncertainty is appropriately estimated.
  - (c) Records of all data of the measurement control programme.
  - (d) Description of the measurement equipment and methods.
  - (e) Approval of the measurement procedures.

## Section 5 Nuclear Material Tracking

1. The nuclear material tracking should document any movement of and the location of every item of nuclear material. It also should imply knowledge of the characteristics of the material and its containment. Any action involving nuclear material that affects the location, the identification, the nature or the quantity of the nuclear material should be documented. In particular, nuclear material tracking should include records that are the basis for re-batching, new measurement, shipper-receiver difference and category change declarations.

### Identity

2. Nuclear material should, where practical, be in containers having a recorded unique identity. When nuclear material is not in a transportable container, a well delimited process location may be considered both as the identity of the 'container' and as the location of the container/material. This includes material in process vessels or other equipment. Identities of containers should be permanent and readily legible for inventory checking. If the identity of the item needs to be changed, the link between old and new identities should be recorded. If nuclear material is in some form of double containment, the nature and characteristics of the material in any container or location should be traceable through identification control.

### Identification of Storage Location

3. The locations in which nuclear material can be held should have identities that are a basis for recording the location and transfers of material. Specific positions within areas should be mentioned, where appropriate, as part of the specification of the exact location. The records for storage control should ensure that the identities of the contents of each storage location are known and that the location of any identified item can be derived. The nature and characteristics of the material in any location should be available through identification control or other means.

### Material Tracking during Production

4. When nuclear material enters a process (or is repackaged), the production records should allow identification of the items from which the material has been fed into the process (or into new containers). This is intended to provide traceability of the relevant nuclear characteristics of the material in process.

Production records should specify the amount of material fed into the process or repackaged and, as mentioned, traceability of information related to the nature of the nuclear material should be maintained.

When new items or sets of material arise as a result of processing or repackaging, mass values and identities should be established for these items and their identity should be linked to the relevant mass results and measurement history.



## Inventory Control

5. Inventory control by the nuclear operator should:
- (a) Ensure that all nuclear material transfers from stores to process areas and vice versa are recorded (Key Measurement Points, KMP).
  - (b) Verify regularly that stock records correspond to KMP flow records, storage location records and processing records, and regularly reconcile local records and central MBA records.
  - (c) Take into account the operating records of the inventory control measures that ensure continuity of knowledge about the nuclear material contents of items.
  - (d) Regularly check the agreement between the information of material present and the physical reality.
  - (e) Resolve and report on found discrepancies and reconciliation with other local accounts or central accounts.

In the event of a transfer of nuclear material that is not a transfer of a contained item, the amount of the transfer material should be measured.

## Management of Discrepancies

6. The installation should have an approach that recognises and investigates NMAC discrepancies, and documents their treatment. The approach should:
- (a) Indicate for each discrepancy type the investigative actions to be taken and the conditions in each case that are considered to resolve the discrepancy. Actions to be taken should include personnel responsibilities and the additional data to be employed.
  - (b) Make the appropriate correction of records and regulatory declarations when a discrepancy has been resolved.
  - (c) Record when a discrepancy remains unresolved and the action taken to resolve it.

## Management of Anomalies

7. The installation should have an approach in place that corresponds to the reporting obligations under Article 6 and Article 14 (Special reports) of Regulation (Euratom) No 302/2005. In addition to the management of discrepancies described in point 6 of Section 5 of this Recommendation, the approach should:
- (a) Recognise, investigate and document the treatment of NMAC anomalies corresponding to Article 15(a) of Regulation (Euratom) No 302/2005. Such NMAC investigations should aim to establish in a timely manner the accountancy evidence showing that all material is accounted for.

- (b) Recognise, investigate and document the treatment of other situations corresponding to Article 15(b) of Regulation (Euratom) No 302/2005.
- (c) Define personnel responsibilities and the form of internal communication required when actions under Article 15(a) or (b) of Regulation (Euratom) No 302/2005 are required. The approach should also define the mechanisms under which the personnel will inform the Commission.
- (d) Define personnel responsibilities and authority in order to provide “further details or explanations” when requested under Article 14 of Regulation (Euratom) No 302/2005.

## **Section 6 Data Processing and Control**

1. A data-processing system should be implemented producing:
  - (a) Safe and secure storage of all data required for the proper working of the NMAC system.
  - (b) Declarations required by Regulation (Euratom) No 302/2005 (inventory change reports, material balance reports, physical inventory listings, special reports, advanced notifications).
  - (c) Material balance standard deviation for material balance tests (if appropriate).
  - (d) Various types of documents linked to inventory change (IC) declarations such as shipping documentation.
  - (e) Working documents for routine inventory control.
  - (f) Working documents for PIT.
  - (g) A list of inventory items (LII) resulting from PIT and used during PIV or other verification.
2. Data-processing procedures should be in place to correct records and generate correction declarations as appropriate for any situation where a discrepancy has been detected. Traceability should be maintained during such correction processes. Quality control and quality assurance measures should ensure the completeness and the correctness of the data processing system.
3. The data-processing capabilities should also include:
  - (a) Provision of inventory lists permitting inventory checking by the operator.
  - (b) Inventory lists providing any information necessary for identifying discrepancies between the locations described in the records and the real physical location.
  - (c) Support of regular reconciliation of local records and central MBA records, when the accountancy of nuclear material in process involves separate storage of these records.

- (d) The possibility of including corrections arising from discrepancy investigation for inventory checking and reconciliation.
  - (e) Documentation of the results of inventory checking and database reconciliation, including documentation of discrepancies encountered for the purpose of performance indicators.
4. The procedures for data-processing execution activities should provide the NMAC system manager with supervisory information. This should include the staff members initiating each software execution, identification of the application program(s) involved as well as identification of the location of the data inputs used and the location of the data outputs created. It should also be possible to identify any execution of application software or access to records and data which do not conform to the authorised data processing policy.

#### Traceability

5. The data processing system should produce the information required by Regulation (Euratom) No 302/2005 and also maintain traceability for all the information provided. It should be possible to identify any information or data that could be needed to resolve discrepancies and anomalies arising from the requirements of Regulation (Euratom) No 302/2005.

### **Section 7     Material Balance**

#### Receipts and Shipments

1. Nuclear operators should apply reception procedures including:
- (a) Check of shipper information (completeness, self-consistency).
  - (b) Check of the nature, identity and integrity of the transport container and seals and initial check on the nature of nuclear material (when appropriate).
  - (c) Introduction of the received material into the accountancy process.
  - (d) Recognition and treatment of shipper-receiver differences.
  - (e) Corrective actions in the event of discrepancies.
  - (f) Recording in a manner that guarantees traceability.
  - (g) Ensuring that the obligations laid down in Articles 21 and 22 of Regulation (Euratom) No 302/2005 are respected.
2. Nuclear operators should apply shipping procedures defining:
- (a) The content of the information being sent to the recipient.
  - (b) How the accountancy should be updated.
  - (c) Corrective actions and the appropriate response to situations of discrepancy indicated by the recipient.

- (d) The preparation and execution of the shipment process.
- (e) Recordkeeping in a manner that guarantees traceability.
- (f) Activities to ensure that the obligations laid down in Articles 21 and 22 of Regulation (Euratom) No 302/2005 are respected.

#### Physical Inventory Taking (PIT)

3. A physical inventory of each MBA should be taken every calendar year and the period between two successive physical inventory takings should not exceed 14 months. The PIT procedures should include those for reporting to the Commission and providing the list of inventory items for physical inventory verifications (PIV). In particular, nuclear operators should have PIT procedures taking account of the following needs:
- (a) Definition of PIT working methods and responsibilities for each storage area and process area.
  - (b) Establishment of a reliable itemised list of all the material in each location of the MBA. Such procedures should be designed to ensure that no material is overlooked.
  - (c) The execution of the physical inventory taking needs to be recorded.
  - (d) If there are PIT activities involving physical checks (tag-check or measurement), the procedures should include rules for defining the necessary corrections to the information in the data-processing systems (when discrepancies are found) as well as rules for transmitting such corrections to the data-processing department.
  - (e) The MBA list of inventory items presented to Commission inspectors as a basis for PIV should be authenticated by the signature of a responsible person before being handed over.
  - (f) In a PIT approach for a storage area relying entirely on transfer records, the credibility of the approach should be enhanced by having:
    - (i) QC and QA provisions for the creation of records of transfers.
    - (ii) QC and QA measures ensuring reliable records of storage locations.
    - (iii) Routine recording of the fact that these QA and QC provisions and measures have been carried out.
    - (iv) Assurance of material integrity during presence within the area.
    - (v) Independent confirmation that transfer records are complete.

4. The list of inventory items for formal verification purposes should include for each item:
  - (a) Location and storage position within location.
  - (b) Type of container and identity of container (if relevant).
  - (c) Material type.
  - (d) Mass of nuclear material per item (gross, tare and net weight).
  - (e) Enrichment of uranium.
  - (f) Isotopic composition of plutonium (if available).

The list of inventory items should include entries for material that is difficult to measure either due to its location (process vessel hold-up) or because it is in a form unsuitable for measurement. In such cases, the operator should declare an estimated range of mass for each item and traceability should provide the link to the data used for the estimate. Mass estimates for material that is inaccessible or in process vessels should include the location of the material. The mass values for measured discards, accidental losses and transfers to waste should have a traceable history.

#### Material Balance Tests

5. In an MBA involving processing or re-measurement, the material balance derived from a PIT, and also the process area material balances forming part of an inventory control approach, should be tested for acceptance using balance standard deviations that take into account justified measurement uncertainty and in the case of estimated amounts, the process and measurement uncertainty. These tests should be an integral part of the QA system.

The procedures for any balance test should take into account the following:

- (a) Software for computing the standard deviation of any balance should come under the quality approach for software and its use.
- (b) Accountancy and measurement method data used for computing the standard deviation of any balance should come under the quality approach for data and its use.
- (c) The algorithms used to compute standard deviation should be described in a technical document.
- (d) The method should provide balance standard deviations which correctly reflect the pattern of processing during the balance interval and which also correctly reflect the measurement history (or estimation method) of the mass values used to compute the balance.
- (e) Where estimates of in-process material are based on historical information or on modelling of some kind, the estimation method and the method of establishing the uncertainty should be described in a technical document.

- (f) The work procedures for balance testing, the software user guide, the software description and the technical method documents should be written in such a manner that their completeness and mutual consistency can be recognised.

This Recommendation is addressed to the Member States.

Done at Brussels, 11.2.2009.

*For the Commission*  
*Andris PIEBALGS*  
*Member of the Commission*

