

# COGNMAS4

## Carry out nuclear material measurement system analysis



### 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 analysing the impact of measurement uncertainty on the NMAS system.

Who is the NOS for?

This NOS is primarily for Technical Specialists. It may also be applicable to NMAS managers and associated Line Managers within nuclear site licence companies who are responsible for managing compliance with NMAS requirements for analysing the impact of measurement performance on the accounting capability at a plant or site level.

The main outcome of this activity is mass balance capability derived from measurement uncertainty in order to establish the benchmark for nuclear material accounting performance.

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 establish all mass contributions from direct or indirect **measurements** used by the **NMAS** system
- P2 identify significance of individual measurement points on mass balance
- P3 identify bias trends and measurement drift/deterioration and recommend measures to eliminate or account for them
- P4 identify overall measurement uncertainty for an accountancy area or group of accountancy areas taking into account correlations
- P5 analyse a system of interrelated measurements for apparent material loss (e.g. across a suite of chemical tanks)
- P6 determine random and systematic error components of all mass balance contributors
- P7 determine the repeatability and reproducibility of the measurement system
- P8 obtain the necessary flow and inventory data to carry out the uncertainty analysis
- P9 identify and exclude from overall uncertainty calculations any correlated uncertainties
- P10 identify warning and action levels for mass balance performance based on overall measurement uncertainty
- P11 carry out mass balance significance tests for **anomalies** and follow alarm procedures where appropriate
- P12 produce and communicate the results of a **measurement system** analysis
- P13 advise an investigation; detail ways of improving the measurement system and to assess the impact on the mass balance of those improvements
- P14 monitor external developments, benchmarking, good practices and learning from experience

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### Knowledge and understanding

*You need to know and understand:*

- K1 the **Implementation Framework** for NMAS on the site
- K2 the site's material balance areas and associated **documentation of the NMAS measurement requirements**, **NMAS capability requirements** and **measurement control programmes** in place
- K3 the different types of direct and indirect measurement systems, their interdependence, including physical and calculation methods to derive nuclear material quantities.
- K4 the determined measurement uncertainties, their interrelation and correlation, and any correction factors used and the relevant **International Target Values**
- K5 the use of measurement systems analysis, and how it can be used in an investigation of anomalies or improvement projects
- K6 national and International regulation relating to nuclear material statistical analysis
- K7 national and International guidance, good practices, and research on theoretical analysis of nuclear material measurement uncertainty
- K8 the linkage between measurement system uncertainty analysis and plant conditions
- K9 **measurement system analysis terminology**
- K10 how to conduct a measurement systems analysis study
- K11 how to produce measurement performance charts
- K12 the extent of your own authority within the project, and to whom you should report in the event of problems that you cannot resolve
- K13 nuclear material measurement action levels and alarm procedures
- K14 independent safeguards measurements and the procedures for resolving differences on overall balance uncertainty compare to the operator's analysis
- K15 applied Mathematics and advanced statistics tools
- K16 relevant uncertainty analysis software

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### Additional Information

#### Glossary

**Anomalies:** are NMAS discrepancies that are consistent with the absence or gain of a significant amount of nuclear material. These include:-

- 1 unacceptable losses or gains detected by the account balances or by process monitoring
- 2 loss or gain of a discrete item on site or in transit
- 3 significant finds of nuclear material
- 4 unacceptable shipper/receiver difference

**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.

**Documentation of the NMAS measurement requirements:** includes:

- 1 the key measurement points in the accounting area.
- 2 accountancy data and its transmission.
- 3 values for equipment precision and accuracy.
- 4 the measurement goals and target achievements set out in the design.

**Implementation Framework:** includes the NMAS physical and the managerial arrangements. It defines; the Material balance areas; transfer boundaries; key measurement points; NMAS capabilities, resources and infrastructure; control arrangements. It defines; organisational structures, responsibilities and accountabilities, separation of duties, those with direct custodial care of nuclear material and the competency framework.

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**International Target Values:** the International Target Values, issued under the auspices of the IAEA that 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.

**Measurement:** may be direct or indirect including use of historical estimates, modelling, statistical averaging and other forms of calculation.

**Measurement Control Programme:** a system to ensure the effectiveness of measurement and analytical systems and the quality and validity of resulting data that is generated for nuclear material accountancy and safeguards purposes. Quality controls include performance monitoring, testing and analysis, calibration and certification, control of certified reference materials and sources.

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

**Measurement system analysis terminology:** includes general **measurement terminology** together with terminology used for uncertainty analysis and material balance detection capability (sequential analysis, anomaly resolution, detection probability, false alarm probability, test statistic, error propagation, limit of error, etc).

**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.

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**Developed by** Cogent

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**Version number** 03

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**Date approved** September 2011

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**Indicative review date** September 2013

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**Validity** Current

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**Status** Original

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**Originating organisation** Cogent

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**Original URN** COGNMAS4

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**Relevant occupations** Technical Specialists; NMAS Managers

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**Suite** Nuclear Materials, Accountancy, Safeguards and Control (NMAS)

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**Key words** Nuclear; Materials; Safeguards; Control