



ONR GUIDE			
Inspection of an Operator Physical Inventory Take (PIT): PITe, PIV and/or accountancy check			
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1. INTRODUCTION

- 1.1 The Nuclear Safeguards (EU Exit) Regulations 2019 ('The Regulations') require operators to make arrangements to comply with obligations under The Regulations. ONR inspects compliance with The Regulations, and also with the arrangements made under them, to judge the suitability of the arrangements made and the adequacy of their implementation. ONR produces a suite of guides to assist inspectors to make regulatory judgements and decisions in relation to the adequacy of compliance on the site. This inspection guide is one of the suite of documents provided by ONR for this purpose.

2. PURPOSE AND SCOPE

- 2.1 The purpose of this guidance is to promote a consistent and uniform approach to inspection activities at an operator site for Physical Inventory Take (PIT): PITe, PIV and/or accountancy check. It is to be used by ONR in judging the operator's compliance with the requirements of The Regulations, the adequacy of the arrangements made by the operator under The Regulations and gain confidence in the correctness of the operators' physical inventory.
- 2.2 The requirements of The Regulations relate only to those activities undertaken for civil purposes. Activities for defence purposes are excluded from the UK nuclear safeguards regime.
- 2.3 The purpose of a Physical Inventory Take (PIT) is for the operator to confirm the book inventory at a given date and involves the operator measuring or deriving estimates of all nuclear material within an accountancy area and/or Material Balance Area (MBA). In the event of a PIT, the inspector may choose one or a combination of the following activities:
- A Physical Inventory Take evaluation (PITe) which will take place at the same time as the PIT to enable the inspector to inspect and assess the operators PIT process;
 - A Physical Inventory Verification (PIV) which involves the inspector selecting suitable components of the inventory to be checked; and
 - An accountancy check as a desk based exercise which may not involve any plant based activity.
- 2.4 The guidance provided is split into three main elements:
1. Section 4 - Purpose of PIT within the regulations;
 2. Section 5 – Guidance on arrangements; and
 3. Section 6 - Guidance on inspection of arrangements and their implementation

3. THE NUCLEAR SAFEGUARDS (EU EXIT) REGULATIONS 2019

- 3.1 The Regulations set out several specific requirements in respect of the Physical Inventory Take (PIT) and associated reporting activities.

Programme of Activities

- 4 (1) An operator of a qualifying nuclear facility must send to the ONR an annual outline programme of activities using the information described in Part 8 of Schedule 1, indicating, in particular, provisional dates for taking a physical inventory.
- 4 (3) an operator must inform the ONR of the programme of activities for the taking of a physical inventory at least 40 days before the day on which the physical inventory is taken.

Operating records

- 10(1) In respect of each material balance area an operator must ensure that the operating records set out;

- (e) a description of the sequence of the actions taken to /prepare for, and take, a physical inventory and to ensure that the inventory is correct and complete;

Material balance report and physical inventory listing

- 15 (3) Unless otherwise specified in the particular safeguard provisions for the qualifying nuclear facility, a physical inventory for each material balance area must be taken every calendar year and the period between two successive physical inventory takings must not exceed 14 months.

The Components of an Accountancy and Control System (Schedule 2)

- 13) a Physical Inventory Taking (PIT), that is carried out in accordance with regulation 15(3) and 31(5)(b) at least every calendar year, with the period between two successive physical inventory takings not exceeding 14 months;
- 14) procedures for a PIT that describe the responsibilities of those involved, the methods they should use, the records that should be kept, the associated measurement uncertainties and material balance tests (where appropriate), the reporting that must be made to the ONR, and the steps for authenticating any information made available to inspectors under these Regulations; and
- 15) a List of Inventory Items (LII), generated from a PIT, that facilitates inspector verification of information provided to ONR against the physical reality. The LII should include information on the mass and composition of qualifying nuclear material per item, as well as its location, containment, identity, and type.

There is also a requirement that the declaration of basic technical characteristics document submitted to ONR in accordance with Regulation 3 contains information outlining processes and procedures associated with physical inventory taking. Schedule 1 Part 1 specifies arrangements required for physical inventory including description of procedures, scheduled frequency and method for operators physical inventory taking.

- 3.2 Additional guidance relating to PITe and PIV inspections in the UK can be found in the following ONR documents:
- “ONR Guidance for the Assessment of Nuclear Material Accountancy, Control and Safeguards”.
 - “Guidance on The Nuclear Safeguards (EU Exit) Regulations 2019”
- 3.3 ONR inspection guidance for all disciplines on how to plan, prepare, deliver and write-up an inspection should be used in conjunction with this guidance document. The reference for this document is: General Inspection Guide – ONR-INSP-GD-064, current version.

4. PURPOSE OF PIT WITHIN THE REGULATIONS

- 4.1 The purpose of a PIT is for the operator to confirm the book inventory at a given date and involves the operator measuring or deriving estimates of all nuclear material within an accountancy area and/or MBA. An inspection will take place to gain assurance that the NMACS system required under regulation 6(1) is maintained such that the operator can demonstrate the system and its implementation meet the requirements specified in regulation 10(1)(e), and when relevant schedule 2, and the outcomes resulting from these. The inspection could take the form of a PITe, a PIV or alternative as determined by the inspector.
- 4.2 A PITe will take place at the same time as the PIT to enable the inspector to inspect and assess the operators PIT process. A PIV will involve the inspector selecting suitable components of the inventory to be checked, for example by physically identifying, counting, check weighing or other means. Alternatively, if a PITe or PIV is not possible or appropriate, the inspector may determine that an alternative inspection

or accountancy check would be sufficient to gain assurance that the operator has control of the qualified nuclear material. This could be a desk-based exercise that may not involve any plant-based activity.

- 4.3 The purpose of Regulation 4(1) and (3) is to ensure that an operator provides ONR with suitable and timely information to allow ONR to plan inspection activities associated with PITe or PIV, and to demonstrate to ONR that the operator will meet the requirements of Regulation 15(3).
- 4.4 The purpose of Regulation 10(1) (e) is to identify the specific content of operating records relating to physical inventory taking that must be included in the system of accountancy and control of the relevant qualifying nuclear material at the qualifying nuclear facility¹
- 4.5 The purpose of Regulation 15(3) is to ensure that the operator carries out a PIT at suitable frequency.
- 4.6 The purpose of Schedule 2, sections 13, 14 & 15 is to identify the components of the accountancy and control system relating to physical inventory taking that an operator must implement in a manner which is proportionate to and appropriate for the basic technical characteristics of the qualifying nuclear facility as reported to the ONR under regulation 3 or 31.²

5. GUIDANCE ON ARRANGEMENTS

- 5.1 This Technical Inspection Guide provides guidance for the inspection of the operators' arrangements for taking a physical inventory and their implementation, the expectations of which have been set out in the ONR Guidance for the Assessment of Nuclear Material Accountancy, Control and Safeguards (ONMACS). The contents are neither exclusive nor exhaustive and will be subject to review and revision in light of operational experience. For completeness, some aspects covered in Section 4 of this document are repeated.
- 5.2 Arrangements should be in place to comply with Regulations 4(1) and (3), and 15 (3) to ensure timely notification of the PIT and at a suitable frequency.
- 5.3 Operating records, for example, instructions should be in place to comply with 10 (1) (e) describing the sequence of actions to prepare for, and take, a physical inventory and to ensure that the inventory is correct and complete.
- 5.4 The operators Accountancy and Control System should include arrangements to comply with Schedule 2 (13) (14) and (15) detailing the procedures for the PIT and the requirement for the generation of a List of Inventory Items (LII).
- 5.5 In addition to the above arrangements required to comply with The Regulations specifically for a PIT there is also a requirement for a Basic Technical Characteristic (BTC) declaration in Regulation 3. In the BTC the Operator should have adequate

¹ Note: This requirement derives from regulation 6.

6 (1) An operator of a qualifying nuclear facility must maintain a system of accountancy and control of the relevant qualifying nuclear material in each qualifying nuclear facility.

(2) The system referred to in paragraph (1), must include in respect of the qualifying nuclear material (a) the operating and accounting records required by regulations 10 and 11;

² Note: This requirement derives from regulation 6.

6.—(1) An operator of a qualifying nuclear facility must maintain a system of accountancy and control of the relevant qualifying nuclear material in each qualifying nuclear facility.

(3) The components of an accountancy and control system are set out in Schedule 2, and an operator must implement the relevant components in a manner which is proportionate to and appropriate for the basic technical characteristics of the qualifying nuclear facility as reported to the ONR under regulation 3 or 31.

arrangements in place for a number of factors that affect the physical inventory take and determination of the physical inventory. The applicability will vary depending on the type of facility and therefore not all these will be in place for every operator. These may include:

- The inventory locations including a flow sheet identifying points where qualifying nuclear material can be identified, measured or estimated. Also the method of identifying individual items.
- Description of physical inventory including procedures and methods for operators physical inventory taking. This should include a description of what material is where at the time of the PIT, particularly any hold ups and or unverifiable material or items. Any inaccessible areas or safety case constraints.
- For a bulk handling facility a description of the method for establishing measurements at the flow or inventory measurement points identifying equations or tables used and calculations to determine quantities. In addition to this any identified areas or systems where there is qualified nuclear material hold ups and the how the amount of hold up is measured or estimated.
- Description of measurement quality control programme needed for material accountancy purposes including calibration of equipment
- For a bulk handling facility a description of methods for statistical evaluation of data collected in measurement control programmes for evaluating the precision and accuracy of measurements and for estimating measurement uncertainties

5.6 Once the requirement comes into force in January 2021 for Accounting and Control Plans (ACPs) the operator will need to provide a more comprehensive description of all aspects of arrangements for Nuclear Material Accountancy and Control (NMACS) as detailed in regulation 7(4). It is expected that arrangements should be included in the ACP for the below areas in relation to a PIT.

- A measurement control programme that validates and provides traceability for measurement results and their uncertainties and ensures that measurements comply with the relevant international standards
- Data processing procedures that store, trace and identify, and produce the information required by the Regulations and that are required to facilitate the checking of data against the physical reality
- Procedures for a PIT that describes the responsibilities of those involved, the methods they use, the records that should be kept, the associated measurement uncertainties
- Arrangements for generating a List of Inventory Items (LII) in a PIT that facilitates inspector verification in selecting suitable components of the inventory to be checked.

5.7 To determine the physical inventory the operator should have arrangements for measurement quality control programmes including calibration of equipment, calculations to determine quantities and statistical evaluation for measurement uncertainties to ensure measures comply with international standards. Guidance on inspection of Nuclear Material Accountancy and Control is in preparation.

5.8 Operators should have arrangements in place to ensure that Material Balance Evaluation (MBE) is carried out to determine if any non-zero inventory difference declared on the Material Balance Report (MBR) is consistent with measurement uncertainty or may reflect other causes.

5.9 For processing facilities the operator should be able to produce a technically justified Inventory Difference Action Level (IDAL) following completion of the PIT and have

arrangements in place to compare the calculated inventory difference declared on the MBR to the IDAL.

- 5.10 Relevant Good Practice (RGP) is for the arrangements to be readily available, up to date, and approved by an appropriate manager or responsible person. They should also identify the job roles competent to perform the activities and note any additional control required
- 5.11 The purpose of this guidance is to provide guidance to the inspector on how to inspect and assess the operators compliance with The Regulations and the adequacy of arrangements made under The Regulations. In addition to this there are principles in the ONR Guidance for the Assessment of Nuclear Material Accountancy, Control and Safeguards (ONMACS) that will assist the inspector in preparing for the PITe or PIV inspection.
- 5.12 In the ONMACS the regulatory philosophy for PIT is detailed in Fundamental State System Accountancy and Control Expectation (FSSACE) 9 Material Balance, Nuclear Material Accountancy and Control 9.2. This details the expectations for site procedures for taking a PIT including:
- halting the movement of qualified nuclear material for the duration of the PIT,
 - for an item facility ensuring qualifying nuclear material is uniquely identified
 - in a process area ensuring that the amount of qualifying nuclear material held is minimised and there is suitable technical justifications for estimates of the quantities involved.
- 5.13 This section details the arrangements that should be in place for a physical inventory take for the operator to determine the physical inventory quantity. If, in the inspectors opinion, it is deemed that the operator is not meeting these expected standards the inspector should discuss the shortfalls with the operator. If the operator's arrangements fall significantly short the inspector should seek guidance from the ONR Safeguards Delivery Lead and refer to the Enforcement Management Model (EMM).

6. GUIDANCE ON INSPECTION OF ARRANGEMENTS AND THEIR IMPLEMENTATION

- 6.1 Part 6 of this guidance is to assist inspectors in their assessment of the arrangements made by the operator and gain confidence in the correctness of the physical inventory. The following list is neither exclusive nor exhaustive and will be subject to review and revision in light of operational experience. It does, however, provide a list of aspects of The Regulations that can be examined during inspections. For completeness, some aspects covered in Part 5 of this document are repeated.

Determine inspection type

- 6.2 The inspector will have in place a Safeguards strategy for the site along with an annual site safeguards implementation plan that will include a place holder for an inspection of the PIT. The inspector should consider the inspection type to be performed and discuss with the operator prior to receiving the formal notification of the PIT date, especially for large bulk handling facilities. Upon notification of the PIT date from the operator (at least 40 days before the day on which the physical inventory is to be taken) the inspector should determine whether a Physical Inventory Take evaluation (PITe), a Physical Inventory Verification (PIV), alternative inspection or desk based accountancy exercise is most suitable. The following list will assist the inspector in the decision making process however the inspector should apply their experience, regulatory intelligence and discretion to determine the inspection type.
- Sensitivity and quantity of nuclear material
 - The complexity and strategic importance of the facility, ie what it is used for

- Quality of the Operators Nuclear Material Accountancy Control and Safeguards System (NMAC&S)
- Consult with the Nuclear Material Accountant (NMA) for the MBA to determine if there are any existent or emerging issues
- Hazard and external factors including dose rate
- Resource availability/operational schedule

Physical Inventory Take by the operator

- 6.3 In preparation for the PIT the operator will ensure the plant is in an appropriate state to ensure the best possible results are obtained. This should be in line with any document the operator has in place describing their arrangements for the PIT and may include, but is not limited, to the below principles:
- In a process area the plant run down to minimise qualifying nuclear material (QNM)
 - QNM segregated into accessible locations, clearly and uniquely identified
 - QNM in a measurable form. Where this is not practicable a technically justifiable estimate
 - Instruments to be used for measurement calibrated with the calibration records readily available
- 6.4 As part of the PIT process, the operator will prepare a List of Inventory Items (LII). The LII is the facility operator's declaration of the QNM in the MBA and lists the measured values or derived estimates of each item physically present at the facility at the declared closing date of the material balance period (MBP). It is good practice for the items to be grouped with similar physical and chemical characteristics and within the same measurement uncertainties, ie measured or estimated.
- 6.5 The LII assists ONR in determining its sampling approach for PIV activities. Note the LII is an accounting record and a working paper for the operator and the inspector which lists individual inventory items, whereas the PIL is an officially submitted accounting report from the operator and lists batch data which may consist of a number of separate items.
- 6.6 The format of the LII is not prescribed, however, it should be compatible and reconcilable with the PIL at batch level and, where possible, be in the same format. A list of data and elements that may be included in an LII is shown in Appendix I, a summary of which has been provided below. The LII should be:
- complete and define all items in an MBA or a specified location within a MBA
 - include identities and locations of the items or batches
 - grouped such that items with similar physical and chemical characteristics and within the same measurement uncertainties are together
 - optionally grouped according to location as this can speed up verification activities and thus reduce the burden on the operator
 - clearly state any qualifying nuclear material within the MBA the operator has been unable to physically measure or estimate with the reason recorded
- 6.7 On completion of the PIT and LII an itemised list will be prepared for all batches of qualifying nuclear material in the MBA in the PIL declaration. This is then compared to the book inventory which will have been determined by summing all the changes in the MBA during the material balance period and declared on the Material Balance Report (MBR). The inventory difference will be reported in the MBR and assessed by the site

and the inspector as detailed in the inventory difference/material balance evaluation section in 6.27-6.31.

- 6.8 The PIL along with the MBR, shall be submitted to ONR within the period of 15 days beginning the day on which the physical inventory was taken and in the specified format detailed in Regulation 15 of The Regulations.

Physical Inventory Take evaluation (PITe)

- 6.9 If the inspector determines that a PITe inspection is most suitable they should consider the below activities. The list is neither exclusive nor exhaustive and will be subject to review and revision in the light of operational experience.
- 6.10 The inspector should notify the operator at least 30 days before the day on which the physical inventory is to be taken of the inspection type to be performed along with an inspection scope document detailing any requests for information or activities that need to be arranged including speaking to relevant personnel.
- 6.11 The PITe will take place at the same time as the PIT to ensure the ONR inspector can inspect and assess the PIT process including speaking with relevant personnel in the facilities carrying out the PIT. The inspector should make all reasonable efforts to ensure the inspection has minimal impact on the work of the operator during PIT or any other operational activity.
- 6.12 A PITe will inspect the suitability of arrangements made and the adequacy of their implementation and could include the below activities.
- The inspector may carry out a BTC inspection at the same time. This will be identified in the inspection scope document issued to the operator.
 - Examine the PIT procedures for consistency. The procedures should describe the responsibility of those involved, the methods they should use, the records that should be kept, and any measurement uncertainties
 - Review the procedures to establish validity, whether any changes have been made since the last review and whether the identified responsible persons are correct.
 - Note whether instructions, methods and quality assurance requirements claimed in procedures have been followed and whether any changes that have been made have been correctly incorporated and validated.
 - Check the implementation of the arrangements and procedures to determine the adequacy of the PIT process.
 - As an example, in facilities where the operator takes measurements to determine the nuclear material inventory, the inspector may wish to examine the relevant procedures document in order to determine the suitability of the measurement. In this instance, previous ONR findings from inspections focussing on the operator's measurement control programme could be used by the inspector as evidence of suitability.
 - Observe the practice of the PIT and interview the personnel involved to ensure they are suitably qualified and experienced people (SQEP)
 - The inspector should consider any additional specialist support required from ONR's assessment specialists, for example to review the calibration records of the Instruments used for measurement or review the calculation models to ensure they are suitable and adequate identifying equations, nominal values, estimates or tables used to determine quantities
- 6.13 The operator should have arrangements and procedures for all measurement activities conducted for accountancy purposes. At item facilities, such as reactor sites, it may be

that only basic measurements, such as counting and item identification are required, supplemented by reactor physics calculations for nuclear material transformation calculations. More complex facilities may require dedicated in-plant equipment and laboratories for measurements.

- 6.14 Measurement results should meet relevant international standards. As such they should be validated, traceable and approved by a responsible person. Where the accountancy data is based on calculations from models, both this data and the models should be validated, traceable and approved by a responsible person.
- 6.15 Best practice is for the measurement results to meet relevant international standards including the IAEA International Target Values (ITVs) 2010 document referenced in the Further Reading Section. If the operator cannot meet the relevant international standards justification should be provided. Guidance on inspection of Nuclear Material Accountancy and Control is in preparation.
- 6.16 On completion of the PIT and LII, the PIL declaration will be produced by the operator, this is an itemised list of all batches of qualifying nuclear material in the MBA. The inspector should compare the LII to the PIL to check the PIL for correctness. The physical balance is then compared by the operator to the book inventory which will have been determined by summing all the changes in the MBA during the material balance period and declared on the Material Balance Report (MBR). The inventory difference will be reported in the MBR and should be assessed by the inspector as detailed in sections 6.27 to 6.31. Note this exercise is likely to be carried out as a desk based activity in the ONR office as the PIL is only required to be submitted 15 days after the PIT is performed.

Physical Inventory Verification (PIV)

- 6.17 If the inspector determines that a PIV inspection is most suitable they should consider the below activities. The list is neither exclusive nor exhaustive and will be subject to review and revision in the light of operational experience.
- 6.18 The inspector should notify the operator at least 30 days before the day on which the physical inventory is to be taken of the inspection type to be performed along with an inspection scope document detailing any requests for information or activities that need to be arranged.
- 6.19 The PIV enables ONR to make an assessment of the physical inventory as taken by the operator and as recorded in the LII.
- 6.20 The PIV will take place at the closing of a material balance period after the completion of the PIT by the operator. The inspector should make all reasonable efforts to carry out the PIV immediately after the PIT or within the period the facility is shutdown whilst the information on the LII is still valid and to ensure the inspection has minimal impact on operational activity.
- 6.21 The operator will provide the LII at the opening meeting (or in advance in agreement with the operator) enabling the inspector to assess the contents. A list of data and elements that may be included in an LII is shown in Appendix I, a summary of which has been provided in 6.6.
- 6.22 If any change in inventory took place after the PIT, the LII may still be used on a case by case basis for PIV provided that:
- Increases of the qualifying nuclear material inventory subsequent to the PIT are kept physically separate and are clearly distinguishable from the qualifying nuclear material on inventory at the PIT date, or if they result from nuclear production.

- Decreases of the qualifying nuclear material inventory subsequent to PIT meet the following conditions:
 - If adequate inspection or assessment of qualifying nuclear material subject to removal from inventory was performed by ONR, or
 - If confirmation of the receipt of such material has been obtained from the receiver of the qualifying nuclear material, or
 - If they are measured discards or nuclear losses.
- 6.23 The inspector should use their judgement to identify from the LII suitable components to be checked, for example by physically identifying, counting, check weighing or other means. The rationale for selecting the components should be recorded and include such factors as:
- Sensitivity and quantity of material
 - The complexity and strategic importance of the facility, ie what it is used for
 - Measurement basis, ie measured or estimated
 - Quality of the Operators Nuclear Material Accountancy Control and Safeguards System (NMAC&S)
 - If there are any existent or emerging issues within the MBA
 - Hazard and external factors including dose rate.
- 6.24 Should the operator have any qualifying nuclear material indicated on the LII which has been either removed from the inventory after the PIT without adequate assessment, or which cannot be inspected or verified during the PIV due to its specific properties or location the operator should provide adequate justification
- 6.25 Changes in the LII due to handling of qualifying nuclear material or to reorganisation of the inventory, may be accepted by ONR if the reconciliation between the PIT results as indicated in the LII and the actual status at the time of the PIV can be done effectively, and without delay, and if valid conclusions can still be drawn by ONR inspection and assessment or if an acceptable explanation is provided by the operator.
- 6.26 On completion of the PIV the inspector should compare the LII to the PIL to check the PIL for correctness. The physical balance is then compared by the operator to the book inventory which will have been determined by summing all the changes in the MBA during the material balance period and declared on the MBR. The inventory difference will be reported in the MBR and should be assessed by the inspector as detailed in sections 6.27 to 6.31. Note this exercise is likely to be carried out as a desk based activity in the ONR office as the PIL is only required to be submitted 15 days after the PIT is performed.

Inventory Difference/Material Balance Evaluation

- 6.27 The physical balance determined by the operator in the PIT will be compared to the book inventory which will have been determined by summing all the changes in the MBA during the material balance period. The difference is the Inventory Difference (ID) and the operator should provide a technical justification for this difference at the time of submission of the PIL and MBR.
- 6.28 The ID is calculated as the “ending physical inventory” (PE) minus the “ending book inventory” (BA) and declared by the Operator on the Material Balance Report.
- 6.29 The IAEA International Standards of Accountancy should be used as a guide to inspectors of typical action levels for various facility types but it is the technically justified and underpinned Inventory Difference Action Level (IDAL) for the facility that should be used to make formal assessment.
- 6.30 IDALs are required for processing facilities. The below table shows the facility types and the IAEA values for the “expected measurement uncertainties associated with a

closing material balance” under normal operations quoted in the IAEA Safeguards Glossary and included in the ONMACS guidance:

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

- 6.31 Material Balance Evaluation will be undertaken as an assessment away from site by the Nuclear Material Accountant and inspector. Analysis of ID and IDAL will highlight areas of statistical significance (3 sigma) and whether or not the facility measurement system is adequate. Where there are areas of statistical significance, an inspector should seek justification and clarification from the operator, this may be achieved through further site inspection.

7. FURTHER READING

Further reading includes:

- Nuclear Safeguards (EU Exit) Regulations 2019
- The Nuclear Safeguards (Fissionable Material and Relevant International Agreements) (EU Exit) Regulations 2019
- ONR Guidance for the Assessment of Nuclear Material Accountancy, Control and Safeguards 2019 Edition (Version DRAFT) (2019/127276)
- ONR Guidance for the Assessment of Accountancy and Control Plans (ACP) (2019/47012)
- General Inspection Guide, ONR Guide. Ref. ONR-INSP-GD-064, current revision
- Guidance for Intervention Planning and Reporting, ONR Compliance Inspection Guide Ref. ONR-INSP-GD-059, current revision
- ONR Nuclear Material Accountancy, Control and Safeguards Inspection Principles (version draft) (2019/53481)
- IAEA Nuclear Material Handbook
- IAEA STR-368 - International Target Values 2010 for Measurement Uncertainties in Safeguarding Nuclear Materials
- IAEA service series 30 – Safeguards implementation practices guide on facilitating IAEA inspection activities

8. APPENDICES

APPENDIX I

List of Inventory Items (LII)

The following data and elements for an LII may be required as appropriate (* items are essential for the inspector to permit verification and evaluation of any measurement results):

- Cut-off time and date of PIT*
- MBA code*
- Locations (KMP / other area identification)*
- Stratum identification*
- Item identification reference*
- Batch identification reference*
- Element code*
- Element weight*
- Isotope weight for enriched uranium and U-233*
- Irradiation status (fresh or irradiated)
- Item description (drum, tray, rod, assembly etc.)
- Material description (MOX, sintered UO₂, alloy etc.)
- Material Description Code (MDC)
- Gross weight
- Tare weight
- Net weight (of chemical compound)
- Element concentration factor (with indication of whether it is nominal, measured or derived)
- Isotope enrichment factor (with indication of whether it is nominal, measured or derived)
- Poison material (weight %)
- Volume
- Density
- Cooling time of irradiated fuel
- Burn up of irradiated fuel
- Remarks (if applicable)

It is good practice for the items to be grouped with similar physical and chemical characteristics and within the same measurement uncertainties (stratification).

Stratification is the process of dividing the QNM into a number of different subgroups with the same certain characteristics. This could be by material form, element category, measurement basis, KMP. The use of stratification enables the inspector to take a sample from each section instead of from the whole population thus providing assurance that no segment of the population is overlooked and therefore fewer samples are needed to achieve the required probability of detection.