Office for Nuclear Regulation

ONR Guidance for the Assessment of Nuclear Material Accountancy, Control and Safeguards

2019 Edition, Version DRAFT
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OFFICIAL

Version Control

Development of the DRAFT ONR Guidance for the Assessment of Nuclear Material Accountancy, Control and Safeguards (ONMACS) was completed in January 2019, the final version will be a product of extensive stakeholder engagement.

Changes may need to be made to this document in response to stakeholder engagement.

For this reason, the website version is the only authorised version.

Where amendments are made to the document, these will be published on the ONR website with an audit trail and, where possible, stakeholders will be alerted to the changes.

Revision History

No	Date	Change Summary
Draft 0	**January 2019**	
Draft 1	**March 2019**	**formatted for publication and use**

FOREWORD

ONR State System of Accounting for, and Control of Nuclear Material (SSAC) Vision:

The ONR UK SSAC vision is to regulate safeguards and enable the UK to meet its international obligations.

What is the purpose of the ONMACS?

The Office for Nuclear Regulation (ONR) is the independent regulator of nuclear safety, civil nuclear security and nuclear safeguards across the United Kingdom. ONR will use this guidance and the assessment expectations encompassed within it, together with supporting Technical Assessment Guides (TAGs), to guide regulatory judgements and recommendations when undertaking assessments of operator submissions on Nuclear Material Accountancy and Control (NMAC) such as Basic Technical Characteristics (BTCs) and Nuclear Material Accountancy and Control Plans (ACPs). Underpinning the requirement for these submissions, and ONR's role in their approval, are the legal duties placed on organisations subject to the Nuclear Safeguards (EU Exit) Regulations 2018 [1].

The ONMACS provide the essential foundation for the introduction of outcome focussed regulation for Nuclear Material Accountancy, Control and Safeguards (NMAC&S). This regulatory philosophy is aligned with the regulatory framework for NMAC&S and provides operators with a coherent regulatory approach applied by the ONR across the UK civil nuclear industry.

Outcome focussed NMAC&S regulation supports clarity that responsibility for ownership and control of NMAC rests with operators. The fundamental expectations of ONMACS set down what ONR considers operators should have / generate to deliver the defined NMAC&S outcomes, with ONR holding them to account for that delivery. However, detailed prescription of the nuclear materials accountancy reports, which must be provided by the UK to the IAEA and therefore by operators to the ONR, will remain a distinctive feature of the safeguards regime.

The new Regulations allow a greater flexibility in approach and encourage innovation in NMAC&S solutions. As a consequence, operators can provide effective and robust measures for nuclear material accountancy and control, whilst working in harmony with business processes and maximising opportunities for adding value. The ONMACS support this flexibility enabling alternative approaches to those defined in the fundamental expectations to be applied when justified.

This is the first draft of the ONMACS and it is expected to take time to embed and reach full maturity. But that process will be important, especially given the diverse nature of the industry that includes new build design and construction, power operations, and extensive decommissioning. The approach enables the effective and robust accountancy and control of qualifying nuclear material by operators. ONR recognises that learning from the new approach, may require the ONMACS to be refined during initial implementation and intends to review this guidance after 12 months.

Further development of this first draft of ONMACS will be informed by extensive stakeholder engagement including a diverse range of industry operators, the Nuclear Decommissioning Authority and the Department for Business, Energy and Industrial Strategy. Comments and views submitted to us during engagement may, in some cases lead us to modify the text. However, decisions on the final text and responsibility for the ONMACS content are the ONR's alone.

1. INTRODUCTION

1.1 UNIFYING PURPOSE STATEMENT

Unifying Purpose Statement	UPS
Operators are responsible for the leadership, design, implementation, operation and maintenance of arrangements to ensure that qualifying nuclear material is accounted for and controlled in an effective and robust manner thus ensuring the UK continues to meet its safeguards obligations and provide assurance to the public, HMG and other stakeholders that the UK continues to operate as a responsible nuclear state.	

1. The state retains responsibility for the maintenance of the legislation and regulatory framework within which operators discharge their NMAC&S responsibilities. Operators should integrate their NMAC&S responsibilities with those for both security and safety. ONR will adopt a targeted and proportionate approach in line with our existing enforcement policy statement. This means regulatory attention will be based on the categorisation of nuclear material, the amount of nuclear material and the scale and complexity of the operators undertaking.

1.2 PURPOSE OF ONR GUIDANCE FOR ASSESSMENT OF NMACS.

2. ONR Guidance for the Assessment of Nuclear Material Accountancy, Control and Safeguards (ONMACS) applies to assessments of NMAC&S arrangements defined in accountancy and control plans (ACP) as well as the arrangements in place to ensure that qualifying nuclear material is accounted for and controlled in an effective and robust manner and, where appropriate, to those arrangements required to facilitate IAEA safeguards activities on UK Sites[1].

3. The term ACP is used throughout this document to encompass the totality of the documentation produced by the licensee, duty holder or operator to demonstrate high standards of NMAC&S. The ACP must describe in writing, the arrangements and procedures adopted or to be adopted by an operator to establish and maintain the system of accountancy and control of qualifying nuclear material (a system of “nuclear material accountancy, control and safeguards”, or NMAC&S) as required by regulation 6 of the Nuclear Safeguards (EU Exit) Regulations 2018.

4. The expectations encompassed in this document relate only to nuclear materials accountancy, control and safeguards for nuclear material and facilities used for civil activities in the UK. Nuclear material for defence purposes is excluded from the safeguards regime.

5. The primary purpose of the ONMACS is to provide ONR with a framework for making consistent regulatory judgements on the adequacy of NMAC&S arrangements. The expectations will be supported by Technical Assessment Guides (TAGs), and other guidance, to further assist decision making within the NMAC&S regulatory assessment process. Although it is not their primary purpose, the ONMACS may also provide advice and guidance to operators on the appropriate content of accountancy and control plans, clarifying ONR expectations in this regard. However, the ONMACS are

[1] *Guidance for the assessment of the arrangements required to facilitate IAEA safeguards activities on UK Sites (that are selected by the IAEA for safeguards) will be available in addition to this guidance.*

not sufficient on their own to be used as design or operational standards, nor are they intended for that purpose.

1.3 REGULATORY CONTEXT

1.3.1 UK REGULATIONS AND LEGISLATION

6. Part 3, Chapter 1 of The Energy Act (TEA) 2013 [2] defines ONR's purposes thus:

   (a) Nuclear Safety;

   (b) Nuclear Site Health and Safety

   (c) Nuclear Security;

   (d) Nuclear Materials Safeguards; and,

   (e) Transport (of radioactive material).

7. For the purposes of TEA, Relevant Statutory Provisions (RSPs) are:

   (a) Part 3 of TEA

   (b) Nuclear Regulations (including The Nuclear Safeguards (EU Exit) Regulations 2018 [3] and the Nuclear Safeguards (Fissionable and Relevant International Agreements) (EU Exit) Regulations 2018 [4], The Nuclear Industries Security Regulations (NISR) (Reference 2) and 'Class 7' aspects of the Carriage of Dangerous Goods & Use of Transportable Pressure Equipment Regulations) [5];

   (c) Sections 1, 3-6, 22 & 24A of the Nuclear Installations Act 1965 [6]; and,

   (d) The Nuclear Safeguards Act 2000 [7].

   (e) The Nuclear Safeguards Act 2018* [8] *Amends TEA but is not an RSP of TEA*

   (f) The Nuclear Safeguards and Electricity (Finance) Act 1978* [9] *Provides access required for IAEA safeguards inspectors, not an RSP of TEA.*

8. In accordance with the Relevant Statutory Provisions (RSP's) above, ONR's safeguards purpose is to ensure compliance with the nuclear safeguards regulations and compliance by the UK or, as the case may be, enabling or facilitating compliance by a Minister of the Crown, with a relevant international agreement, and the development of any future obligations relating to nuclear safeguards.

9. ONR's role in ensuring compliance with safeguards regulations includes assessing ACPs, inspecting compliance with arrangements made under these plans. For sites selected for IAEA safeguards, the ONR will assess and inspect measures in place to facilitate UK compliance with any applicable safeguards agreements.

1.3.2 INTERNATIONAL FRAMEWORK AND CONTEXT

1.3.2.1 Relevant International Agreements

10. In anticipation of the departure of UK from Euratom, The UK has currently concluded the following safeguards agreements with international stakeholders, which are relevant to this document. The Secretary of State specifies each of the following agreements as a "relevant international agreement" for the purposes of section 112(1A) of the Energy Act 2013:

(a) the Agreement, signed on 7th June 2018, between the United Kingdom and the International Atomic Energy Agency for the application of safeguards in the United Kingdom in connection with the Treaty on the Non- Proliferation of Nuclear Weapons;

(b) the Additional Protocol, signed on 7th June 2018, between the United Kingdom and the International Atomic Energy Agency which is additional to the Agreement described in paragraph (a);

(c) the Agreement, signed on 4th May 2018, between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of the United States of America for Cooperation in Peaceful Uses of Nuclear Energy;

(d) the Agreement, signed on 2nd November 2018, between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of Canada for Cooperation in Peaceful Uses of Nuclear Energy;

(e) the Agreement, signed on 21st August 2018, between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of Australia for Cooperation in Peaceful Uses of Nuclear Energy; and

(f) the Agreement, signed on 25th February 1998, between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of Japan for Cooperation in Peaceful Uses of Nuclear Energy;

1.3.2.2 Responsibilities of the State

11. The UK is a member state of the International Atomic Energy Agency (IAEA) and is committed to the Non Proliferation Treaty (NPT) [10]. To fulfil commitments made in connection with the NPT, the UK has concluded a voluntary offer safeguards agreement (VOA) with the IAEA [11], which provides for the application of IAEA safeguards in the UK *'on all source or special fissionable material in facilities or parts thereof within the United Kingdom, subject to exclusions for national security reasons only'*. Under the VOA, the UK has a responsibility to establish, implement and maintain a State System of Accountancy for, and Control (SSAC) of civil nuclear material subject to the agreements with the IAEA. Furthermore, the SSAC must also have arrangements to provide NMAC&S reports to the IAEA and measures to provide assurance that accountancy systems of UK civil nuclear facilities function correctly.

12. The UK has also concluded an Additional Protocol (AP) [12] with the IAEA which contains measures additional to the UK VOA. Under the AP the UK has a responsibility to provide declarations on the UK nuclear fuel cycle related research and the manufacture or export of specified nuclear equipment, and allows access to the IAEA in connection with such information. Declarations made under the AP have only limited

nuclear materials accountancy related content and are therefore outside of the scope of this document.

1.3.2.3 State System for Accountancy and, for Control of Nuclear Material

13. In line with its responsibilities under international safeguards agreements, the UK is obliged to establish and maintain a State System of Accountancy for, and Control (SSAC) of civil nuclear material. The ONR's safeguards purpose includes ensuring compliance by the UK with relevant international agreements. This includes provision of nuclear materials accountancy and other safeguards declarations required of the UK under such agreements. In order to ensure this, the UK has put in place a new domestic nuclear safeguards regulation. The framework requires the implementation of robust arrangements to enable the timely and comprehensive reporting of NMAC&S declarations along with a system of assessment and compliance inspection, together with a means of enforcement, including effective sanctions, as summarised in Figure 1.

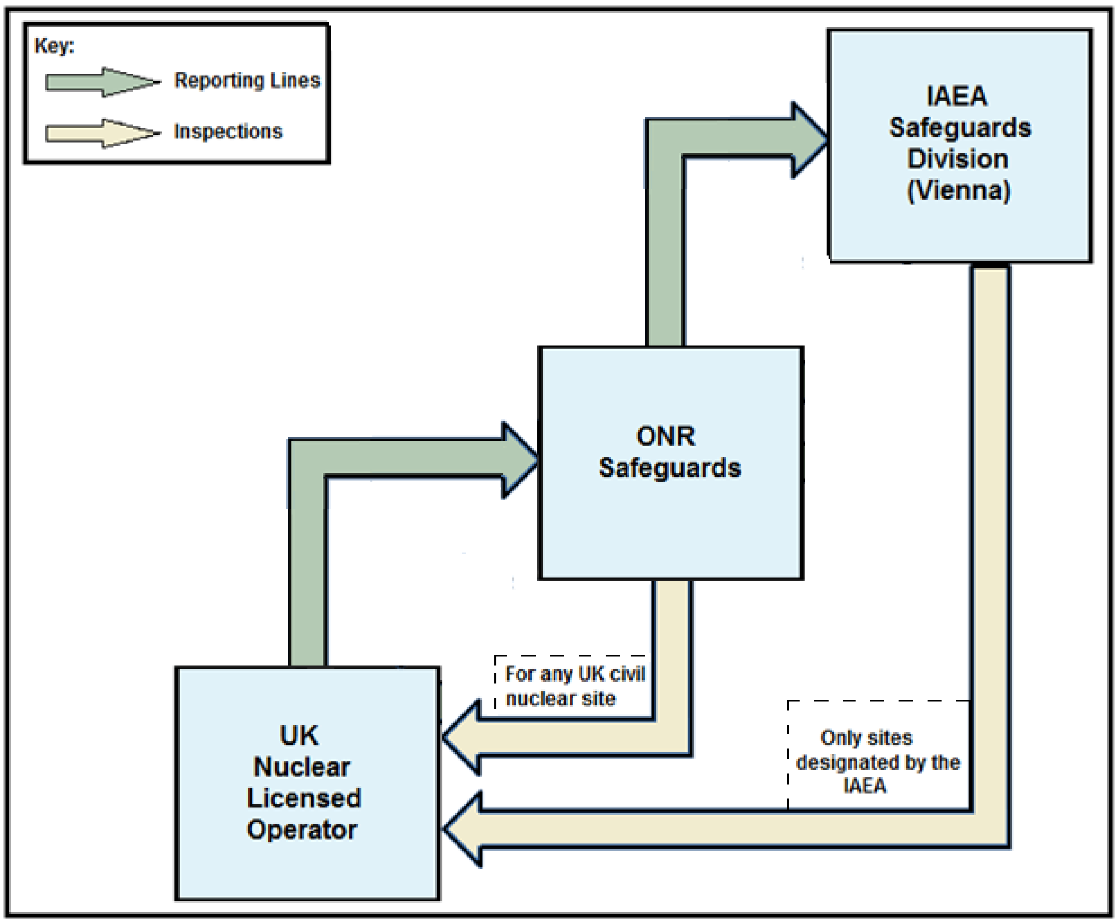

Figure 1: High Level Overview of UK SSAC Framework.

1.3.2.4 Responsibilities of Operators

14. The Nuclear Safeguards (EU Exit) Regulations 2018 place requirements on operators to establish, implement and maintain a system of accountancy and control of the relevant qualifying nuclear material in each qualifying nuclear facility. Operators must also ensure arrangements are in place to provide the NMAC&S declarations required by the nuclear safeguards regulations.

15. Throughout this document, the term operator is used to refer to all persons or organisations that have legal obligations placed on them by The Nuclear Safeguards Regulations.

1.4 REGULATORY CONTEXT

1.4.1.1 General

16. The ONMACS contains expectations and guidance. The expectations form the underlying basis for regulatory judgements made by inspectors, and the guidance associated with the expectations provides either further explanation of a principle, or their interpretation in actual applications and the measures against which judgements can be made.

17. The expectations are a reference set from which the inspector should select those relevant to the particular situation. The expectations apply to all qualifying nuclear facilities that are used for the production, processing, storage, handling, disposal or other use of qualifying nuclear material.

18. Nuclear licensed sites used solely for defence purposes are not subject to safeguards requirements and their NMAC&S does not fall within the responsibilities of the ONR. Nevertheless, it is MOD policy to have NMA standards and management arrangements that are, so far as is reasonably practicable, at least as good as those required by safeguards legislation.

19. Civil nuclear licensed sites, which handle nuclear materials that are excluded from safeguards, for reasons of national security, are expected to comply with the MOD requirements as specified in the SW PT ANM Accounting and Control Manual for all such nuclear material.

1.4.1.2 Lifecycle

20. ONMACS is designed to support regulatory assessments throughout the lifecycle of nuclear facilities. It is important to note that different areas of a nuclear facility may be in different lifecycle phases and proportionate and appropriate arrangements and procedures for NMAC&S should be in place which reflect this.

21. Facilities identified for decommissioning or closure remain subject to safeguards requirements and the ONMACS until it is determined that all nuclear material has been removed. The physical inventory can then be recorded as zero, and any remaining difference from the book inventory recorded as an inventory difference (ID). The status of the facility can then be amended to decommissioned for safeguards purposes.

1.4.1.3 New Facilities

22. ONMACS support the regulatory NMAC&S assessment of new (proposed) nuclear facilities. They represent the ONR's view of good practice and it is an expectation that modern facilities satisfy their overall intent.

1.4.1.4 Facilities Built to Earlier Standards

23. Inspectors should assess ACPs and NMAC&S arrangements against the relevant assessment expectations when judging if an operator has demonstrated that legal NMAC&S requirements and regulatory NMAC&S outcomes have been met. The extent to which the expectations ought to be satisfied must also take into account the age of the facility or the plant. For facilities designed and constructed to earlier standards, the issue of whether suitable and sufficient (compensatory) NMAC&S measures have been implemented will need to be assessed.

1.4.1.5 Nuclear Safety, Security and Safeguards Assessments

24. Nuclear safety, security and safeguards legislation impose separate, specific duties on licensees, operators and dutyholders. Sometimes these duties are inter-related. For example, in the event of unusual occurrences where a loss of nuclear material control and suspected theft or diversion of nuclear material has occurred, operators have a duty to submit a special report to the ONR as soon as they become aware of any such occurrence. Incidents of this nature would be of interest to the nuclear safeguards and nuclear security authorities.

25. The aims of Nuclear safety, security and safeguards legislation are complementary; in that all are intended to lead to measures that reduce the risk of harm to the public and workers arising from nuclear facilities, and so measures that adequately address the requirements of one set of legislation may satisfy the requirements of another. On other occasions a common solution will not be possible, and designers or operators will need to determine a solution that separately addresses the requirements of safety, security and safeguards legislation.

26. Detailed information on safety aspects can be found in the Safety Assessment Principles 2014 document [13] and for security aspects in the Security Assessment Principles for the Civil Nuclear Industry 2017 [14].

1.4.1.6 Alternative Approaches

27. The ONMACS express ONR's expectations for the content of ACPs submitted to us. However, designers and/or operators may wish to put forward ACP's that differ from these expectations. ONR inspectors should consider such submissions on their individual merits. That said, where the approach being followed differs substantially from the expectations set in this document, designers and/or operators may wish to discuss the method of demonstration with ONR beforehand. ONR will need to be assured that such plans demonstrate equivalence to the outcomes associated with the use of the expectations here and such a demonstration may need to be examined in greater depth to gain that assurance.

1.5 STRUCTURE OF THE EXPECTATIONS

28. This section (1) defines the unifying purpose for operators NMAC&S regimes and provides context (including international aspects) for the ONMACS. Section 2 contains the Fundamental SSAC Expectations (FSSACEs). These expectations are founded in UK law and/or international good practice, and underpin all activities that contribute to sustained high standards of NMAC&S. They fall into two categories:

(a) Strategic Enablers – FSSACEs 1-5 are focussed on creation of the right conditions to support effective NMAC&S strategy; and,

(b) Material Controls – FSSACEs 6-10 are focused on the implementation and maintenance of effective and robust NMAC&S arrangements.

29. Each FSSACE is supported by one or more Nuclear Material Accountancy and Control Organisational Expectation (NMACOE), as detailed in Section 3. Notwithstanding alternative approaches detailed above, it is against these expectations that inspectors judge the adequacy of an operator’s submission.

30. The Nuclear Safeguards (Eu Exit) Regulations 2018 require the submission of an accountancy and control plan for the qualifying nuclear material in each facility. Additional Guidance on the regulatory assessment of accountancy and control plans (RAACPs) is provided in a separate document, the expectations of RAACPs should be applied across the breadth of the FSSACEs and NMACEs covered in any accountancy and control plan submitted to the ONR. RAACPs provide guidance that sets the foundation for the production and assessment of robust and effective ACPs. It is underpinned by the concepts and expectations articulated within the ONMACs.

31. The glossary annexed to the expectations is provided to assist in understanding some of the terms used. Where relevant, the glossary includes the sources of the definitions adopted. Abbreviations and references are also provided to assist readers’ understanding.

32. This document has been developed following the Regulators’ Code, particularly regarding engagement with those we regulate and ensuring that ONR’s approach to regulatory activities is transparent and easily accessible, including being available at a single point on our website.

2. Fundamental Expectations for Nuclear Material Accountancy and Control

The Fundamental expectations for NMAC&S are considered to be the foundation for the subsequent NMACEs in this document. They reflect UK law, international obligations and accepted international good practice. The FSSACEs are split into two distinct classes, outlined in Table 1 below. These include Strategic Enablers, which are aligned with other ONR regulatory compliance arrangements and material controls, which focus specifically on the implementation and maintenance of NMAC arrangements. Strategic Enablers are structured to align with SyAPS and mMaterial controls are structured to align with European Commission recommendation of 11 February 2009 [15] (on the implementation of a nuclear material accountancy and control system by operators of nuclear installations).

Strategic Enablers		Material Controls	
FSSACE I	Leadership and Management for Nuclear Material Accountancy and Control	FSSACE VI	Measurement programme and control
FSSACE II	Organisational Culture	FSSACE VII	Nuclear material tracking
FSSACE III	Competence Management	FSSACE VIII	Data processing and control
FSSACE IV	Reporting, Anomalies and Investigations	FSSACE IX	Material balance
FSSACE V	Reliability, Resilience and Sustainability	FSSACE X	Quality Assurance and Control for Nuclear Material Accountancy and Control

Table 1: SSAC Fundamental Expectations for Nuclear Material Accountancy and Control.

2.1FSSACE 1 – Leadership and Management for Nuclear Material Accountancy, Control & Safeguards

Fundamental Expectation for Nuclear Material Accountancy and Control	Leadership and Management for NMAC&S	FSSACE 1
Operators must implement and maintain organisational capability for Nuclear Material Accountancy, Control & Safeguards (NMAC&S) underpinned by strong leadership, robust governance, an adequate management and accountability of NMAC arrangements incorporating internal and independent evidence-based assurance processes.		

2.2 FSSACE 2 – Organisational Culture

Fundamental Expectation for Nuclear Material Accountancy and Control	Organisational Culture	FSSACE 2
Operators must encourage and embed an organisational culture that recognises and promotes the importance of Nuclear Material Accountancy, Control and Safeguards.		

2.3 FSSACE 3 – Competence Management

Fundamental Expectation for Nuclear Material Accountancy and Control	Competence Management	FSSACE 3
Operators must implement and maintain effective arrangements to manage the competence of those with assigned NMAC roles and responsibilities.		

2.4 FSSACE 4 – Reporting, Anomalies and Investigations

Fundamental Expectation for Nuclear Material Accountancy and Control	Reporting, Anomalies and Investigations	FSSACE 4
Operators must implement and maintain arrangements for the timely and accurate reporting of information required by the Nuclear Safeguards (EU Exit) Regulations 2018. Arrangements for the investigation, resolution and reporting of discrepancies must be in place.		

2.5 FSSACE 5 – Reliability, Resilience and Sustainability

Fundamental Expectation for Nuclear Material Accountancy and Control	Reliability, Resilience and Sustainability	FSSACE 5
Operators must design and support their nuclear material accountancy and control regime to ensure it is reliable, resilient and sustained throughout the entire lifecycle of the facility.		

2.6 FSSACE 6 – Measurement Programme and Control

Fundamental Expectation for Nuclear Material Accountancy and Control	Measurement Programme and Control	FSSACE 6

Where measurements are performed, operators must implement and maintain robust arrangements to ensure the appropriate performance of measurement systems that provide data for the purposes of nuclear material accountancy and control.

2.7 FSSACE 7 – Nuclear Material Tracking

Fundamental Expectation for Nuclear Material Accountancy and Control	Nuclear Material Tracking	FSSACE 7

Operators must implement and maintain a nuclear material accountancy and control system that is able to provide identification, quantity, characteristics and track any nuclear material in their facilities at any time.

2.8 FSSACE 8 – Data Processing and Control

Fundamental Expectation for Nuclear Material Accountancy and Control	Data Processing and Control	FSSACE 8

Operators must implement and maintain data processing systems that are capable of producing the nuclear material accountancy and control declarations required under the Nuclear Safeguards Regulations and that integrate technical and procedural controls to protect the confidentiality, integrity and availability of sensitive nuclear information.

2.9 FSSACE 9 – Material Balance

Fundamental Expectation for Nuclear Material Accountancy and Control	Material Balance	FSSACE 9

Operators must implement and maintain arrangements to ensure that material shipped, received, processed and stored within facilities is subject to robust nuclear material accountancy and control arrangements that guarantee traceability, include arrangements for physical inventory taking and, where appropriate material balance evaluation.

2.10 FSSACE 10 – Quality Assurance for Nuclear Material Accountancy and Control

Fundamental Expectation for Nuclear Material Accountancy and Control	Quality Assurance for Nuclear Material Accountancy and Control	FSSACE 10

Operators must implement and maintain quality assurance and quality control measures for Nuclear Material Accountancy and Control.

3. Nuclear Material Accountancy, Control and Safeguards Organisational Expectations

33. The nuclear material accountancy, control and safeguards organisational expectations (NMACEs) comprise specific outcomes focused on the delivery of an effective NMAC&S regime that operators must demonstrate that they have addressed within their ACP. Further context to the discipline being covered by the FSSACE to which the subsequent NMACE relate is provided below each expectation for information. As such, the FSSACE does not contain any regulatory expectations, which are articulated in the NMACEs.

34. The NMACEs are directly associated with the FSSACEs. Accordingly, expectations linked to FSSACEs 1-5 are concerned with enabling the delivery of effective NMAC&S strategy, whilst those linked to FSSACEs 6-10 are concerned with the delivery of effective and robust NMAC&S arrangements.

3.1. FSSACE 1 – Leadership and Management for Nuclear Material Accountancy, Control & Safeguards

Fundamental Expectation for Nuclear Material Accountancy and Control	Leadership and Management for NMAC&S	FSSACE 1
Operators must implement and maintain organisational capability for Nuclear Material Accountancy and Control underpinned by strong leadership, robust governance, an adequate management and accountability of NMAC arrangements incorporating internal and independent evidence-based assurance processes.		

35. The expectations in this section enable the effective delivery of NMAC&S. Inspectors should use these expectations proportionately, reflecting the categorisation of nuclear material, the amount of nuclear material and the scale and complexity of the operators undertaking.

36. This fundamental expectation contains five high-level inter-related expectations: Governance & Leadership, Capable Organisation, Decision Making, Organisational Learning and Assurance. These set the outcomes to be achieved for effective leadership and management for NMAC&S, rather than describing the systems, processes and procedures for achieving effective NMAC and effectively facilitating safeguards activities. Because of their inter-connected nature there is some overlap between the expectations. Therefore, it is necessary for them to be considered as a whole and delivered via an integrated approach.

37. The expectations combine the key features of an effective nuclear material accountancy and control system arising from current national law and guidance (in particular The Nuclear Safeguards Regulations 2018 and TEA). They also draw on international guidance including ESARDA and IAEA Guidance.

38. In combining the key features of leadership and management for NMAC&S from a range of sources, the expectations reflect:

    (a) The emphasis ONR gives to leadership and management for NMAC&S, the role of the Board, directors and worker involvement;
    (b) The pivotal role played by good and effective leadership, people management and processes; and

    (c) The need to consider the management of NMAC&S at all levels throughout the whole organisation in building and sustaining a positive NMAC&S culture.

3.1.1. NMACE 1.1 – Governance and Leadership

FSSACE 1 – Leadership and Management for NMAC&S	Governance and Leadership	NMACE 1.1
Directors, managers and leaders at all levels should focus the organisation on achieving and sustaining high standards of nuclear material accountancy, control and safeguards and on delivering the characteristics of a high reliability organisation.		

39. Robust governance includes clear Terms of Reference to ensure a coherent, direct chain of accountability for NMAC&S through to the main Board member responsible for NMAC&S oversight. Reporting structures should be clearly understood, with well-defined budget responsibilities and delegated personal authorities.

40. Leadership is key to achieving effective NMAC&S and establishing and sustaining a positive NMAC&S culture. In meeting Expectation NMACE 1.1 the expectation is that the behaviour and activities of directors, managers and other leaders should include:

(a) establishing the strategies, policies, plans, goals and standards for NMAC&S and ensuring that they are delivered throughout the organisation;

(b) providing direction, governance and oversight to establish and foster an organisational culture that underpins NMAC&S;

(c) demonstrating a visible commitment to NMAC&S through their activities;

(d) recognising and resolving conflict between NMAC&S and other goals (e.g. safety, security, production and commercial pressures);

(e) ensuring that NMAC&S is participative, actively drawing on the knowledge and experience of all staff;

(f) ensuring that performance management tools promote the identification and management of risk, encourage positive NMAC&S behaviours and discourage poor behaviours or complacency;

(g) understanding that apparent past success is no guarantee of future success and that fresh perspectives on ways to enhance NMAC&S should be sought and acted upon; and

(h) monitoring and regularly reviewing NMAC&S performance and culture.

41. The value of NMAC&S as an integral part of good business and management practice should be reinforced through interactions between directors, managers, other leaders and staff, including contractors (as required), to establish a common purpose and collective organisational responsibility. Consultation and involvement of all staff secures effective engagement and co-operation in the development, maintenance and improvement of NMAC&S and promotes a shared concern for achieving NMAC&S goals. As a result, people at all levels in the organisation should be engaged in a common purpose that recognises responsibility and accountability to each other and external stakeholders to ensure high standards of NMAC&S. The dutyholder should ensure that this extends to contractors down the supply chain as required.

42. Oversight of NMAC&S performance, led by the Board of the organisation, should provide assurance at all levels, and throughout all stages of the life of the undertaking, that NMAC&S is being maintained and improved. It should utilise diverse sources of information, including feedback from independent challenge and reviews, in order to

provide confidence (by means of governance, monitoring and auditing processes) that NMAC&S, quality policies, strategies, plans, goals, standards, systems and procedures are being implemented through the application of an effective management system.

43. The management system should give due regard to NMAC&S, and NMAC&S should be considered explicitly when developing and implementing any new arrangements for managing the organisation. An integrated management system should be adopted so that the potential for conflicts between the organisation's goals and responsibilities is minimised. The management system should:

(a) be based on national or international standards or equivalent requirements;

(b) be aligned with the goals of the organisation and contribute to their achievement;

(c) be subject to regular review, seeking continual improvement; and

(d) support a positive NMAC&S culture.

3.1.2. NMACE 1.2 – Capable Organisation

FSSACE 1 – Leadership and Management for NMAC&S	Capable Organisation	NMACE 1.2
The organisation should have the capability to implement and maintain the nuclear material accountancy, control and safeguards arrangements for its undertakings.		

44. The organisation should have adequate Human Resources (HR). This includes having the necessary competencies, experience and knowledge in sufficient numbers to provide resilience and maintain the capability to govern, lead and manage NMAC&S at all times. A properly resourced NMAC&S governance structure should typically include (but is not limited to) the following roles:

- Board Member responsible for NMAC&S
- Director or Chief NMAC&S Officer
- NMAS Manager
- Commercial Contract Management
- Analytical Measurement Management
- Other specialists relevant and specific to the organisation's needs

45. In addition, an individual should be appointed, who is responsible for NMAC&S, with sufficient authority, autonomy and resources to implement and oversee all NMAC&S activities. The organisation's structure and baseline staffing levels should be based on appropriate organisational design expectations. HR baseline provisions should be established, controlled and reviewed regularly through robust, auditable processes. Changes to the organisation (including to structure, staffing, resources or competencies) should be subject to systematic evaluation to ensure that they do not adversely affect the capability of the organisation to deliver nuclear materials accountancy and control and facilitate safeguards activities. There should be succession planning arrangements (especially where there is limited or singleton

expertise). Succession planning should take into account expected changes (e.g. retirements) and make contingencies for the unexpected (e.g. resignations).

46. The organisational structure, roles and responsibilities should secure effective co-ordination and collaboration between all those involved, including contractors. Roles, responsibilities, accountabilities and performance standards for NMAC&S at all levels should be clear and manage conflict with other business roles, responsibilities, accountabilities and objectives. All those with responsibilities for NMAC&S should have authority and access to resources to discharge those responsibilities effectively. The organisation should ensure that proportionate governance and supervision of NMAC&S at all levels is achieved. The design of jobs, processes and procedures should take account of those factors that affect reliable performance of the organisation.

47. Processes and systems should secure and assure maintenance of appropriate technical and behavioural competence of directors (both executive and non-executive), managers, leaders and all other staff and contractors with NMAC&S roles and responsibilities.

48. Being a capable organisation requires the retention and use of knowledge so that NMAC&S requirements are understood and are controlled throughout all activities, including those that may be undertaken by contractors at all levels within the supply chain. An ‘intelligent customer’ capability should therefore be maintained to ensure that the use of contractors in any part of the organisation does not adversely affect its ability to manage NMAC&S.

49. The organisation should sustain a capability that includes suitable and sufficient experts with a detailed and up-to-date understanding of the site, its facilities and their design, operation and associated NMAC&S arrangements. Knowledge of the intended design performance of NMAC&S equipment, processes and systems should be maintained to provide an adequate corporate memory and baseline for monitoring. This includes the need for an effective process to transfer and so retain knowledge from experienced staff leaving the organisation.

50. Knowledge should be captured and communicated within the organisation in a systematic, appropriate and reliable manner to all those who need to make decisions which impact NMAC&S. There should be provision for identifying, updating and preserving documents and records relevant to NMAC&S. Such documents and records should be stored securely and should be retrievable and readable throughout their anticipated useful life (including statutory retention periods). Documents and records relevant to NMAC&S should include those:

    (a) of value throughout the whole life of a facility;

    (b) that would assist during an incident or circumstances of NMAC&S significance (e.g. LFE);

    (c) relevant to making future modifications; or,

    (d) that could contribute to improvements in NMAC&S.

3.1.3. NMACE 1.3 – Decision Making

FSSACE 1 – Leadership and Management for NMAC&S	Decision Making	NMACE 1.3
Decisions made at all levels in the organisation affecting nuclear material accountancy, control and safeguards should be informed, rational, objective and prudent.		

51. NMAC&S should be evident in all decision making processes. The processes should ensure that all relevant data and opinions are collected, recorded and considered, respecting and encouraging the contribution of those with divergent views. The processes should encompass means for setting NMAC&S priorities to aid decision making at all levels. NMAC&S decisions should not be delayed unnecessarily and personnel should be empowered to take timely decisions in the interests of NMAC&S obligations.

52. Decisions affecting NMAC&S should consider the following factors (where relevant):

    (a) the quality, accuracy and sufficiency of the information;

    (b) the significance of uncertainties;

    (c) the questioning of assumptions;

    (d) exploration of all relevant scenarios that may threaten NMAC;

    (e) the range of options to appropriately manage risk in the short and long term;

    (f) the criteria and standards that should be applied.

    (g) the impact on regulatory compliance.

53. Decision making should be based on processes that ensure conflicts between NMAC&S and other business goals are recognised and appropriately resolved.

54. Decisions at all levels affecting NMAC&S should also cater for the potential for error, uncertainty and the unexpected, and those taken in the face of uncertainty or the unexpected should be appropriately and demonstrably conservative.

55. Decisions at all levels affecting NMAC&S should be documented and traceable.

3.1.4. NMACE 1.4 – Organisational Learning

FSSACE 1 – Leadership and Management for NMAC&S	Organisational Learning	NMACE 1.4
Lessons should be learned from internal and external sources to continually improve leadership, organisational capability, the management system, nuclear material accountancy, control and safeguards decision making and performance.		

56. Organisations should have effective processes for seeking out, analysing and acting upon lessons from a wide range of sources. A learning organisation should challenge established understanding and practice by reflecting on experiences to identify and understand the reasons for differences between actual and intended outcomes. An absence of NMAC&S events does not necessarily indicate that SNM is being adequately accounted for and controlled and should not breed complacency. Near

misses should be seen as opportunities to learn and a culture of open reporting should be fostered.

57. Learning should drive improvement throughout the organisation. Information should be collected from a range of sources inside the organisation, including from:

(a) Workers (e.g. about strengths, weaknesses, deviations and errors, or concerns in relation to NMAC&S procedures and processes);

(b) Monitoring, review and audit of the implementation and effectiveness of governance, NMAC&S strategies, policies, plans, goals, standards, processes and procedures;

(c) Monitoring of plant, systems and processes with NMAC&S relevance;

(d) Effectiveness of meeting NMAC&S regulatory requirements (eg regulatory follow up from inspections and interventions).

(f) Investigations of NMAC&S events and/or anomalies, to ascertain underlying causes, including organisational, NMAC&S management and cultural factors;

(g) Self-assessments; and

(h) External assessments commissioned by the organisation.

58. Information should be sought actively and systematically from external sources, including from beyond the nuclear industry (e.g. on approaches to and standards for metrology), to identify learning, best practice and improvement opportunities. Sources outside the organisation should include:

(a) reviews against international standards and practices;

(b) lessons from the investigation of events in other organisations from both within and outside the nuclear industry;

(c) benchmarking NMAC&S performance, management, learning methods and processes against those of other organisations from both within and outside the nuclear industry (e.g. the IAEA, ESARDA and other UK government bodies and centres of excellence e.g. NPL);

(d) NMAC&S data, (e.g. accountancy data and regulatory feedback); and

(e) feedback on NMAC&S performance and issues from regulators.

59. Information from both internal and external sources should be analysed to identify trends and issues, e.g. the influence of human or organisational factors, such as leadership and culture. The lessons learned should be embedded through a structured system for implementing corrective actions in a timely manner, which is rigorously applied and actively followed up to confirm completion. Effectiveness reviews should be undertaken to confirm that the changes have delivered the desired improvements. The learning processes and systems for implementation should themselves be subject to review and improvement.

60. The investigation of events of NMAC&S relevance should include within their scope the potential for a loss of nuclear material. Trends should be reviewed alongside individual events to determine if repeat actions are occurring on the site or facility. Suitable processes should be in place to ensure that the appropriate investigatory

approach and techniques are applied for the identification, and elimination of the cause of the errors.

3.1.5. NMACE 1.5 – Assurance Processes

FSSACE 1 – Leadership and Management for NMAC&S	Assurance Processes	NMACE 1.5
There should be evidence-based assurance processes in place to inform strategy through the Governance process, which welcomes challenge from across the organisation.		

61. The management system should ensure Board-level assurance and oversight of the operators NMAC&S performance, which should include compliance. A primary aim of assurance should be to provide on-going confirmation that the NMAC&S regime is delivering the required outcome

62. Governance and assurance cannot be effective unless the operator is confident in their processes for performance assessment. This confidence can be secured through implementation of a suitable, evidence-based methodology, incorporating performance indicators, to support internal assessment of performance. In addition to monitoring performance, indicators should be used to correct adverse trends before NMAC&S compliance is impacted and to inform decision making. Operators should therefore ensure that metrics and performance data are integrated with Board-level processes to allow decision making at the right level in order to influence strategy and drive continuous improvement.

63. Analysis and interpretation of data are important in developing meaningful performance indicators. The set of indicators should draw from an appropriately wide and diverse range of sources, chosen so that the indicators provide meaningful information. Both leading and lagging indicators should be included and reliance solely on quantitative indicators should be avoided since the picture they create can be over-simplistic, therefore appropriate qualitative information should also be sought.

64. Metrics should be designed primarily to provide operators with business information and self-verification for NMAC&S to inform strategy, rather than to assure regulators. In order to gain confidence in the efficacy of the metrics chosen, dutyholders should ensure that:

    (a) they are appropriate for the audience;

    (b) the rationale underpinning the metric is clear and understood;

    (c) they provide the Board with information that they need to know;

    (d) there is clear cause and effect between the metric and the outcome/performance for which it is designed to provide information;

    (e) the dutyholder actually has the ability to impact on the variables being measured;

    (f) they are aligned with other relevant business metrics as appropriate;

    (g) there is broad coverage of functions and stakeholders (i.e. not simply covering similar aspects in different ways); and,

(h) there is adequate focus on leading, not just lagging, indicators.

3.2. FSSACE 2 – Organisational Culture

Fundamental Expectation for Nuclear Material Accountancy and Control	Organisational Culture	FSSACE 2
Operators must encourage and embed an organisational culture that recognises and promotes the importance of Nuclear Material Accountancy, Control and Safeguards.		

65. Organisational culture encompasses the values and behaviours that contribute towards the social and psychological environment within a company. It represents the collective values, beliefs and principles of its employees and is influenced by factors such as history, industry, market, strategy and management style. Safety and security culture sit within and influence the wider organisational culture. More generally, the workforce that comes into contact with nuclear material should also be aware of NMAC&S, separate to safety and security.

66. NMAC&S culture can be defined as 'The assembly of characteristics, attitudes and behaviour of individuals, organisations and institutions which serves as a means to support and enhance NMAC&S as a crucial part of the international regime to prevent the proliferation of nuclear weapons.

67. While both nuclear safety and nuclear security consider the risk of inadvertent human error, NMAC&S culture requires attitudes and behaviours, such as multidisciplinary collaboration between NMAC&S specialists, analytical specialists and operational personnel, correctness and completeness of data and leadership and management for NMAC&S. Accordingly, assurance of good safety and safety culture cannot be considered to provide assurance of good NMAC&S culture, and vice versa.

68. An appropriate NMAC&S culture aims to ensure that the implementation of NMAC&S measures receives the attention warranted by their significance. Where it is embedded, NMAC&S culture brings significant benefits to a NMAC&S regime, providing greater assurance that the entire NMAC&S system will accomplish its functions of maintaining an authoritative breakdown of all nuclear materials which reflects physical reality, maintaining appropriate nuclear material control (including rapid and effective resolution of anomalies) and enable effective and efficient safeguards verification.

69. NMAC&S, safety and security cultures coexist and need to reinforce each other because they share the common objective of limiting risk, but there will be occasions where there are differences between NMAC&S, safety and security requirements and these need to be carefully managed to ensure required outcomes are achieved. Therefore, successful organisational cultures foster an approach that integrates NMAC&S safety and security in a mutually supporting manner.

3.2.1. NMACE 2.1 – Maintenance of a Robust NMAC&S Culture

FSSACE 2 – Organisational Culture	Maintenance of a Robust NMAC&S Culture	NMACE 2.1
Operators should ensure that the Board gives due priority to the development and maintenance of a NMAC&S culture necessary to ensure all staff involved in NMAC&S and who may come into contact with the safeguards inspectorates have appropriate awareness that NMAC&S is important and the role of the individual in maintaining it is key.		

70. Operators should commit to maintaining a strong NMAC&S culture and communicating NMAC&S expectations and standards to all staff involved in NMAC&S and all parts of the organisation that may come into contact with the safeguards inspectorates. Operators should have the processes and arrangements in place to create and sustain this aspect of culture across the organisation and supply chain.

71. Operators should also establish an appropriate, independent governance regime, led by the Board to ensure that an adequate NMAC&S culture is in place and it is maintained by the use of appropriate management systems/ structures. The methods and processes used for the maintenance of NMAC&S culture should be subjected to internal assurance by NMAC&S and operational staff that are Suitably Qualified and Experienced (SQEP). Furthermore, there should also be processes in place to review and test NMAC&S culture across the organisation and its supply chain and mechanisms established that drive continuous improvement, tackle poor and inappropriate behaviour, enforce sanctions and encourage the sharing of relevant good practice.

72. A primary requirement should be setting out the NMAC&S expectations and standards that need to be met, which should be communicated and understood by all staff involved in NMAC&S and all parts of the organisation that may come into contact with the safeguards inspectorates. Therefore, roles, responsibilities and accountability for each level of the organisation responsible for NMAC&S should be clearly defined and all staff should be accountable for compliance with all relevant aspects of the NMAC&S regime.

73. The organisational culture should also support business and NMAC&S priorities, be cognisant of HMG's priorities and be aligned to the organisation's own appreciation of risk. It is essential that any possible conflicts between the needs of safety and security are appropriately identified and addressed within the organisation's culture in a prompt manner.

74. Leaders can have a significant influence and therefore operators should encourage leadership behaviour that supports and demonstrates a commitment to NMAC&S culture. They should involve staff in decision making and ensure that sufficient resources are allocated to implement any assigned NMAC&S responsibilities. The reporting of any event or matter that could affect NMAC&S should also be encouraged.

3.3. FSSACE 3 – Competence Management

Fundamental Expectation for Nuclear Material Accountancy and Control	Competence Management	FSSACE 3
Operators must implement and maintain effective arrangements to manage the competence of those with assigned NMAC roles and responsibilities.		

75. The human contribution to the NMAC&S system is crucial, and may be made during facility design, construction, commissioning, operation, maintenance or decommissioning. A systematic approach to competence management will help to minimise the potential for human error to contribute to or escalate NMAC&S events.

76. It is essential that all personnel whose activities have the potential to impact on NMAC&S are demonstrably competent (i.e. SQEP to carry out their work and responsibilities in respect of the NMAC&S system). This includes both those who directly carry out operations and others (such as directors, managers, technical staff, nuclear material accountancy and control plan authors etc.) whose roles, if inadequately conceived or executed, may affect NMAC&S in less visible ways – for example, through introducing latent technical or organisational vulnerability. Therefore, robust arrangements for identifying its competence needs and assuring these are met and maintained are essential for an organisation seeking to achieve operations with effective and robust NMAC&S.

77. The process for identifying and delivering competence typically encompasses the phases of: job analysis; identification of competence requirements; training needs analysis; training programme design and implementation; formal assessment of competence and experience; and, training programme evaluation.

78. Training is a fundamental mechanism through which personnel acquire and maintain the skills and knowledge needed to perform a job to defined standards. It is instrumental in developing and sustaining competence. The IAEA has defined competence as ‘the ability to put skills and knowledge into practice in order to perform a job in an effective and efficient manner to an established standard’. Other factors contributing to a person’s competence include their prior experience, aptitudes, attitudes, behaviours, skills and qualifications. Competence can therefore broadly be equated to SQEP.

3.3.1. NMACE 3.1 – Analysis of NMAC&S Roles and Associated Competencies

FSSACE 3 – Competence Management	Analysis of NMAC&S Roles and Associated Competencies	NMACE 3.1
Analysis should be carried out of all tasks important to NMAC&S and used to justify the effective delivery of the NMAC&S functions to which they contribute.		

79. Dutyholders should routinely train and assure the competence and capability (including, where appropriate, medical fitness) of all members of the workforce who have responsibility for any operations which may affect NMAC&S, based on a task analysis.

80. This analysis should be applied to all actions and controls required to effective and robust NMAC&S so that there is high confidence in the feasibility of completing these tasks within requisite timescales. In so doing, the analysis should inform the way tasks are designed and supported to achieve reliable and effective task performance.

81. The analysis should evaluate the demands these tasks place upon personnel in terms of perception, decision making and action. It should also take into account the physical and psychological factors that could impact on human performance. Consequently, management process and control should be in place to ensure the fitness for duty of personnel to perform all NMAC&S tasks identified in the ACP. These management processes should address aspects such as fatigue arising from shift patterns and hours worked and the effects of wider factors impacting fitness for duty, including occupational stress, and drug and alcohol use.

82. The analysis should be sufficiently detailed to provide a basis for developing user interfaces, procedures and job aids, as well as helping define NMAC&S roles and responsibilities, personnel competence and training needs, communication networks and workspace design. The task analysis should also provide the basis for establishing required staffing levels (which should be maintained), for normal operations. Once defined, competencies and staffing levels should be kept under periodic review.

83. The workload of personnel required to undertake these tasks and controls should be analysed and demonstrated to be achievable. The workload of personnel and its impact on the effective completion of tasks important to NMAC&S should be reviewed periodically.

84. The analysis of NMAC&S roles and associated competencies may result in the identification and appointment of Nuclear Material Custodians to control and supervise operations critical for NMAC&S; and arrangements to ensure that only SQEP personnel perform any duties which may affect NMAC&S.

3.3.2. NMACE 3.2 – Identification of Learning Objectives and Training Needs

FSSACE 3 – Competence Management	**Identification of Learning Objectives and Training Needs**	**NMACE 3.2**
An analysis of roles, tasks and competencies should be used to generate learning objectives, which inform the development of a set of training needs and are used to derive the criteria, or standards, against which the trainee is assessed during and/or after training.		

85. Dutyholders should develop Learning Objectives (LO) from their analysis of NMAC&S roles and associated competencies. This is to inform the design and implementation of appropriate training arrangements and measures to determine, monitor and sustain competence of all personnel with NMAC&S responsibilities.

86. This will help operators demonstrate within their arrangements that competencies needed of each role and post-holder have been identified systematically, and that training is provided for all those areas in which the person is not able to demonstrate an adequate level of competence. The competencies should include both technical and other areas such as decision making, leadership and management, communications, behaviour, etc.

87. A training programme should be designed to help develop and maintain the competence of all personnel with NMAC&S responsibilities. The programme should set out the learning objectives and detail how they are to be achieved. Training programmes may be initial or continuation and their design should give consideration to the most effective means of meeting the competence requirements by selection of the most appropriate methods and media.

88. When the training method has been determined, attention should be given to the materials (for example manuals, lesson plans) needed to apply the training method and to planning its implementation to ensure it is structured and effective. Operators should demonstrate that the training methods and media they have selected promote effective development of the learning objectives and competencies which have been specified.

3.3.3. NMACE 3.3 – Measurement of Competence

FSSACE 3 – Competence Management	Measurement of Competence	NMACE 3.3
Dutyholders should implement and maintain a process of assessment which provides confidence that all personnel whose actions have the potential to impact upon NMAC&S meet defined competence expectations.		

89. Operators should assess and periodically re-assess the competence of workforce personnel who have NMAC&S responsibilities in order to establish and maintain SQEP. Assessment methods can include written, oral or practical demonstrations of learning competence. Accordingly, operators should select and employ the most effective competence assessment methodologies based upon their validity, objectivity, reliability and frequency for the NMAC&S role being assessed.

90. Assessment should not be regarded as a one-off activity which takes place after initial training, because a person's competence may change over time due to a range of reasons including the formation of bad habits. The frequency of reassessment should be determined by factors such as NMAC&S significance, frequency of the task undertaken and operational experience.

91. Operators should implement a well-defined system for monitoring the effectiveness of training, and for identifying areas where training may need to be augmented or revised. The evaluation should involve intelligence gathering in order to confirm that training has been specified properly, and that it is comprehensive, effective and up to date.

3.3.4 NMACE 3.4 - Organisation of and Support to the Training Function

FSSACE 3 – Competence Management	Organisation of and Support to the Training Function	NMACE 3.4
Training and competence assurance of personnel with NMAC&S roles should be given due priority by dutyholders.		

92. Competence delivery functions should be supported by commitment from senior levels in the organisation and by an appropriate management structure. The commitment should be defined in policy which recognises the need to develop and maintain the

competence of staff in order to meet NMAC&S requirements and which ensures adequate resources to maintain a training system to support the implementation of the policy.

93. Responsibilities for training should be clearly defined and line management should be aware of the purpose and significance of training. It is also important that they appreciate the need to monitor staff performance and facilitate competence. Appropriate interfaces should exist between training and other departments to identify training needs and make personnel available for training. Resources should also be made available for trainers to maintain and develop their own capability.

94. Appropriate training records should be maintained. The value of training records is related to the quality of information which is entered into them, and the use that is made of this information. Operators should therefore ensure that this information, and the design of the records management system enables training to be planned, scheduled, delivered and monitored effectively.

3.4 FSSACE 4 – Reporting, Anomalies and Investigations

Fundamental Expectation for Nuclear Material Accountancy and Control	Reporting, Anomalies and Investigations	FSSACE 4

Operators must implement and maintain arrangements for the timely and accurate reporting of information required by the Nuclear Safeguards (EU Exit) Regulations 2018. Arrangements for the investigation, resolution and reporting of discrepancies must be in place.

95. An anomaly is defined as ‘a discrepancy or series of discrepancies that are consistent with the absence or gain of a significant amount of nuclear material’. An anomaly can be detected during an investigation of discrepancies of whatever kind’.

96. Operators should have a detection capability for nuclear material lost during normal operations and should not rely solely on an annual PIT. Such a capability should include detection of abrupt and protracted loss consistent with safeguards authorities’ detection goals on quantity and timeliness.

97. Operators should have an approach in place that corresponds to the reporting obligations under Regulation 5 (Particular Safeguard Provisions) and Regulation 16 (Special Reports) of the Nuclear Safeguards (EU Exit) Regulations 2018.

98. Operators should recognise, investigate and document the treatment of NMAC anomalies corresponding to Regulation 17 (a) (Unusual Occurrences) of the Nuclear Safeguards (EU Exit) Regulations 2018.

99. Operators should notify and report NMAC incidents and events to ONR corresponding to ONR Guidance: Notifying and Reporting Incidents and Events to ONR [reference].

3.4.1 NMACE 4.1. – Reporting

FSSACE 4 – Reporting, Anomalies and Investigations	**Reporting**	**NMACE 4.1**
Operators should implement and maintain arrangements for the monitoring, reporting and review of NMAC&S performance which includes the effectiveness of meeting NMAC&S requirements and identifying trends.		

100. Procedures should be developed, implemented and maintained for detecting, reporting, responding to and handling NMAC&S anomalies.

101. Operators should monitor and review NMAC&S performance which should include effectiveness of meeting NMAC&S requirements and identifying trends. Performance metrics will be tailored to local conditions but should include information on:

a) nuclear material control of movements, measurements and inventory;

b) NMA accuracy and timeliness;

c) anomalies; their investigation, corrective action and Learning From Experience (LFE);

d) human performance in conduct of operations so as to reduce intrinsic risk of human errors;

e) safeguards compliance, assurance and responsiveness; and

f) NMAS competence, culture and regulatory confidence.

102. Communications channels should be established that ensure NMAC&S performance and relevant information regarding the investigation, identification and elimination of the cause of NMAC&S anomalies is communicated to those involved / responsible and to a wider site review of NMAC&S performance and learning.

103. Operators should define personnel responsibilities outlining the form of internal communication required when actions under Regulation 17 (a) or (b) of the Nuclear Safeguards (EU Exit) Regulations 2018 are required. This approach should also define the mechanisms under which the personnel will inform the ONR.

104. Operators should define personnel responsibilities and authority in order to provide ‘further details or explanations’ when requested under Regulation 16 of the Nuclear Safeguards (EU Exit) Regulations 2018.

3.4.2 NMACE 4.2. – Anomalies and Investigations

FSSACE 4 – Reporting, Anomalies and Investigations	**Anomalies and Investigations**	**NMACE 4.2**
Operators should have an approach that recognises, investigates and manages Nuclear Material Accountancy and Control discrepancies in a timely manner and documents their treatment. Such investigations should aim to establish in a timely manner the accountancy evidence that all material is accounted for.		

105. Operators should develop, implement and maintain arrangements for investigation, identification and elimination of the cause of NMAC&S anomalies. Such investigations should aim to establish in a timely manner the accountancy evidence that all material is accounted for.

106. Operators should develop, implement and maintain NMAC&S related response procedures for:

a) Inventory Differences (ID) or Shipper Receiver Differences (SRD) that exceed action levels including any that involve discrete items;

b) Unexpected changes in the containment of nuclear material, to a point where unauthorised removal of nuclear material has become possible; and

c) Anomalies that are deemed significant by a Nuclear Material Custodian or Nuclear Material Accountant including items that cannot be found at their recorded location.

107. The procedures should ensure:

a) The abnormal ID or SRD is documented immediately after it is identified (eg during a PIT or PIV). It is not appropriate to wait for the results of investigatory work before documenting and reporting the ID.

b) The nuclear material custodian ensures the investigating offices issues an initial report within 14 days of the initial recording of the ID or SRD; and

c) The investigation remains open until a final report on the incident is issued and this is accepted by the NMAS Manager.

108. Wherever possible, nuclear material that has been subject to significant SRDs should not be further processed or converted into other batches until management approval has been obtained. Normally, this would only be after management is satisfied that adequate measures have been taken to resolve the SRD.

3.4.3 NMACE 4.3. – Corrective Actions

FSSACE 4 – Reporting, Anomalies and Investigations	**Corrective Actions**	**NMACE 4.3**
Operators should have procedures to deal with NMAC&S incidents which include escalation, investigation and corrective action arrangements to resolve incidents. Procedures should prevent reoccurrence of NMAC&S incidents and ensure wider dissemination of learning from experience.		

109. Corrective actions are defined for safeguards purposes as an 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.

110. Operators should develop, implement and maintain procedures to deal with NMAS incidents including escalation, investigation and corrective action arrangements. Clear escalation processes are needed for suspected loss of nuclear material control and suspected theft or diversion of nuclear material. Such processes cover conditions requiring suspension of movements/operations; the taking of a physical inventory at short notice (an Emergency Physical Inventory Taking – EPIT); and reporting to the safeguards and nuclear security authorities. Incidents classed as NMAC&S-related include those which:

a) Are a potential loss of control of nuclear material (eg anomalies exceeding action levels, unexpected changes in containment, items which cannot be found and unauthorised movements);

b) Undermine the authenticity of NMA information;

c) Are non-compliant with NMAS-related requirements;

d) Negatively impact the safeguards authorities (eg involve inspectors or inspection equipment); and

e) Impact on customer nuclear material management and reporting.

111. Operators should develop, implement and maintain improvement action procedures to prevent recurrence of NMAS incidents and ensure wider dissemination for LFE. Incidents at other nuclear sites should also be included in LFE processes. The QMS should assign responsibility for managing improvements and the criteria for recognising when improvements are needed.

3.5 FSSACE 5 – Reliability, Resilience and Sustainability

Fundamental Expectation for Nuclear Material Accountancy and Control	Reliability, Resilience and Sustainability	FSSACE 5
Operators must design and support their nuclear material accountancy and control regime to ensure it is reliable, resilient and sustained throughout the entire lifecycle of the facility.		

112. NMAC&S systems and components need to be designed to deliver their required NMAC&S functions with appropriate reliability and so provide confidence in the robustness of the overall design of the NMAC&S system.

113. For NMAC&S purposes, the life cycle of a nuclear facility can be sub-divided into nine separate phases:

a) Pre-Construction
b) Construction
c) Commissioning
d) Operating
e) Maintenance/Modification
f) Shut-down
g) Closed-down
h) Decommissioned (for safeguards purposes)
i) Demolition & Site Remediation

Each phase is associated with specific NMAC&S requirements; it is important to keep in mind that different areas of a nuclear facility may be in different life cycle phases.

114. Sustainability is defined by the set of objectives and implementing actions incorporated into the NMAC&S system to support its continuing effectiveness. If the NMAC&S system is to remain effective, its constituent parts must be sustained and supported over time to ensure it continues to achieve the required outcomes.

3.5.1 NMACE 5.1. – Reliability and Resilience

FSSACE 5 – Reliability, Resilience and Sustainability	Reliability and Resilience	NMACE 5.1
Operators must incorporate reliability and resilience into the design of systems for the purposes of nuclear material accountancy and control.		

115. Operators should ensure availability of sufficient resources to maintain continuity of NMAC&S provision. Continuity arrangements, aligned to appropriate standards should be developed in order to maintain an effective and robust NMAC&S system.

116. Redundancy should be incorporated as appropriate within the designs of NMAC&S systems and components and accountancy and control plans should demonstrate that the required level of redundancy for the intended NMAC&S function has been achieved.

117. Source data and associated records to substantiate NMAC&S reports and if necessary reconstruct the accounts (eg if any part of the system is destroyed or rendered ineffective) are required to be maintained for 5 years from the date on

which they were generated. All accountancy information is to be readily traceable from its generation as source data through to final production of NMAS reports.

118. The measures whereby the claimed reliability of NMAC&S systems and components will be achieved in practice should be stated. Evidence should be provided to demonstrate the adequacy of these measures. This should include a reliability analysis of both random and systematic failures. Assumptions made in the course of the reliability analysis should be justified.

119. Where reliability data is insufficient to support a claim, appropriate measures should be taken to ensure that the onset of failures will be detected, and that the consequences of failure are minimised. Such measures may, for example, include planned replacement after a fixed lifetime, or be achieved through a programme of examination, maintenance, inspection and/or testing.

3.5.2 NMACE 5.2 – Examination, Inspection, Maintenance and Testing

FSSACE 5 – Reliability, Resilience and Sustainability	**Examination, Inspection, Maintenance and Testing**	**NMACE 5.2**
Systems and components for the purposes of nuclear material accountancy and control should receive regular and systematic Examination, Inspection, Maintenance and Testing (EIMT).		

120. A process for in-service testing, inspection and other maintenance procedures of NMAC&S systems and components should be identified in the accountancy and control plan.

121. The EIMT should be commensurate with the reliability required of each element and carried out in a manner, governed by procedures, and applying codes and standards appropriate to the NMAC&S system or component. Such inspection should be of sufficient extent and frequency to give adequate confidence that degradation will be detected before loss of the NMAC&S function to ensure continuing quality and reliability. Accordingly, EIMT should prove the outcome of the complete system and the NMAC&S function of each functional group.

122. Where test equipment, or other engineered means, is used for EIMT (e.g. for measurement equipment), the extent to which they reveal failures affecting NMAC&S functions should be justified. The test equipment, or other engineered means, should itself be tested at intervals sufficient to uphold the reliability claims of the equipment under test.

123. EIMT is part of normal operation and it should be possible to carry out these tests without any loss of any NMAC&S function. In other cases, the ACP should justify that there will be sufficient compensatory measures in place at all times to ensure any risk is adequately mitigated.

124. Where complete functional testing is claimed not to be appropriate, an equivalent means of functional proving should be adopted. In circumstances where this cannot be done, either additional design measures should be incorporated to compensate for the deficiency, or it should be demonstrated that adequate long-term performance would be achieved without additional measures.

125. The continuing validity of equipment qualification of NMAC&S structures, systems and components should not be unacceptably degraded by any modification or by the carrying out of any maintenance, inspection or testing activity. Furthermore, NMAC&S systems and components should be subject to extraordinary EIMT and/or re-validation after any event that might have challenged their reliability.

3.5.3 NMACE 5.3 – Sustainability

FSSACE 5 – Reliability, Resilience and Sustainability	Sustainability	NMACE 5.3
Operators should ensure that the constituent parts of its nuclear material accountancy and control regime are sustained and supported over time to ensure it continues to achieve the required outcomes.		

126. Senior managers within operator organisations should set priorities and identify the long-term financial resources needed (e.g. for asset replacement) in addition to on-going operational expenditure related to issues such as training, configuration management, asset care and maintenance.

127. Operators should ensure effective management and planning in order to sustain the NMAC&S regime through reviewing resources allocated for effective design, implementation, operation and maintenance.

3.6 FSSACE 6 – Measurement Programme and Control

Fundamental Expectation for Nuclear Material Accountancy and Control	Measurement Programme and Control	FSSACE 6
Where measurements are performed, operators must implement and maintain robust arrangements to ensure the appropriate performance of measurement systems that provide data for the purposes of nuclear material accountancy and control.		

128. Bulk handling facilities should have a fully implemented measurement system compliant to the criteria of this section. To accomplish this, the ISO/IEC 17025:2005 [16] and ISO 10012:2003 [17] can serve as relevant good practice. Item facilities should only apply the criteria where accountancy declarations are based on calculations (i.e. burn-up declarations in power reactors), this applies for the whole section 3.6.

129. The quality of measurements from which NMA records are based, at a minimum, should meet the International Target Values 2010 for Measurement Uncertainties in Safeguarding Nuclear Materials [18].

130. The implementation of an effective measurement system with an associated measurement control programme are crucial for achieving accurate and robust NMAC&S. Aspects of the measurement system, and control programme that are likely to be important for achieving and maintaining accurate and robust NMAC&S are highlighted in individual sections of these expectations. These have not been written to be exhaustive.

131. Operators should ensure SQEP measurement controllers are in place for the management of the measurement control programme. Measurement controllers are ideally organisationally independent of those performing measurements and either directly responsible for or have oversight of:

a) measurement quality and authenticity;
b) measurement performance, including for PIT;
c) the planning, development, coordination, and administration of a measurement control program;
d) the appropriate use of and traceability to reference standards;
e) the measurement resources (equipment, instruments and procedures used in performing a measurement);
f) hold up modelling and statistical handling of measurement errors;
g) improvements to eliminate/minimise significant source of bias or improve measurement capability; and
h) measurement disputes.

3.6.1. NMACE 6.1 – Measurement Control Programme

FSSACE 6 Measurement Programme and Control	Measurement Control Programme	NMACE 6.1
A system should be implemented for accountancy areas where nuclear material is processed, to ensure the effectiveness of measurement and analytical systems and the quality of resulting data that is generated for NMAC&S purposes.		

132. The facility should have documented procedures for monitoring the validity of the measurement results to be used for nuclear material accountancy. The criteria to assess the results must be predetermined and statistical tools should be used where possible. The programme should include the regular use of certified reference material to demonstrate analytical performance, participation in inter-comparisons, replicate tests and retesting. The programme should be subject to periodic review and improvement.

133. Operators should ensure the measurement control programme includes a calibration and verification plan for instruments used in measurements used for NMAC&S purposes. Verifications and calibrations should be performed according to procedures in place to ensure metrological traceability. Calibration uncertainty should be estimated according to established methods, further considerations are outlined below:

a) Verification and calibration parameters should be stipulated in advance.
b) Routine checks should be also planned when needed.
c) Actions to solve nonconformities should be foreseen.
d) Follow-up and history of every relevant instrument should be ensured by means of a records system.

134. The measurement control programme (MCP) should provide assurance that accountancy mass values are free from any significant measurement bias and that the measurement uncertainty is appropriately estimated. The measurement control programme should include measures to ensure that factors influencing measurements are under control, considerations should include:

a) Instrumentation and equipment

b) External conditions
c) Human factors
d) Measurement Methods

Estimation methods to quantify measurement uncertainties should be documented. They should include every component which are of importance in a given situation and should guarantee metrological traceability of measurements and calibrations.

135. Provision should be made for the record keeping of all measurement activities performed. Operators should ensure that the implementation of a records management system enables the maintenance of a comprehensive record of measurement data.

136. Measurement procedures according to measurement methods should be in place and should be known and understood by those performing measurements.

137. A suitably qualified and experienced person (SQEP) should be nominated as responsible for approving measurement results.

138. Where nuclear material sampling is performed for NMAC&S purposes, a sampling plan should be in place and appropriate sampling procedures should be identified based on statistical considerations. Sampling and the sampling technique should be recorded appropriately.

139. In cases where data provided for the purposes of NMAC&S is based on calculations that are not direct measurements, the values provided should be validated, traceable and approved. Similar requirements apply to item counting. The calculation method applied should be documented, technically justified and validated with real data where possible. The results should be approved by a nominated SQEP person and every activity should be recorded.

3.6.2. NMACE 6.2 – Traceability and Validation

FSSACE 6 Measurement Programme and Control	Traceability and Validation	NMACE 6.2
Measurements performed for the purposes of nuclear material accountancy and control should be conducted as to have traceability and should be validated appropriately.		

140. Records of every measurement related activity should permit to reproduce exactly how, who, when, the equipment used and under what conditions the measurement was made. Templates for records should take this criterion into account, a system to archive records should be documented and implemented.

141. Measurement results must be traceable to units of the international system when possible, by means of traceable calibrations. For the purposes of this document, traceability should be read as metrological traceability as it is defined in International Vocabulary of Metrology (VIM) [19] '*property of a measurement result whereby the result can be related to a stated reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty*'.

142. The measurement methods and techniques used for NMAC&S purposes should be subject to appropriate validation. Measurement methods completely covered by recognised international standards or normative documents (International Organization for Standardization (ISO) standards, European standards (EN), International Organization of Legal Metrology (OIML) Recommendations) do not

need to be validated. (This does not imply that metrological validation should not be performed). Any other method should be validated according to predetermined performance criteria. Operators should document and record each validation study. In the case of nuclear power reactors, the calculation codes for the burn-up are considered as validated by the provider. It should be ensured that the code is used under the conditions allowed by the validation and using the correct data.

143. Measurement techniques employed for the purposes of the NMAS system should:

a) be appropriately identified, and documented in NMAS procedures; and

b) be calibrated, maintained and used so as to provide accurate data in line with the prevailing measurement standards.

3.6.3. NMACE 6.3 – Precision and Accuracy

FSSACE 6 Measurement Programme and Control	**Precision and Accuracy**	**NMACE 6.3**
Where measurements are performed for the purposes of nuclear material accountancy and control, a programme should be established for providing sufficiently accurate and precise quantification and characterisation of the material subject to measurement.		

144. Precision is defined in VIM as ‘*the closeness of agreement between indications obtained by replicate measurements on the same or similar objects under specified conditions’* and should be assessed in situations such as a validation study, when new measurement equipment is introduced to the system and for conditions change verifications etc. by means of the performance parameters repeatability and/or reproducibility.

145. Accuracy is defined in VIM as ‘*closeness of agreement between measured quantity values that are being attributed to the measurand, the concept measurement accuracy is not given a numerical value, but a measurement is said to be more accurate when it offers a smaller measurement uncertainty’*. To assess accuracy, measurement uncertainty should be calculated. This should, where appropriate be done according to the Guide to the expression of uncertainty in measurement (GUM) (ISO, OIML, BIPM, …) [20]. Limits on uncertainty should be pre-stated, and it should be assessed not only during validation etc. but on a regular basis for every measurement.

3.7 FSSACE 7 – Nuclear Material Tracking

Fundamental Expectation for Nuclear Material Accountancy and Control	Nuclear Material Tracking	FSSACE 7
Operators must implement and maintain a nuclear material accountancy and control system that is able to provide identification, quantity, characteristics and track any nuclear material in their facilities at any time.		

146. For the purposes of these expectations, control of internal (on-site) movements is as follows:

a) document the expected nuclear material routes through and locations in each accountancy area; the accountancy points at which transfer of nuclear material custody occurs; and methods for determining the quantity of nuclear material transferred;
b) retain custodial control with the issuing accountancy area until the consignment is physically handed over to the recipient and approved on the source documentation;
c) record and authenticate all movements of nuclear material between different accountancy areas and transfer the NMA data to the Nuclear Material Accountant within one working day of the transfer taking place;
d) prove the integrity of the reporting system for fully automated systems of movement control during commissioning;
e) ensure that any interventions or corrections to source accountancy data are documented and traceable to the personnel involved; and
f) agree NMAS arrangements for new flows of nuclear material in an existing plant before the first movement takes place.

3.7.1. NMACE 7.1 – Inventory Control

FSSACE 7 Nuclear Material Tracking	Inventory Control	NMACE 7.1
Operators should ensure that processes and arrangements are established and implemented to ensure any processing and/or transfers of nuclear material are controlled, recorded and authenticated appropriately.		

147. Inventory control requires the operator to ensure that all nuclear material transfers into and out of the facility and transfers between process areas are recorded. Operators should have documented processes in place and implemented to ensure that all transfers of nuclear material are correctly recorded.

148. Timeliness is a key aspect of the capability of an accountancy system to provide an up-to-date statement of nuclear material inventories, and so the system aim should be to record transactions within one working day of them taking place. Where the required accountancy data rely on results from sampling and analysis, provisional estimated data should be entered, and identified as such.

149. A regular interval for records matching should be defined and the process documented, ensuring that stock records corresponds with KMP flow records, storage location records and processing records. Records matching should also encompass regular reconciliation of local records and central MBA records.

150. Where appropriate, the NMAC&S system should take into account any inventory control measures that ensure continuity of knowledge of the nuclear material contents of items (e.g. items under seal).

151. Operators inventory control arrangements should, in a proportionate manner include physical checks of inventory in addition to the PIT. This requirement should be proportionate to the type and size of the installation in addition to its operational status.

152. The NMAC&S system should be able to provide location, identification, quantity and the characteristics of all nuclear material in the installation at any time, irrespective of custodial handover and pending reception acceptance/documentation.

153. NMA data authentication should include a full audit trail to original source documents. Accounts may be updated on the basis of an electronically authorised source document, providing this is secured, retained and protected from unauthorised correction. Source data for nuclear material movements should never be amended without endorsement by the Nuclear Material Custodian or delegated nominee.

154. Where blending and mixing of a variety of nuclear material is not aimed at producing a target product batch (eg within an analytical laboratory), then the Nuclear Material Custodian should ensure that details of the nuclear materials being blended in the batch are provided to the Nuclear Material Accountant. Where the items are small, or contain only sub-gram quantities of nuclear material, this can be aggregated on a monthly basis for NMAS purposes.

3.7.2. NMACE 7.2 – Identification of Nuclear Material

FSSACE 7 Nuclear Material Tracking	Identification of Nuclear Material	NMACE 7.2
Operators should ensure that procedures are in place to enable the unique identification of all nuclear material within the facility.		

155. Nuclear material should, where practical, be in containers having a recorded unique identity. When nuclear material is not in a transportable container (e.g. in process vessels), a well-defined process location can be considered both as identity of the ‘container’ and as the location of the material.

156. Identities of the containers must be permanent and readily legible for inventory checking. If the identity of the item needs to be changed, the link between the old and new identities should be recorded.

157. If nuclear material is within multiple layers of containment, the NMAC&S system should be able to provide the characteristics and quantity of the nuclear material by means of the containers unique identity.

158. The locations in which nuclear material can be held should be defined and identified on the NMAC&S documentation (e.g. the BTC) and used as the basis for recording the location and transfers of material.

159. Where appropriate, specific positions within storage areas should be encompassed in the information provided by the NMAC&S system for the location of nuclear material (e.g. storage facilities).

160. For nuclear material storage, the NMAC&S system should be able to provide identification, quantity and characteristics of nuclear material present in every specific location of the facility. Records of nuclear material movements into and out of the facility or between different positions within the facility should be kept.

161. When nuclear material enters a process or is subject to repacking, the operating records should enable identification of the items from which the material has been fed into the process (or into new containers).

162. Operating records should specify the amount of material fed into the process or repackaged and, provide traceability of the characteristics and quantity of the nuclear material.

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

164. In the event of a transfer of nuclear material that is not a transfer of a contained item, the amount of the transferred material should be measured. It should be documented which methods and instruments are used for this purpose, all the requirements of FSSACAP 6 apply.

165. The records associated with nuclear material movements should include information on the protective marking; on what nuclear material was moved, how and when it was transported, where it was moved from, and the handshake and confirmation sign offs. Data should include locations, batch and container identification, quantity and form, the actual date of movement, and authorisations and confirmations of those accountable.

166. Operators should ensure that the records associated with blending or mixing of nuclear material with different isotopic compositions include a unique blend identity, where and when the blend took place, the nuclear material identity, quantity, form, and isotopic composition of the blend inputs and outputs.

3.7.3. NMACE 7.3 – NMAC Discrepancies

FSSACE 7 Nuclear Material Tracking	**NMAC&S Discrepancies**	**NMACE 7.3**
Operators should ensure that arrangements are in place that recognise and investigate NMAC discrepancies whilst recording their management.		

167. The term ‘NMAC discrepancy’ is defined for the purposes of this document as ‘*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*.’

168. The term ‘Nuclear Material Control Discrepancy’ is defined for the purposes of this document as ‘*a non-conformance in the identification or location of nuclear material*’.

169. The accountancy system should include procedures to minimise data discrepancies resulting from misreading or incorrect data transmission or calculation, with checking mechanisms employed to provide timely detection of errors, discrepancies or omissions in records.

170. Investigations into NMAC&S discrepancies should indicate the actions to be taken and the conditions, in each case that are considered to resolve the discrepancy. Actions to be taken should include responsibilities and the additional data to be utilised. Operators should have procedures in place for resolving and reporting discrepancies which fulfil the requirements of relevant good practice [16].

171. Operators should make the appropriate correction of records and regulatory declarations when a discrepancy has been resolved.

172. Operators should record when a discrepancy remains unresolved and the action taken to resolve it.

173. Operators should have procedures in place to resolve and report discrepancies and reconciliation with other local or central accounts.

3.8 FSSACE 8 – Data Processing and Control

Fundamental Expectations for Nuclear Material Accountancy and Control	Data Processing and Control	FSSACE 8
Operators should implement and maintain data processing systems that are capable of producing the nuclear material accountancy and control declarations required under the Nuclear Safeguards Regulations.		

174. Data processing systems and components need to be designed to deliver their required NMAC&S functions whilst maintaining an appropriate level of control of the documentation and data they handle. This fundamental expectation for nuclear material accountancy and control describes ONR's expectations of how operators will implement effective data processing and control to ensure the NMAC&S system can function effectively and efficiently.

175. The NMACE's below do not specify particular processes but describe what good data processing and control will look like. It should be noted that the ONR's security assessment expectations [14] outline the ONR's expectations of how organisations within the civil nuclear industry and third parties handling SNI and other assets will apply protective security to ensure the civil nuclear industry can function effectively, efficiently and securely.

3.8.1. NMACE 8.1 – Data Processing Capabilities

FSSACE 8 Data Processing and Control	Data Processing Capabilities	NMACE 8.1
Operators should have the appropriate capabilities in place to ensure that declarations required under the Nuclear Safeguards Regulations can be produced in the correct format, within the required timescales.		

176. Operators should implement a data processing system which is capable of producing the declarations required under The Nuclear Safeguards (EU Exit) Regulations 2018 in a safe and secure manner, the system should be capable of producing the following:

a) Material Balance standard deviation for material balance tests (where appropriate.
b) Various types of documents linked to inventory change (IC) declarations such as shipping documentation.
c) Working documents for routine inventory control (e.g. List of Inventory Items).
d) Working documents for the PIT.
e) A list of inventory items (LII) resulting from PIT and used during PIV or other verification.
f) 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 should ensure the completeness and correctness of the data-processing system.

177. 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) Procedures to describe how to deal with discrepancies which guarantee traceability of corrections.
e) Documentation of the results of inventory checking and database reconciliation, including documentation of discrepancies encountered (for the purpose of performance indicators).

178. The procedures for data-processing activities should provide the NMAC&S system manager with supervisory information. This should include the staff member initiating each software execution, identify the application program(s) involved as well as identify the location of the data inputs used and 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 authorized data processing policy (ISO 17799:2005 [8] requirement. – traceability).

179. Source (operating) data and associated records to substantiate reports to the ONR and if necessary reconstruct the accounts (eg if any part of the system is destroyed or rendered ineffective) are required to be maintained for 5 years from the date on

which they were generated. All accountancy information is to be readily traceable from its generation as source data through to final production of NMAS reports.

180. Timeliness is a key aspect of the capability of an accountancy system to provide an up-to-date statement of nuclear material inventories, and so the system aim should be to record transactions within one working day of them taking place. The nuclear material accountancy system should show both the date the transaction took place and the date it was entered into the books, and include means of monitoring any delay. Where the required accountancy data rely on results from sampling and analysis, provisional estimated data should be entered, and identified as such.

181. The accountancy system should include procedures to minimise data errors resulting from misreading or incorrect data transmission or calculation, with checking mechanisms employed to provide timely detection of errors, discrepancies or omissions in records.

3.8.2. NMACE 8.2 – Compilation of Nuclear Material Accounts

FSSACE 8 Data Processing and Control	Compilation of Nuclear Material Accounts	NMACE 8.2
Operators should ensure that the appropriate arrangements and procedures are in place to ensure the effective management of their nuclear material accounts.		

182. Book inventories and balances for nuclear material are updated so that source data are recorded in the accounts within one working day of their creation. Nuclear material accounts for each accountancy area are finalised (and statemented) when PIT data become available and the nuclear material balance has been calculated and the ID derived. This should be as soon as possible following the end of the material balance period and as agreed with the safeguards authorities. Subsequent corrections will then apply to the accounts for the period in which the correction is made.

183. Units of accountancy for nuclear material;

a) quantities of nuclear material are required to be expressed in grams for reporting to the safeguards authorities. NMA is therefore expressed in units of grams, or smaller;
b) uranium accounts are required for each nuclear material category (natural, depleted or enriched) in terms of total uranium. A single (unified) category may be agreed with safeguards authorities for bulk processes which are dominated by a particular category;
c) uranium accounts are required to record the fissile component for low and high enriched uranium stocks;
d) plutonium accounts are required to be kept in terms of total plutonium (and may also record fissile content); and
e) where nuclear material is present as discrete items, then the nuclear material accounts should also be balanced by number of items.

184. Good Practice is to:

a) account for sub gram items held in discrete containers and which have higher concentrations of nuclear material (eg metallic uranium or plutonium), especially if there are large number of such items. In this case, such items can be aggregated and reported as a single batch with a number of items.

b) record all item nuclear material weights to the same level of significance (as determined by the sensitivity or capability of the measurement) for the purpose of aggregating.

185. All accounting or recording conventions used in deriving nuclear material quantities from source data should be documented and approved.

186. Corrections:
a) to NMAS transactions should be in a form that indicates what has been changed along with both the old and new values;
b) to transactions that have not already been reported formally to the safeguards authorities should be recorded, but only the corrected transaction need be included in formal reporting;
c) to transactions that have already been reported formally to the safeguards authorities should be recorded, with that correction also included in the next formal report submitted;
d) in formal reports to the safeguards authorities should be by means of deletion and addition of the reporting lines concerned, or use of the New Measurement (NM) inventory change code, as agreed with those inspectorates; and
e) all corrections should show the date of the correction and the identity of the person making the correction.

187. Category changes:
a) where blending or mixing of batches of nuclear material with different isotopic compositions leads to a change of nuclear material category (e.g. from high enriched uranium to low enriched uranium), the change is reported in the accountancy area in which the blending occurred and needs to take into account/balance the uranium, the U235/233 and the obligation codes involved;
b) if a category change is required as a result of a new analytical result, it is reported in the accountancy area where the nuclear material arose and any subsequent transactions already declared are treated in accordance with the procedure for corrections.

188. Re-batching:
a) where a batch or batches of nuclear material are re-batched into new discrete batches, then a full audit trail is maintained between the original and new batch(es); and
b) re-batching takes place entirely within one accountancy area and one category and should not give rise to any discrepancies other than rounding.

189. Nuclear productions: the generation of nuclear material as a result of irradiation (e.g. in a reactor) is required to be accounted for. Such production in irradiated fuel is reported to the safeguards authorities when the fuel is transferred from the reactor MBA or otherwise within 12 months of the fuel being discharged from the reactor. Elsewhere, nuclear production should be accounted for and reported as specified in PSPs or otherwise agreed with the safeguards authorities.

190. Nuclear loss -information on the conversion of uranium and plutonium and on decay isotopes for plutonium and reference dates for their calculation should (if recorded for operational reasons) be provided to the safeguards inspectorates on request.

191. Quantities of SNM may be rounded down when the first decimal is 0 to 4 and rounded up when the first decimal is 5 to 9. Individual nuclear material accounting records may be rounded in such a manner as to ensure they remain meaningful -in

particular to enable their summation to provide reports accurate to the nearest gram.

192. Change of safeguards status (i.e. nuclear material withdrawn from or brought under safeguards), nuclear material can only be withdrawn from safeguards following ONR approval of a request made in advance. UK Government policy is that withdrawals are limited to small quantities of nuclear materials not suitable for weapons purposes, the details of which are made public. Non-safeguarded nuclear material can only be brought under safeguards from the UK military cycle following approval from the MoD. Separate notification should be provided to the ONR.

3.8.3. NMACE 8.3 – Records Management

FSSACE 8 Data Processing and Control	Records Management	NMACE 8.3
Operators should ensure that the appropriate arrangements are in place to effectively manage the control of NMAC&S documentation and data.		

193. NMAS documentation and data;
   a) all NMA data, whether for safeguards, commercial or other purposes, need to be derived from and readily reconcilable with a single set of source data (the same nuclear material is not to be the subject of parallel accountancy systems /arrangements);
   b) all documentation and data associated with the nuclear NMA system requires appropriate protective marking in accordance with the classification policy issued by OCNS. It is held, handled and transmitted in accordance with current security policy for government protectively marked information and, where appropriate, procedures for the control of commercial information. Personnel require appropriate security clearance for the information or IT systems to which they have access;
   c) NMA data needs to be readily retrievable for independent audit/verification. NMA data reflects the quantity of nuclear material on inventory for each MBA, including details of nuclear material received and issued and other inventory changes. The records system should be capable of being updated on a daily basis or on-demand for all nuclear material transactions, and of producing book inventory figures for MBAs within one working day; and
   d) all records used for NMA are to be traceable to an authenticated source and kept in a manner that guarantees traceability. In particular, all mass values for effluents, discards, wastes and accidental losses require a traceable history.

194. Disaster recovery processes need to include the reconstruction or reconstitution of the nuclear material accounts for any MBA or accountancy area, if any part of the accountancy system for that area is destroyed or rendered ineffective. The source data and accompanying records necessary to reconstruct the accounts are to be maintained for a period of at least 5 years following the end of the accountancy period in which they were created. Note however that Nuclear Site Licence Condition 6 requires 'the licensee shall make and implement adequate arrangements to ensure that every document required, every record made, every authorisation, consent or approval granted and every direction or certificate issued in pursuance of the conditions attached to this licence is preserved for 30 years or such other periods as the Executive may approve'.

195. IT management systems should:
   a) assure the authenticity and security of data. This includes protection from training and program testing activities;
   b) have a configuration controlled environment for quality assurance and provide a full audit trail of data and programme changes, so as to enable independent confirmation;
   c) provide a description to the safeguards inspectorates of the computerised NMA system at least to a level which documents the data handling procedures;
   d) ensure the computer system has the appropriate OCNS accreditation; and
   e) ensure that any migration/upgrade strategy includes suitable arrangements for maintenance of data integrity during migration and provision of long term record storage and retrieval capability of historic data not migrated.

3.9 FSSACE 9 – Material Balance

Fundamental Expectation for Nuclear Material Accountancy and Control	Material Balance	FSSACE 9
Operators must implement and maintain arrangements to ensure that material shipped, received, processed and stored within facilities is subject to robust nuclear material accountancy and control arrangements that guarantee traceability, include arrangements for physical inventory taking and, where appropriate material balance evaluation.		

196. NMAS requires an authoritative breakdown of all nuclear materials which reflects physical reality. This breakdown needs to be localised enough to maintain appropriate nuclear material control and enable effective and efficient safeguards verification. The level of localisation needed is determined by the ONR in consultation with the operator (and the IAEA for selected sites) and define the facility as comprising one or more Material Balance Areas (MBAs). The operator may decide to subdivide an MBA into accountancy areas.

197. General guidelines for constructing accountancy areas are that physical boundaries and Key Measurement Points (KMPs) are defined to maximise the control of nuclear material flow and physical inventories (which contribute to the mass balance of each category of nuclear material held in the accountancy area) and that an accountancy area does not span more than one MBA.

198. Ongoing accountability and control is exercised over an accounting area by: documenting the area; assigning a Nuclear Material Custodian to control the area; conducting a regular physical inventory of locations which can hold nuclear materials; controlling measurements; deploying performance monitoring criteria; and controlling the authenticity and technical provenance of all NMA-related data.

199. Good practice is that:

   a) There are separate accountancy areas for: bulk handling processes; storage of discrete items of nuclear material; areas with significantly different safeguards approaches; separate physical areas of the site and separate areas of management responsibility;
   b) Systems cater for reconfiguration of accounting areas (merging or splitting) and the size of the accountancy area is proportionate with cost effective measurement and recording;

c) There is a single responsibility for the correct and accurate functioning of the nuclear material measurement systems used for NMAS;
d) Formal handover arrangements exist within an accountancy area to enable continuity of knowledge for ongoing activities (moves, physical inventories in progress, investigations etc).

3.9.1. NMACE 9.1 – On/Off Site Movements of Nuclear Material

FSSACE 9 Material Balance	On/Off Site Movements of Nuclear Material	NMACE 9.1
Operators should ensure that the appropriate arrangements are in place to ensure that nuclear material shipped from sites and external receipts of nuclear material onto sites are controlled and subject to effective and robust NMAC&S arrangements that guarantee traceability.		

200. Operators should have arrangements for the control of external receipts into and issues out of the site as follows:
   f) Each site has a nominated person with overall responsibility for nuclear material in transit to or from the location; and
   g) Agreement should be obtained from the relevant Nuclear Material Custodian before delivery of the material is agreed;
   h) Formal agreement for the shipment of nuclear material is required from the consignee, prior to the dispatch of any nuclear material from the site.
   i) Information relevant to on/off site movements of nuclear material should be recorded in a way that guarantees traceability.
   j) Accountancy data are transmitted to Nuclear Material Accountants within one working day of receipt or issue of nuclear material.

201. Operators should have arrangements in place for the receipt of nuclear material onto sites, which encompass the following:
   a) Arrangements should be in place clearly identifying those responsible and the activities required to check and enter NMAC&S information provided to the site upon receipt of nuclear material. These activities should include the corrective actions to be taken in the event of discrepancies.
   b) Nuclear material receipts are physically checked as far as practicable against accompanying source data (eg which should indicate or allow the derivation of nuclear material weight, isotopic composition, the safeguards obligation code and, where available, the MBA code for the shipper), including check measurements where appropriate. The nuclear material is not released for use until these checks are complete.
   c) The NMAC&S system uses the shipper data. If, after measurement, a difference is found outside the acceptance criteria and a correction is not supplied by the shipper, then the data is instead corrected to the site's values by declaring a Shipper Receiver Difference (SRD).
   d) A management procedure or escalation process is needed to deal with receipts that have no accompanying nuclear material documentation or for nuclear material subsequently found in equipment or apparently empty containers received at the site.
   e) If, on receipt, the data recorded on the shipper's documentation are clearly in error then the shipper should provide corrected documentation (personnel at the receiving site are not to amend shipper's documentation). Until a difference is resolved, the shipment follows a quarantine procedure.

f) Advance notification of certain imports is required to be communicated to the ONR (as specified in Regulation 22 (2) of The Nuclear Safeguards (EU Exit) Regulations 2018) Unless otherwise stated, such notification has to reach the ONR at least four days before the nuclear material is unpacked, carry the appropriate protective marking and be submitted via UKSO.
g) Good practice is the use of electronic data exchange between consignor and consignee for regular and detailed consignments.

202. Operators should have arrangements in place for the shipment of material from sites, which ensure the following:
a) Nuclear material is appropriately measured (physically checked) and accounted for before dispatch and NMAS shipping advice notes are produced. These activities should include the check of the NMAC&S information to be sent to the receiver.
b) The NMAC&S system is appropriately updated to reflect the dispatch of material.
c) Arrangements should be in place to manage the appropriate response and corrective actions and to be taken in the event of the recipient reporting discrepancies.
d) Advance notification of certain exports is required to be communicated to the ONR (as specified in Regulation 21 of The Nuclear Safeguards (EU Exit) Regulations 2018). Unless otherwise stated, such notification has to reach the ONR at least seven days before the day on which the nuclear material is packed for shipment, carry the appropriate protective marking and be submitted via UKSO.
e) An auditable system of checks should be in place to ensure that nuclear material is not shipped from the site in apparently empty containers.

3.9.2. NMACE 9.2 – Physical Inventory Taking

FSSACE 9 Material Balance	Physical Inventory Taking	NMACE 9.2
Operators should ensure that the appropriate Physical Inventory Taking arrangements are in place to ensure that all nuclear material within an accountancy area and/or material balance area is recorded accurately through measurement or derived estimates, as specified in Regulation 15 of The Nuclear Safeguards (EU Exit) Regulations 2018.		

203. A PIT involves measuring or deriving estimates of all nuclear material within an accountancy area and/or MBA, and is performed in order to verify the book inventory at a given date. Unless otherwise specified in the PSPs and /or Facility Attachments (FAs), a PIT is required for each MBA every calendar year, with the period between two successive PITs not exceeding 14 months. The Nuclear Safeguards (EU Exit) Regulations 2018 require, on an annual basis, an outline programme of activities that includes provisional dates for taking a PIT -with confirmatory details of the PIT provided to the ONR at least 40 days prior to it taking place. Any subsequent changes to the intended programme require communication to the ONR without delay. Such declarations carry an appropriate protective marking and, unless agreed otherwise, are to be submitted to the ONR via UKSO.

204. Site procedures for PIT should take into account all relevant organisational policies, management procedures and work instructions and include clear definition of responsibilities and specific criteria for the planning, housekeeping, pre-checks, conducting, and reconciling the results of the inventory. They should ensure that

nuclear material movements are halted for the duration of the PIT and that the presence of all nuclear material is recorded accurately:

a) nuclear material is uniquely identified;
b) items that can be shown to have retained their integrity since last being measured do not require re-measurement but should receive some continuity check measurements to maintain confidence;
c) the amount of nuclear material held in any process areas is minimised, and there is suitable technical justification for estimates of the nuclear material quantities involved (i.e. they are not determined by the difference between receipts and issues in a particular location);
d) wherever necessary to determine its nuclear material content, nuclear material is converted to a measurable form and/or transferred to a suitable measurement location. Where this is not practicable then a technically justifiable estimate can be used;
e) nuclear material which is in a measurable form, and for which the nuclear material content is not accurately known, is homogenised, sampled and analysed;
f) all personnel who participate in the PIT are trained and have achieved the necessary competence for their area of responsibility; and
g) instruments used for nuclear material measurements at KMPs are in calibration and records of recent calibrations and derived measurement uncertainties are available.

205. Best practice is that operators, as part of their PIT procedures, develop MBA specific standards to target at PIT/PIV which ensure that facilities are in an optimal configuration (considering points from 204). This provides outage management and operational personnel with a clear target to aim for at PIT/PIV and can begin preparations from an early stage.

206. If it is not possible to perform a direct check of all nuclear material (e.g. in areas where it cannot be safely accessed, such as reactor cores, fuel storage ponds and waste stores), then the PIT may involve the use of a sampling plan or record check as approved by the NMAC&S Manager. Where the PIT relies entirely on transfer records then quality controls on such records need to be undertaken, supported by assurance of the nuclear material integrity during presence in the area.

207. Procedures should ensure that PIT results are recorded on uniquely identified source documents that facilitate the accurate recording of data and, as a minimum, include batch and container/vessel identities, quantitative information on number of items and bulk quantity of nuclear material; location information and accountancy area; physical and chemical form; isotopic data and category of nuclear material; and sign off data of those taking/checking the inventory.

208. Any corrections to PIT data are to be authorised by or with the consent of the Nuclear Material Custodian and the Nuclear Material Accountant. PIT results are reported to the safeguards authorities in the form of a Physical Inventory Listing (PIL), submitted along with a Material Balance Report (MBR) within 15 days of the date of the PIT.

209. Process control and/or other requirements not directly related to safeguards may mean that inventory monitoring and verification are required on a more frequent basis than an annual PIT. Such monitoring may take a number of forms, for example, process monitoring, check inventories, interim assurance or Near Real Time Material Accountancy (NRTMA). The safeguards authorities may take such monitoring systems into account when formulating safeguards inspection approaches.

210. Good Practice is that:

a) PIT frequency should be no greater than 12 months so as to allow a contingency in achieving a successful PIT/PIV within 14 months. Intervals between PITs should be of similar duration but optimising PIT intervals is risk based (taking into account the control and monitoring measures in place; the levels of inventory difference found; the accuracy of the system; plant opportunities and the degree of confidence in the system);
b) following a PIT, a timely critique of the PIT performance and anomaly resolution should be produced and communicated to those involved/responsible and to a wider site review of PIT performance and learning;
c) stores with high turnover of items (e.g. pellet store, rod store) should be subject to interim stock checks (e.g. cycle counting) in order to identify items in error earlier, thus triggering investigation, identification, and elimination of the cause of the errors;
d) sites have a detection capability for nuclear material lost during normal operations and do not rely solely on an annual PIT. Such a capability includes detection of abrupt and protracted loss consistent with safeguards authorities' detection goals on quantity and timeliness; and
e) sites are able to carry out an EPIT to confirm or discount claims (external or internal) concerning loss of nuclear materials.

3.9.3. NMACE 9.3 – Material Balance Evaluation

FSSACE 9 Material Balance	Material Balance Evaluation	NMACE 9.3
Operators should ensure that where appropriate, arrangements are in place to ensure that Material Balance Evaluation is carried out to determine if any non-zero material unaccounted for can be explained by measurement uncertainty or reflects other causes.		

211. ***Inventory Differences*** (IDs) -An ID is calculated as:

ID = closing physical inventory minus opening physical inventory minus receipts plus issues

A positive ID is therefore referred to as an apparent nuclear material 'gain' and a negative ID as an apparent nuclear material 'loss'.

212. IDs in bulk handling facilities are recorded in the nuclear material accounts for the plant in which they are determined. These should be tested for significance against the limits of error identified by the measurement control plan (MCP). If, exceptionally, no MCP is in place then interim action levels can be assigned using historic performance or the IAEA values for the "expected measurement uncertainty associated with closing a material balance" under normal operations quoted in the IAEA Safeguards Glossary.

Facility type	relative standard deviation, δE
Uranium enrichment	0.002
Uranium fabrication	0.003
Plutonium fabrication	0.005
Uranium reprocessing	0.008
Plutonium reprocessing	0.010

Separate scrap storage	0.04
Separate waste storage	0.25

213. The methodologies for calculating MUF and σMUF should be part of the PIT arrangements and any statistical evaluation should be described in a technical document.

214. Where estimates of in-process material are based on historical information or modelling, the estimation method and method of estimating the uncertainty should be described in a technical document.

215. IDs in storage facilities may arise as a result of rounding, when batches are issued as two or more sub-batches. Such differences are recorded as rounding adjustments and not IDs. Differences can also arise from analytical results or mistakes in batch details. An amendment to the quantity associated with a package in a store should not generate an ID in that store. The difference between the original and amended quantities is instead transferred back, as a correction to the original receipt, to the area in which the package arose, or generates an SRD in the case of external receipts.

216. Where it is necessary to confirm or refresh characterisation data for a batch it is normal for any sampling/re-containerisation to be conducted in a process (contact) area. Differences which arise from such characterisation can be recorded as new measurement in that process area and not passed back to plant of origin. Where the process performs other fuel cycle operations, then re-characterisation differences should be recorded separately from normal plant performance/ID action levels.

217. Finds of nuclear material where the presence of nuclear material is both unexpected and unusual are normally brought onto inventory using the inventory change code Accidental Gain (GA). Use of this code requires a special report to be sent to the ONR. Unless there is evidence that the nuclear material has been accounted for previously, the inventory change should not be included in consolidated figures for IDs. Additional advice on NMAC&S reporting in such circumstances can be obtained by contacting the ONR and advice on security reporting should be obtained from the site security manager.

218. IDs are identified as significant at the 3 sigma, 99% confidence level with follow-up required at the 2 sigma level. For accountancy areas where nuclear material is stored in the form of discrete items, the IDAL is one or more items. The NMAS manager is responsible for specifying IDALs, records for which (and their derivation) are to be maintained for all accountancy areas on the site.

219. Shipper/Receiver Differences (SRDs) is calculated as:

SRD = Receiver value minus Shipper value

220. SRDs should not exist between accountancy areas within the same site, where there should be procedures to ensure that shipping and receiving areas use the same figure for the quantity of nuclear material transferred. Agreement should be on the basis of measurement and not, for example, commercial or financial convention.

221. Where a site's processes generate a better understanding/measurement of nuclear material content received from another site then any difference can either be recorded using SRD or by correcting the shipment documentation. SRD is the normal method for regular differences such as those arising from reprocessing spent fuel.

222. Action levels for SRDs are deemed significant at the 3 sigma, 99% confidence level. Warning levels should be set at the 2 sigma level. The NMAS manager is responsible for specifying SRD action levels. In the case of reprocessing SRDs action levels will vary depending on fuel type and burn up.

223. Formal NMAS-related response procedures need to exist for:

a) IDs or SRDs that exceed action levels including any that involve discrete items;
b) unexpected changes in the containment of nuclear material, to a point where unauthorised removal of nuclear material has become possible; and
c) anomalies that are deemed significant by a Nuclear Material Custodian or Nuclear Material Accountant including items that cannot be found at their recorded location.

224. The procedures should ensure:

a) the abnormal ID or SRD is documented immediately it is identified (eg during a PIT or PIV). It is not appropriate to wait for the results of investigatory work before documenting and reporting the ID (i.e. such documentation should be the trigger for investigation);
b) the Nuclear Material Custodian ensures the investigating officer issues an initial report within 14 days of the initial recording of the ID or SRD; and
c) the investigation remains open until a final report on the incident is issued and this is accepted by the NMAS Manager.

225. Wherever possible, nuclear material that has been subject to significant SRDs should not be further processed or converted into other batches until management approval has been obtained. Normally, this would only be after management is satisfied that adequate measures have been taken to resolve the SRD.

226. Cumulative ID and SRD figures should be maintained such that lifetime positions by accountancy area and by plant are available. Trends should be identified and investigated.

227. Good practice is that:

a) when IDs occur due to re-measurement then the difference should be open to validation against the original and new measurement methods, the rational for accepting the new measurement and (in cases of gross differences) assurances about batch integrity;
b) a trend of linked IDs of opposite sign should be investigated. This includes coupled MBAs with opposite sign inventory differences (e.g. regular pattern of gains in one in line with losses in another) and includes mixed uranium/plutonium streams (one category losses and the other gains); and
c) an MCP is used for bulk handling plants (safeguards regulations only require that measurements comply with standards and that a site describes its control of accuracy, statistical evaluation and determination of errors and error propagation).

4.0 FSSACE 10 – Quality Assurance for Nuclear Material Accountancy and Control

Fundamental Expectation for Nuclear Material Accountancy and Control	Quality Assurance for Nuclear Material Accountancy and Control	FSSACE 10
Operators must implement and maintain quality assurance and quality control measures for Nuclear Material Accountancy and Control.		

228. An operator's quality management system (QMS) needs to ensure that all NMAC&S requirements are encompassed. The QMS should set-out the organisation, responsibilities, documentation, controls and operational activities of the NMAC&S arrangements. Documentation for current and historic system parameters includes: MBA structures; accountancy areas; Nuclear Material Custodian appointments; technical justifications; action levels; performance indicators; investigations; and current and cumulative apparent losses/gains.

229. Good practice is to:

a) harmonise NMAC&S processes across the site;
b) have a clear and concise statement of how NMAC&S requirements are implemented;
c) pursue continuous improvement and adoption of better practice;
d) have an NMAC&S testing and comparison regime for important locations;
e) have an overall records management system compliant with or equivalent to ISO 15489; and
f) ensure that the authoritative nuclear material inventory for the site is the NMAS inventory (i.e. all nuclear material inventory (mass) information, past and present, is derived from that held in the NMAC&S system).

4.0.1. NMACE 10.1 – NMAC&S Performance Measures

FSSACE 10 NMAC&S Performance Measures	NMAC&S Performance Measures	NMACE 10.1
Operators should ensure that the appropriate arrangements are in place to ensure that NMAC&S performance is monitored and reviewed.		

230. Monitoring and review of NMAC&S performance should include effectiveness of meeting NMAC&S requirements and identifying trends. Performance metrics will be tailored to local conditions but should include information on:

a) nuclear material control of movements, measurements and inventory;
b) NMA accuracy and timeliness;
c) anomalies; their investigation, corrective action and Learning From Experience (LFE);
d) human performance in conduct of operations so as to reduce intrinsic risk of human errors; e) safeguards compliance, assurance and responsiveness; and
e) NMAS competence, culture and regulatory confidence.

231. Review of the NMAS processes helps ensure performance is maintained and, where necessary, improved. Such review includes system effectiveness; mitigating

weaknesses and risks; self-verification; measures of performance/quality; communication with regulators on deficiencies; and an annual statement for the NMAS authority on nuclear material balance anomalies.

4.0.2. NMACE 10.2 – Quality Assurance & Control Measures

FSSACE 10 NMAC&S Performance Measures	**Quality Assurance & Control Measures**	**NMACE 10.2**
Operators should ensure that key NMAC&S tasks incorporate quality assurance and quality control measures.		

232. Automation of data handling should be implemented where possible and effective. Second checking and other quality control measures to ascertain the accuracy of data should be documented and implemented where needed.

233. The methodology used to calculate performance indicators should be documented along with criteria defining poor performance from the results. Operators should take action to improve poor performance and retain records of historic performance. Examples of relevant indicators may include:

    a) MUF figures.
    b) Number of NMAC&S anomalies.
    c) Number of regulatory comments arising from NMAC&S inspections.

234. An internal assessment programme should be in place that covers key NMAC&S tasks. It should include a schedule, the individuals responsible to carry out audits and the audit criteria to use. Records of the internal audits should be kept and issues identified during NMAC&S audits should be managed appropriately.

5.0. REFERENCES:

1. Nuclear Safeguards (EU Exit) Regulations 2018

   http://www.legislation.gov.uk/ukdsi/2018/9780111175545/pdfs/ukdsi_9780111175545_en.pdf

2. The Energy Act 2013

   http://www.legislation.gov.uk/ukpga/2013/32/pdfs/ukpga_20130032_en.pdf

3. Nuclear Safeguards (Fissionable and Relevant International Agreements) (EU Exit) Regulations 2018

   http://www.legislation.gov.uk/ukdsi/2018/9780111175569/pdfs/ukdsi_9780111175569_en.pdf

4. The Nuclear Industries Security Regulations (NISR)

   http://www.legislation.gov.uk/uksi/2003/403/pdfs/uksi_20030403_en.pdf

5. 'Class 7' aspects of the Carriage of Dangerous Goods & Use of Transportable Pressure Equipment Regulations)

   http://www.legislation.gov.uk/uksi/2009/1348/pdfs/uksi_20091348_en.pdf

6. Nuclear Installations Act 1965

   http://www.legislation.gov.uk/ukpga/1965/57/pdfs/ukpga_19650057_en.pdf

7. The Nuclear Safeguards Act 2000

   https://www.legislation.gov.uk/ukpga/2000/5/pdfs/ukpga_20000005_en.pdf

8. The Nuclear Safeguards Act 2018

   https://www.legislation.gov.uk/ukpga/2018/15/pdfs/ukpga_20180015_en.pdf

9. The Nuclear Safeguards and Electricity (Finance) Act 1978*

   https://www.legislation.gov.uk/ukpga/1978/25/pdfs/ukpga_19780025_en.pdf

10. Non Proliferation Treaty

    http://www.un.org/en/conf/npt/2015/pdf/text%20of%20the%20treaty.pdf

11. UK Voluntary Offer Safeguards Agreement (VOA) with the IAEA

12. INFCIRC/263/Add.1 - UK Additional Protocol (AP) with the IAEA

13. Safety Assessment Principles 2014

http://www.onr.org.uk/saps/saps2014.pdf

14. Security Assessment Principles

http://www.onr.org.uk/syaps/security-assessment-principles-2017.pdf

15. European Commission recommendation of 11 February 2009

https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009H0120&from=EN

16. ISO/IEC 17025:2005 **(this has been revised by ISO/IEC 17025:2017)**

https://www.iso.org/standard/66912.html

17. ISO 10012:2003 https://www.iso.org/standard/26033.html

18. International Target Values 2010 for Measurement Uncertainties in Safeguarding Nuclear Materials

https://esarda.jrc.ec.europa.eu/images//Bulletin/Files/B_2012_048.pdf

19. International Vocabulary of Metrology

https://www.bipm.org/utils/common/documents/jcgm/JCGM_200_2012.pdf

20. Guide to the expression of uncertainty in measurement (GUM) (ISO, OIML, BIPM, …)

https://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf

6.0. Glossary of Key Terms, Abbreviations and Acronyms

5 Description of some of the terms below includes their definition as included in EC regulation (Euratom) 302/2005 or EC recommendation 2009/120/Euratom.

5.1 ***Accountancy area*** -A uniquely identified area, wholly within a single MBA, with its own nuclear material account. The physical boundaries of an accountancy area are defined by the operator, in contrast to those of an MBA, which are defined by the safeguards inspectorates.

5.2 ***Anomaly*** -Defined for Euratom safeguards purposes at Section 2.11 of 2009/120/Euratom as a 'discrepancy or series of discrepancies that are consistent with the absence or gain of a significant amount of nuclear material'. An anomaly can be detected during an investigation of discrepancies of whatever kind.'

5.3 ***Basic Technical Characteristics*** (BTCs) -Design information for plants or locations where safeguarded nuclear material is stored or used as required by Article 3 of (Euratom) 302/2005. BTCs include a description of the installation, the form, quantity, location and flow of nuclear material being used, the layout of the installation, containment features and procedures for nuclear material accountancy and control. The information is used, inter alia, to prepare the safeguards approach for the installation and any Particular Safeguards Provisions (PSPs). The equivalent in the IAEA system of safeguards is known as Design Information (DI).

5.4 ***Batch*** -Defined at Article 2.11 of (Euratom) 302/2005 as 'a portion of nuclear material handled as a unit for accounting purposes at a key measurement point and for which the composition and quantity are defined by a single set of specifications or measurements. The nuclear material may be in bulk form or contained in a number of items'. Examples of a batch therefore include one fuel assembly, one UF6 cylinder, a tray of pellets prepared for loading into one fuel rod and several drums of UO2 powder with the same specifications. The term 'batch data' is defined at Article 2.11 of (Euratom) 302/2005 as 'the total weight of each category of nuclear material and, in the case of plutonium and uranium, the isotopic composition when appropriate. For reporting purposes the weights of individual items in the batch shall be added together before rounding to the nearest unit'.

5.5 ***Book inventory*** -Defined at Article 2.16 of (Euratom) 302/2005 as 'the algebraic sum of the most recent physical inventory of that material balance area, and of all inventory changes that have occurred since that physical inventory was taken.'

5.6 ***Category*** -For purposes of NMAS, nuclear material is assigned to categories. These are (Article 2.9 and Annex III of (Euratom) 302/2005):

Article 2.9 and Annex III of (Euratom) 302/2005): Category	Isotopic Enrichment
D – Depleted Uranium (DU)	Uranium in which the percentage U-235+U-233 is less than that occurring in natural uranium
N – Natural Uranium (NU)	Uranium as it normally occurs in nature, containing nominally 0.711% U-235
L – Low Enriched Uranium (LEU)	Uranium having a U-235+U-233 content higher than natural uranium, but less than 20%
H – High Enriched Uranium	Uranium having a U-235+U-233 content of 20% or

(HEU)	greater
P – Plutonium (Pu)	All isotopes
T – Thorium (Th)	All isotopes in the form of metal/oxide, major constituent of an alloy or as concentrated intermediate/feed compounds
(D,N,L,H) Uranium 233	Uranium enriched in U-233 by weight in the same enrichment bands defined for U-235

5.7 ***Conditioned waste*** -Defined for Euratom safeguards purposes at Article 2.7 of Euratom) 302/2005 as 'waste, measured or estimated on the basis of measurements, which has been conditioned in such a way (for example, in glass, cement, concrete or bitumen) that it is not suitable for further nuclear use.'

5.8 ***Containment*** -Defined for safeguards purposes at Section 2.1 of Recommendation 2009/120/Euratom as '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.' The continuing safeguards integrity of the containment itself is usually assured by seals or surveillance measures, especially for containment penetrations such as doors, vessel lids and water surfaces.

5.9 ***Correction*** -Defined for safeguards purposes at Article 92(2) F of the UK/IAEA/Euratom voluntary offer Safeguards Agreement (INFCIRC/263) as 'an entry made in an accounting record or report to rectify an identified mistake or to reflect an improved measurement of a quantity previously entered in a record or report. Each correction must identify the entry to which it pertains'.

5.10 ***Corrective action*** -Defined for safeguards purposes at Section 2.2 of 2009/120/Euratom as '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'.

5.11 ***Data processing*** -Defined in 2009/120/Euratom as '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.

5.12 ***Decommissioned Installation*** -Defined for Euratom safeguards purposes at Article 2.24 of (Euratom) 302/2005 as 'an installation for which it has been verified that residual structures and equipment essential for its use have been removed or rendered inoperable so that it is not used to store and can no longer be used to handle, process or utilise source material or special fissile material.' The term 'closed-down installation' is defined for Euratom safeguards purposes at Article 2.25 of Euratom) 302/2005 as 'an installation for which it has been verified that operations have been stopped and the nuclear material removed but which has not been decommissioned.'

5.13 ***Discards*** (to the environment) -Defined for Euratom safeguards purposes at Article 2.8 of Euratom) 302/2005 as 'waste, measured or estimated on the basis of measurements, which has been irrevocably discarded to the environment as the result of a planned discharge.'

5.14 ***Discrepancy*** -The term 'NMAC discrepancy' is defined for Euratom safeguards purposes at Section 2.10 of 2009/120/Euratom as '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.' The term 'Nuclear Material Control Discrepancy' is defined for Euratom safeguards purposes at Section 2.12 of Commission Recommendation 2009/120/Euratom as 'a non-conformance in the identification or location of nuclear material'.

5.15 ***Effective kilogram*** -A special unit used in the safeguarding of nuclear material, reflecting its strategic value as defined at Article 2.13 of (Euratom) 302/2005:

a) for plutonium, its weight in kilograms;
b) for uranium with an enrichment of 1% (0.01) and above, its weight in kilograms multiplied by the square of its enrichment;
c) for uranium with an enrichment below 1% (0.01) and above 0.5% (0.005), its weight in kilograms multiplied by 0.0001; and
d) for depleted uranium with an enrichment of 0.5% (0.005) or below, and for thorium, its weight in kilograms multiplied by 0.00005.'

5.16 ***Emergency Physical Inventory Taking (EPIT)*** -A rapid stock take of nuclear material in response to the suspected loss, theft, or allegation of theft, the objective of which is to confirm or rule out the suspicions/allegations.

5.17 ***ENER*** -The EC Directorate General for Energy, which includes the nuclear accountants and safeguards inspectorate who discharge the EC's safeguards responsibilities under the Euratom Treaty.

5.18 ***Equivalence principle*** -The equivalence principle is a feature of obligation accountancy and provides that where nuclear material of a particular obligation loses its separate identity because of process characteristics (e.g. mixing), an equivalent quantity is designated as obligated nuclear material (on the basis that atoms or molecules of a substance are indistinguishable from another). The principle of equivalence does not permit substitution by a lower quality material, e.g. enriched uranium cannot be replaced by natural or depleted uranium. See also the principles of fungibility and proportionality.

5.19 ***Euratom regulation*** -EC Regulation (Euratom) 302/2005, which specifies Euratom safeguards reporting requirements.

5.20 ***Facility*** -Defined for IAEA safeguards purposes at Article 92.(2)I of the UK/IAEA/Euratom Safeguards Agreement as 'a reactor, a critical facility, a conversion plant, a fabrication plant, a reprocessing plant, an isotope separation plant or a separate storage installation; or any location where nuclear material in amounts greater than one effective kilogram is customarily used.' The term 'installation' as used for Euratom safeguards purposes (see below) differs by also including waste treatment and storage installations and locations with holdings of less than one Effective Kilogram of nuclear material.

5.21 ***Facility Attachment*** -A facility-specific part of the subsidiary arrangements to safeguards agreements with the IAEA which details how the reporting and inspection provisions of the agreement are to be applied at a particular facility or group of similar facilities.

5.22 ***Find*** -The discovery of a discrete item or items of nuclear material whose existence is previously unknown or unquantified – see Euratom safeguards reporting codes NM (New Measurement) and GA (Accidental Gain).

5.23 ***Fungibility principle*** -Uranium, in common with a number of other commodities, is ‘fungible’ in that, during processing, uranium from any source is identical to uranium from any other and it is not possible to differentiate, physically, the origin of the uranium. It is this fungibility that has led to the establishment and use of the principles of equivalence and proportionality.

5.24 ***GA (Accidental Gain)*** -Euratom safeguards reporting code – see Annex III of (Euratom) 302/2005.

5.25 ***Holdup*** -Nuclear material deposits remaining after shutdown of a plant in and about process equipment, interconnecting piping and adjacent areas. For plants in operation the Holdup is the amount of nuclear material contained in the process, and is also referred to as ‘in-process inventory’.

5.26 ***Installation*** -Defined for Euratom safeguards purposes at Article 2.23 of (Euratom) 302/2005 as ‘a reactor, a critical installation, a conversion plant, a fabrication plant, a reprocessing plant, an isotope separation plant, a separate storage installation, a waste treatment or waste storage installation; or any other location where source material or special fissile material is customarily used’. This differs from the definition of ‘facility’ used for IAEA safeguards purposes (see above). The definition of ‘installation’ for Euratom safeguards purposes also differs from that for a ‘nuclear installation’ contained in the Nuclear Installations Act 1965.

5.27 ***International Atomic Energy Agency (IAEA)*** -An independent intergovernmental United Nations organisation which is, amongst other things, responsible for applying the international safeguards measures required by the Nuclear Non-Proliferation Treaty (NPT).

5.28 ***International Target Values (ITVs)*** -The International Target Values, issued under the auspices of the IAEA as document STR-327 of April 2001 and also available from ESARDA (esarda2.jrc.it/bulletin/bulletin_31/08.pdf), 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. The values reflect what is regarded as achievable in the conditions normally encountered in industrial laboratories or during safeguards inspections. They do not represent the measurement uncertainties achievable under ‘ideal’ research laboratory conditions.

5.29 ***Inventory Changes*** -Defined for IAEA safeguards purposes at Article 92.(2)J of the UK/IAEA/Euratom Safeguards Agreement as ‘an increase or decrease, in terms of batches, of nuclear material in a material balance area;

5.30 ***Inventory change increases***:

a) *Imports;*
b) *Receipts within the UK* -receipts from another UK nuclear sites, or from another material balance area on site, or from an activity not subject to safeguards under this Agreement, or at the starting point of safeguards;
c) *Nuclear production* -production of special fissionable material in a reactor;
d) *Accidental gains* -finds of nuclear material in plant areas where the presence of material is both unexpected and unusual; and
e) *New measurements (+ve)* – Inventory difference and new measurements which result in an apparent gain of nuclear material.

5.31 ***Inventory Change Decreases***:

a) *Exports;*
b) *Shipments within the UK* -shipments to another UK nuclear site or to another material balance area on site; or to an activity not subject to safeguards under this Agreement;
c) *Nuclear loss* -loss of nuclear material due to its transformation into other element(s) or isotope(s) as a result of nuclear reactions;
d) *Measured discard* -nuclear material which has been measured, or estimated on the basis of measurements, and disposed of in such a way that it is not suitable for further nuclear use;
e) *Retained waste* -nuclear material generated from processing or from an operational accident, which is deemed to be irrecoverable for the time being but which is stored;
f) *Accidental loss* -loss that is, irretrievable and inadvertent loss of nuclear material as the result of an operational accident or theft; and
g) *New measurement (-ve)* – Inventory difference and new measurements which result in an apparent loss of nuclear material.

5.32 ***Inventory Change Report (ICR)*** -A report that describes changes in the inventory of nuclear material in an MBA, and one of the accountancy reports (i.e. declarations) required by (Euratom) 302/2005 (its Article 12).

5.33 ***Inventory Difference (ID)*** -The difference between the Physical Inventory and the inventory indicated by the nuclear material accountancy system (book inventory). Also known as 'Material Unaccounted For' (MUF) and for which it should be noted that the Euratom convention (Physical Inventory – Book Inventory) is the opposite of the IAEA convention. Annual publication of Nuclear Material Balance figures for UK sites where civil nuclear material is processed includes information on Inventory Difference/Material Unaccounted For at the sites concerned.

5.34 ***Inventory Difference Action Level (IDAL)*** -The limit on an ID which, if exceeded, will require a special report to be made by the operator to the safeguards inspectorates.

5.35 ***Item*** -Defined for Euratom safeguards purposes at Article 2.10 of (Euratom) 302/2005 as 'an identifiable unit, such as a fuel assembly or a fuel pin.'

5.36 ***Key Measurement Point (KMP)*** -Defined at Article 2.15 of (Euratom) 302/2005 as 'a location where nuclear material appears in such a form that it may be measured to determine material flow or inventory, including but not limited to, the places where nuclear material enters, leaves or is stored in, material balance areas'.

5.37 ***Key Performance Indicator (KPI)*** -Metrics that may be used to monitor the effectiveness of a nuclear material accountancy system and nuclear operations – see Section 6 of this guidance. Section 2.15 of 2009/120/Euratom defines 'performance indicator' as 'a leading indicator of attainment achieved by an individual, team, organisation or an action.'

5.38 ***List of Inventory Items (LII)*** -See Physical Inventory.

5.39 ***Material Balance*** -The output from the process of comparing and reconciling the book inventory for a category of nuclear material and the amount of that material which is physically present. The balance for areas where material is processed may therefore include a statement of inventory difference (i.e. the amount of Material Unaccounted For, MUF). The term 'material balance test' is defined at Section 2.6 of 2009/120/Euratom as '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.' The term 'material balance discrepancy' is defined at Section 2.7 of the recommendation as 'a material balance value which is not accepted by the material balance test'.

5.40 ***Material Balance Area (MBA)*** -Defined at Article 2.14 of (Euratom) 302/2005 as 'an area such that, for the purpose of establishing the material balance:

a) the quantity of nuclear material in each transfer into or out of each material balance area can be determined; and
b) the physical inventory of nuclear material in each material balance area can be determined when necessary in accordance with specified procedures.

5.41 ***Material Balance Report (MBR)*** -A report of the nuclear material in an MBA, facility, installation or other location where safeguarded nuclear material is stored or used, which shows aggregated transactions for the material balance period (e.g. year) in comparing the physical inventory with the book inventory.

5.42 ***Material Unaccounted For (MUF)*** -EC and IAEA terminology for an ID. The term is defined at Article 2.18 of (Euratom) 302/2005 as 'the difference between the physical inventory and the book inventory.'

5.43 ***Measurement Control Programme (MCP)*** -A system to ensure the effectiveness of measurement and analytical systems and the quality of resulting data that is generated for nuclear material accountancy and safeguards purposes (e.g. using ITVs to judge performance).

5.44 ***Ministry of Defence*** (MoD)

5.45 ***Near Real Time Material Accountancy (NRTMA)*** -A form of material accountancy for bulk handling facilities in which verification of flow is supplemented by physical inventories at frequent intervals, e.g. weekly, through the use of in-process instrumentation (generally operator equipment) that does not interfere with process operations.

5.46 ***New Measurement (NM)*** -Euratom safeguards reporting code – see Annex III of (Euratom) 302/2005.

5.47 ***Non-Destructive Assay (NDA)*** -The measurement of the nuclear material content of an item without producing significant physical or chemical changes in the item. Non-Destructive Assay usually involves measurement of the radioactivity of the item for comparison with a calibration based on similar items whose nuclear material contents are very accurately known.

5.48 ***Non-Safeguarded nuclear material*** -Nuclear material that is excluded from the accountancy and safeguards requirements for reasons of national security and/or defence purposes. Accountancy requirements for such non-safeguarded nuclear material are specified by the Ministry of Defence (MoD), and are consistent with this guidance.

5.49 ***Nuclear material*** -Ores, source material or special fissile material as defined in Article 197 of the Euratom Treaty (see Annex I).

5.50 ***Nuclear Material Account*** – A group of debit or credits entries brought together under a specific heading to indicate an accounting condition (MBA, Accounting Area, Customer, material Type).

5.51 ***Nuclear Material Accountancy (NMA)*** -A system to register material quantities and locations, track items and quantities through transfers and processes, record measurement data, and provide information for reporting and analysis. The term ‘Nuclear Material Accountancy and Control’ (NMAC) is defined for Euratom safeguards purposes at Section 2.10 of 2009/120/Euratom as ‘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.’

5.52 ***Nuclear material control account*** – An account which controls a number of other accounts. It contains the totals of debits and credits of a number of accounts to show at any time the balance of the aggregate of these accounts (eg site account).

5.53 ***Nuclear safeguards*** -Measures, including NMA, to verify that civil nuclear materials are properly accounted for and are not diverted to undeclared uses.

5.54 ***Nuclear Material Accountancy and Safeguards (NMAS) systems*** -The totality of operator measures for nuclear material accountancy to enable the implementation of nuclear safeguards.

5.55 ***Civil Nuclear Security (CNS***) -The security regulator for the UK’s civil nuclear industry.

5.56 ***(Facility/Installation) Operator*** -The term ‘Nuclear operator’ is defined for Euratom safeguards purposes at Section 2.14 of Commission Recommendation 2009/120/Euratom as ‘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.’

5.57 ***Particular Safeguards Provisions (PSPs)*** -Specific requirements for the implementation of safeguards at a site or location within a site where safeguarded nuclear material is stored or used. These are drawn up by the EC using information provided in the BTCs and addressed to the operator, that take into account operational and technical constraints of application of the general provisions of (Euratom) 302/2005. PSPs together with the Regulation are the legal requirements of Euratom safeguards reporting. The equivalent in the IAEA system of safeguards is known as the Facility Attachment (FA).

5.58 ***Physical Inventory -Taking (PIT), Listing (PIL) and Verification (PIV)*** The ***Physical Inventory*** is defined at Article 2.17 of (Euratom) 302/2005 as ‘the sum of all the measured batch quantities or derived estimates of batch quantities of nuclear material on hand at a given time within a material balance area, obtained in accordance with specified procedures’. The Physical Inventory is therefore as determined by the operator by means of a physical inventory taking (PIT), and defined at Section 2.16 of 2009/120/Euratom as ‘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’.

5.59 The results of the PIT must be reported to the safeguards inspectorates in the form of a ***Physical Inventory Listing (PIL),*** which lists all batches of nuclear material present at the time of the PIT. Requirements for provision of the PIL are as specified at Article 13 of (Euratom) 302/2005. The PIL is supplemented by detailed information in the form of a ***List of Inventory Items (LII),*** defined at Section 2.5 of 2009/120/Euratom as ‘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.' The PIT as recorded in the PIL and LII is verified by the safeguards inspectorates during a physical inventory verification (PIV) inspection, defined at Section 2.17 of 2009/120/Euratom as '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.' The ending physical inventory for a material balance period is therefore the beginning physical inventory for the next material balance period.

5.60 ***Proportionality principle*** -The proportionality principle is a feature of obligation accountancy and provides that where obligated nuclear material is mixed with other nuclear material, and is processed or irradiated, a proportion of the resulting material will be regarded as obligated nuclear material to the same proportion as was obligated nuclear material initially.

5.61 ***Retained waste*** -Defined for Euratom safeguards purposes at Article 2.6 of (Euratom) 302/2005 as 'waste, generated from processing or from an operational accident, measured or estimated on the basis of measurements, which has been transferred to a specific location within the material balance area from which it can be retrieved.'

5.62 ***Safeguards agreement*** -An international agreement involving the IAEA which specifies the application of safeguards by the IAEA. So-called 'comprehensive' or 'full scope' such agreements are required of non-nuclear-weapon states (NNWS) under the Nuclear Non-Proliferation Treaty (NPT). The states defined as nuclear-weapon states (NWS) under the NPT, including the UK, have also agreed so-called 'voluntary offer' safeguards agreements in connection with the Treaty, which make some or all of their civil nuclear activities eligible for the application of IAEA safeguards. There are also safeguards agreements with the IAEA which predate and/or do not relate directly to the NPT, but provide for IAEA safeguards application to particular nuclear material and/or facilities (many of which are known as 'INFCIRC/66' type agreements).

5.63 ***Safeguards By Design (SBD)*** -to ensure that safeguards requirements are fully integrated into the design process stages (design, construction, commissioning, operation and decommissioning) and the project management structure from project inception.

5.64 ***Safeguards inspectorates*** -International nuclear safeguards are measures to verify that countries abide by their commitments to use nuclear material for declared peaceful purposes. The necessary international confidence is based on independent verification by the international safeguards inspectorates of the EC (currently part of the Directorate General for Energy , DG ENER) and the International Atomic Energy Agency (IAEA).

5.65 ***Safeguards obligations*** -Conditions on the use of nuclear material specified in the terms of inter-Governmental nuclear supply or co-operation agreements. See also Article 17 of (Euratom) 302/2005.

5.66 ***Seal*** -A tamper indicating device used to join movable segments of containment in a manner such that access to its contents without opening the seal or breaking of the containment is difficult. A sealing system comprises the containment enclosing the material to be safeguarded, the means of applying the seal (e.g. a metal wire) and the seal itself. All three components must be examined in order to verify that the sealing system has fulfilled its function of ensuring continuity of knowledge of the identity and integrity of the material concerned. See also containment.

5.67 ***Shipper/Receiver Difference*** (SRD) -Defined at Article 2.19 of (Euratom) 302/2005 as 'the difference between the quantity of nuclear material in a batch as measured at the receiving material balance area and the quantity as stated by the shipping material balance area.'

5.68 ***Small Holder of Nuclear Material (SHNM)*** -Those responsible for nuclear material which is not at licensed nuclear sites but is nevertheless subject to the safeguards requirements of the Euratom Treaty, for example:

a) universities, colleges and research institutes that use nuclear material for academic studies;
b) analytical laboratories that use nuclear material as reference sources;
c) manufacturers of measurement instruments that use sealed sources as standards for calibration and/or who use plutonium, enriched uranium or uranium-233 in gram quantities or less as sensing components in instruments (e.g. for fission chambers or smoke alarms);
d) organisations that use depleted uranium, natural uranium or thorium in exclusively non¬nuclear activities (e.g. as radiation shielding, including depleted uranium transport containers for medical or industrial radioisotopes, as ballast/counterweights, as high hardness alloys of the kind used in aerospace applications, as catalysts for use in the chemical industry or as pigments in glass); and
e) organisations with inventories of plutonium which has an isotopic concentration of plutonium-238 exceeding 80%.

5.69 ***Source data*** -Defined at Article 2.20 of (Euratom) 302/2005 as 'those data, recorded during measurement or calibration or used to derive empirical relationships, which identify nuclear material and provide batch data, including: weight of compounds; conversion factors to determine weight of element; specific gravity; element concentration; isotopic ratios; relationship between volume and manometer readings; and relationship between plutonium produced and power generated'.

5.70 ***Source materials*** -Defined at Article 197 of the Euratom Treaty as 'uranium containing the mixture of isotopes occurring in nature; uranium whose content in uranium 235 is less than the normal; thorium; any of the foregoing in the form of metal, alloy, chemical compound or concentrate; any other substance containing one or more of the foregoing in such a concentration as shall be specified by the Council, acting by a qualified majority on a proposal from the Commission.' Definition of the term 'source material' at Article XX of the IAEA Statute is essentially the same.

5.71 ***Special fissile materials*** -Defined at Article 197 of the Euratom Treaty as 'plutonium 239; uranium 233; uranium enriched in uranium 235 or uranium 233; and any substance containing one or more of the foregoing isotopes and such other fissile materials as may be specified by the Council, acting by a qualified majority on a proposal from the Commission; the expression special fissile materials' does not, however, include source materials.' Definition of the term 'special fissionable material' at Article XX of the IAEA Statute is essentially the same.

5.72 ***State (or Regional) System of Accountancy and Control (SSAC)*** -Organisational arrangements to account for and control nuclear material in a state or region and thus provide the basis for application of IAEA safeguards – and as such a requirement of safeguards agreements with the IAEA. The EC fulfils the role of SSAC for the UK/IAEA/Euratom voluntary offer safeguards agreement.

5.73 ***UK Safeguards Office (UKSO)*** -Operational aspects of safeguards implementation in the UK were transferred to the Nuclear Directorate of the HSE, on 1 April 2007. UKSO's role is to work with the safeguards inspectorates and the UK nuclear industry to ensure that the UK's safeguards requirements are met in a proportionate manner.

5.74 ***Waste*** -Defined at Article 2.5 of (Euratom) 302/2005 as 'nuclear material in concentrations or chemical forms considered as irrecoverable for practical or economic reasons and which may be disposed of.' Section 2.5.2.1 of the EC Recommendation (2006/40/Euratom) which provides guidance on aspects of the implementation of Regulation 302/2005 states that Euratom safeguards can be terminated on waste containing very low concentrations of nuclear material as indicated below:

natural uranium	1,000 g/tonne
Low enriched uranium	200 g/tonne
High enriched uranium	10 g/tonne
Plutonium	4 g/tonne

5.75 ***Intelligent Customer*** - The capability of an organisation to understand where and when work is needed; specify what needs to be done; understand and set suitable standards; supervise and control the work; and review, evaluate and accept the work carried out on its behalf.