

COGNMAS2

Define and deploy approved nuclear material measurement capability



Overview

This NOS forms part of a suite of standards which cover the activities carried out by individuals working within and on behalf of nuclear site licensed companies to meet nuclear material accountancy, control and safeguard (**NMAS**) requirements.

What is the NOS about?

A nuclear licensed site must ensure that nuclear materials are accounted for, controlled and safeguarded in order to demonstrate; good governance arrangements; meeting international safeguards commitments; and compliance with legal requirements and any voluntary undertakings. This NOS describes the standard expected of individuals who are responsible for provision of an adequate measurement capability used by the NMAS system.

Who is the NOS for?

This NOS is primarily for NMAS Managers and Technical Specialists within the nuclear site licence companies who are responsible for managing compliance with NMAS requirements for determining nuclear material content of materials at a project, site, and organisational level.

The main outcome of this activity is an established nuclear material measurement capability.

Where text is highlighted in bold, it is more fully defined in the Glossary section of this NOS.

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Performance criteria

You must be able to:

- P1 identify and review the sampling and measurement requirements for NMAS.
- P2 develop strategy, policies and procedures for nuclear materials measurement in line with **NMAS requirements** and security requirements for the protection of nuclear materials and detection of theft
- P3 identify the appropriate **capability requirements** for each NMAS accountancy area
- P4 identify suitable measurement capability to meet requirements for:
 - P4.1. routine nuclear material measurements
 - P4.2. confirming empty containers
 - P4.3. confirming the presence of trace levels of nuclear materials
 - P4.4. confirming appropriate levels of material held up in process
 - P4.5. independent direct measurement/sampling by safeguards inspectorates
 - P4.6. mass assignments which will not be derived from direct measurement
- P5 develop suitable arrangements to ensure **measurement integrity and authenticity**, and to prevent, detect and recover from measurement failure
- P6 develop suitable arrangements for **quality control** and traceability of nuclear measurement
- P7 ensure **sampling arrangements** are appropriate, representative and repeatable
- P8 monitor measurement benchmarks, good practice, **deficiencies** and risks, and respond to opportunities for improvement, learning from experience and knowledge exchange with other operators
- P9 provide automated data capture and transfer to the NMAS accounts where appropriate
- P10 ensure NMAS measurement provision is not deliberately biased pessimistic, as is the case for safety considerations
- P11 define Commissioning requirements and the level of integration of safeguards equipment required

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Knowledge and understanding

You need to know and understand:

- K1 **general metrology, measurement systems, calibration systems and measurement terminology**
- K2 **sampling, analysis and measurement requirements** and techniques (destructive and non-destructive) available or under development, their tolerances, capabilities, precision and accuracy and ease of adoption and integration in the **process**
- K3 systems of measurement control and quality assurance, traceability and tamper proofing
- K4 the **process context and relevant process control features of possible use to NMAS**
- K5 the systems appropriate for the relevant fuel cycle area and materials, measurement good practice and available measurement experience and resources
- K6 **safeguards by design** and provisions for deploying independent safeguards equipment or **branching** from operator's equipment
- K7 the material balance and key measurement points incorporated in the design and the associated measurement requirements and NMAS capability requirements
- K8 the requirements for risk analysis and operability assessments
- K9 limitations on direct measurement of heterogeneous materials and materials with complex matrices and the associated methods for assigning mass values
- K10 research and development arrangements for developing new measurement systems
- K11 measurement uncertainty determination and application of correction factors (e.g. **buoyancy**)
- K12 measurement systems modelling and error propagation to forecast the overall material balance performance
- K13 commissioning requirements documentation

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Additional Information

Glossary

Branching: is an independent off-take from operating equipment used for regulatory verification.

Buoyancy: describes atmospheric and environmental conditions which affect the accuracy of measurement equipment.

Calibration Systems: includes calibration procedures, methods, processes and practices, control of the calibration environment and manual and automatic systems.

Capability Requirements: including:

- 1 inventory and flow measurements
- 2 precision and accuracy specifications
- 3 identification of which measurements have most impact on the accountancy material balance
- 4 measurement techniques

Deficiencies: are shortcomings in performance or capability which put the NMAS system at risk. These vulnerabilities include for example:-

- 1 insufficient protection of NMA data against falsification or loss of classified data
- 2 unreliable or inadequate measurement systems subject to frequent failure, bias, or intolerable uncertainties.

International Target Values: are issued under the auspices of the IAEA as document STR368 set out expected values for random and systematic measurement uncertainty components for destructive analysis (DA) and non-destructive assay (NDA) measurements performed on nuclear material.

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General Metrology: includes SI units, factors and fundamental constants, types of measurement and standards, traceability and measurement terminology.

Measurement Integrity: includes: measurement resilience, reliability and repeatability, the need for primary and secondary measurement systems, and equipment redundancy

Measurement Systems: includes measurement methods, characteristics, systems and capabilities, measurement records, primary error sources and measurement assurance.

Measurement Terminology: used in measurement systems includes bias, linearity, stability, accuracy, repeatability, discrimination, resolution, reproducibility etc.

NMAS: is taken to include nuclear materials accountancy, nuclear materials control and nuclear material safeguards.

NMAS requirements: comprise mandatory requirements set down in binding legal contracts, set, set down in UK policy and commitments, and set down in national and international Treaties and Regulations (particularly the safeguards reporting regulations and associated implementation guidelines). They also include optional requirements to which the site voluntarily subscribes.

Process Context: includes the plant design, the measurement envelope, the physical and chemical properties of materials in the plant flow-sheet, the ionising radiation environment, measurement system maintenance and eventual decommissioning policy and the plant operating parameters and expected throughputs.

Quality control: includes performance monitoring and testing, consistency checks, process controls, quality assurance measurements, record keeping, and where appropriate, measures to protect from unauthorised tampering or to prevent measurement systems being bypassed.

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Safeguards by design: is an approach to the design and construction of nuclear plant or equipment in which nuclear safeguards provisions and features are designed into the plant, system or equipment from the very beginning of the design process.

Sampling, analysis and measurement requirements: including legal and regulatory requirements and any voluntary undertakings concerning certification, accreditation, reference materials, ISO standards, and **International Target Values**. Requirements include equipment systems used for nuclear material mass determination and for nuclear material control

Sampling arrangements: including: homogeneity, sample size, sub sampling, sample preparation, transfer, analysis, retention, and sample disposal.

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