ONR GUIDE			
CATEGORISATION FOR THEFT			
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1. INTRODUCTION

1.1 The Office for Nuclear Regulation (ONR) has established a set of Security Assessment Principles (SyAPs) (Reference 1). This document contains Fundamental Security Principles (FSyPs) that dutyholders must demonstrate have been fully taken into account in developing their security arrangements to meet relevant legal obligations. The security regime for meeting these principles is described in security plans prepared by the dutyholders, which are approved by ONR under the Nuclear Industries Security Regulations (NISR) 2003 (Reference 2).

1.2 The term 'security plan' is used to cover all dutyholder submissions such as nuclear site security plans, temporary security plans and transport security statements. NISR Regulation 22 dutyholders may also use the SyAPs as the basis for Cyber Security and Information Assurance (CS&IA) documentation that helps them demonstrate ongoing legal compliance for the protection of Sensitive Nuclear Information (SNI). The SyAPs are supported by a suite of guides to assist ONR inspectors in their assessment and inspection work, and in making regulatory judgements and decisions. This Technical Assessment Guidance (TAG) is such a guide.

2. PURPOSE AND SCOPE

2.1 This TAG contains guidance to advise and inform ONR inspectors in exercising their regulatory judgment during assessment activities relating to a dutyholder's processes to identify theft targets through the categorisation of its inventory of Nuclear Material and Other Radioactive Material (NM/ORM). It aims to provide general advice and guidance to ONR inspectors on how this aspect of security should be assessed. It does not set out how ONR regulates the dutyholder's arrangements. It does not prescribe the methodologies for dutyholders to follow in demonstrating they have addressed the SyAPs. It is the dutyholder's responsibility to determine and describe this detail and for ONR to assess whether the arrangements are adequate.

2.2 Inspectors should note that the scope of this TAG is limited to the categorisation of materials where the intent is an act of unauthorised removal for subsequent malicious use. Dutyholders are also required to categorise their inventories from the perspective of direct acts of sabotage (i.e. attacking the radioactive material or associated facilities). This is known as vital area identification and TAG 6.2 is provided to assist inspectors assessing dutyholder vital area identification studies.

3. RELATIONSHIP TO RELEVANT LEGISLATION

3.1 The term 'dutyholder' mentioned throughout this guide is used to define 'responsible persons' on civil nuclear licensed sites and other nuclear premises subject to security regulation, a 'developer' carrying out work on a nuclear construction site and approved carriers, as defined in NISR. It is also used to refer to those holding SNI.

3.2 NISR defines a 'nuclear premises' and requires 'the responsible person' as defined to have an approved security plan in accordance with Regulation 4. It further defines approved carriers and requires them to have an approved Transport Security Statement in accordance with Regulation 16. Persons to whom Regulation 22 applies are required to protect SNI. ONR considers Physical Protection Systems (PPS) to be an important component of a dutyholder's arrangements in demonstrating compliance with relevant legislation.

4. RELATIONSHIP TO IAEA DOCUMENTATION AND GUIDANCE

4.1 The essential elements of a national nuclear security regime are set out in the Convention on the Physical Protection of Nuclear Material (CPPNM) (Reference 3) and the IAEA Nuclear Security Series 20 Nuclear Security Fundamentals (Reference 4). Further guidance is available within IAEA Technical Guidance and Implementing Guides.

4.2 Annex II to the CPPNM consists of a table specifying how nuclear materials are to be categorised. The content of this table is reflected and enshrined within UK legislation through the schedule to NISR. It is supplemented by the tables at Annex A to SyAPs.

4.3 Fundamental Principle H of the CPPNM refers to the graded approach and states that physical protection requirements should be based on a graded approach, taking into account the current evaluation of the threat, the relative attractiveness, the nature of the material and potential consequences associated with the unauthorised removal of material and with sabotage against the nuclear material or nuclear facilities. The importance of issues relating to identifying targets based on the potential consequences of compromise and the application of risk informed approaches is also recognised in the Nuclear Security Fundamentals, specifically:

- Essential Element 8: Identification and Assessment of Targets and Potential Consequences – 3.8 A nuclear security regime ensures that:

  a) Targets under the State's jurisdiction are identified and assessed to determine if they require protection from nuclear security threats;

  b) The assessment is based on the potential consequences should the targets be compromised;

  c) An up to date assessment of such targets is maintained.

- Essential Element 9: Use of Risk Informed Approaches – 3.9 A nuclear security regime uses risk informed approaches, including the allocation of resources for nuclear security systems and nuclear security measures and in the conduct of nuclear security related activities that are based on a graded approach and defence in depth, which take into consideration:

  a) The State's current assessment of the nuclear security threats, both internal and external;

  b) The relative attractiveness and vulnerability of identified targets to nuclear security threats;

  c) Characteristics of the nuclear material, other radioactive material, associated facilities and associated activities;

  d) Potential harmful consequences from criminal or intentional unauthorized acts involving or directed at nuclear material, other radioactive material, associated facilities, associated activities, sensitive information or sensitive information assets, and other acts determined by the State to have an adverse impact on nuclear security.

4.4 A more detailed description of the graded approach is provided in Recommendations level guidance, specifically Nuclear Security Series (NSS) 13, Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5) (Reference 5). This document states that a graded approach is used to provide higher

levels of protection against events that could result in higher consequences. For protection against unauthorised removal, the State should regulate the categorisation of NM in order to ensure an appropriate relationship between the NM of concern and the physical protection measures.

5. RELATIONSHIP TO NATIONAL POLICY DOCUMENTS

5.1 The SyAPs provide ONR inspectors with a framework for making consistent regulatory judgements on the effectiveness of a dutyholder's security arrangements. This TAG provides guidance to ONR inspectors when assessing a dutyholder's submission demonstrating they have effective processes in place to achieve SyDP 6.1 – Categorisation for Theft, in support of FSyP 6 – Physical Protection Systems. The TAG is consistent with other TAGs and associated guidance and policy documentation.

5.2 The HMG Security Policy Framework (SPF) (Reference 6) describes the Cabinet Secretary's expectations of how HMG organisations and third parties handling HMG information and other assets will apply protective security to ensure HMG can function effectively, efficiently and securely. The security outcomes and requirements detailed in the SPF have been incorporated within the SyAPs. This ensures that dutyholders are presented with a coherent set of expectations for the protection of nuclear premises, SNI and the employment of appropriate personnel security controls both on and off nuclear premises.

5.3 The Classification Policy (Reference 7) indicates those categories of SNI, which require protection and the level of security classification to be applied.

6. ADVICE TO INSPECTORS

6.1 Dutyholders should categorise their site and facilities for theft in accordance with the quantities of all NM and ORM. For some dutyholders this may be a relatively simple task but for others, with a large and varied inventory that may also change over time, requires suitable access to specific knowledge and expertise. Physical protection requirements should be based on a graded approach, taking into account the current evaluation of the threat, the relative attractiveness, the nature of the nuclear material and potential consequences associated with its unauthorised removal. Table 1 in Annex A to the SyAPs reflects the schedule to NISR that defines categories of nuclear material based on isotope (and enrichment for uranium) and weight but provides more granularity to facilitate application of the graded approach. Table 2 provides an alternative scheme for categorisation that takes dilution, dispersion, type and form into account. Table 3 and Table 4 are to be used for the categorisation of radioactive sources and Other Radioactive Material (ORM).

6.2 It is essential that radioactive materials are allocated to the appropriate categories in order to identify the correct security outcome to be achieved in applying the graded approach. Both Table 1 and Table 2 grade materials based on their utility from a proliferation perspective and are not appropriate when considering malicious acts other than constructing a Nuclear Explosive Device (NED), for example the improvisation of a Radiological Dispersal Device (RDD) or Radiological Exposure Device (RED). The security groups within Table 3 and Table 4 are provided for the purpose of grading the risk to human health posed by exposure to radioactive materials (and hence utility in the construction of an RDD or RED) and similarly, these tables are not appropriate for consideration of proliferation. Therefore, where categorisation for theft is being applied to radioactive material that is also nuclear material (for example a radioactive source

comprising of plutonium), it will require a nuclear material category under Table 1 or Table 2 **and** a security group against Table 3 or Table 4. However, in application this is only necessary where the nuclear material falls below Category III because at this quantity and above, the security outcome dutyholders need to achieve will be driven by the proliferation categorisation. Allocation of categories is explained in more detail later.

6.3 Wherever cases regarding categorisation for theft presented by a dutyholder are challengingly technical and complex, inspectors should seek advice from the ONR Security Informed Nuclear Safety (SINS) team. When arriving at any judgement on the dutyholder's case, they might also seek appropriate peer review.

Regulatory Expectation

6.4 The regulatory expectation placed on the dutyholder is that they should demonstrate within their security plan how site or facility categorisation for theft has been implemented according to the quantities and forms of all NM and ORM held or used. They should also demonstrate how they identify and manage planned or potentially unplanned changes to the inventory and/or operations at a site/facility that might affect its categorisation, in order to ensure an appropriate PPS and the associated outcomes are maintained at all times.

FSyP 6 - Physical Protection Systems	Categorisation for Theft	SyDP 6.1
Dutyholders should undertake a characterisation of their site and facilities in order to determine the categorisation for theft.		

7. CATEGORISATION OVERVIEW

7.1 Table 1 (with notes) of Annex A to SyAPs details the categorisation of NM. It reflects the schedule to NISR and the table in the extant versions of INFCIRC/225, the Nuclear Suppliers Group Guidelines, the CPPNM and the contents of the Guidelines for the Management of Plutonium. However, Table 1 is not identical with the schedule or these international tables/documents and should not be referenced outside the UK.

7.2 Intermediate and low level waste containing NM may be categorised in accordance with Table 2 where specific criteria are met. This table provides an alternative scheme for categorisation that makes allowances for considerations of dilution, dispersion, type and form. For example, waste maybe in the form of a sludge and NM not be easily recoverable because it might be highly dispersed and not readily separated. Dutyholders may also be able to make a case for materials to be categorised in accordance with Table 2 under special arrangements where the characteristics do not meet every aspect, but are broadly comparable to, the specific criteria.

7.3 Radioactive sources and ORM should be assigned a security group in accordance with Table 3 and Table 4 respectively. This categorisation system is taken from the IAEA Safety Guide RS-G-1.9 Categorisation of Radioactive Sources and is based on the concept of 'dangerous sources', which is quantified in terms of '*D* values'. The *D* value is the radionuclide specific activity of a source which, if not under control, could cause severe deterministic effects for a range of scenarios that include both external exposure from an unshielded source and internal exposure following dispersal of the source material.

7.4 Inspectors should note that Table 1 and Table 2 both categorise materials solely based on the attractiveness of the material from a proliferation perspective (i.e. the ease with which it could be used to fashion an improvised nuclear device). Hence, the categorisations are derived from the quantities, isotopes and enrichments of fissile materials. Table 3 and Table 4 are based primarily on the potential for radioactive material to cause deterministic health effects and considerations therefore relate to the attractiveness of material in terms of theft in order to fashion a RDD or RED. In many cases (e.g. where a radioactive source is comprised of plutonium), it will be appropriate for material to be categorised against one of either Table 1 or Table 2 and one of either Table 3 or Table 4. Where this is the case, the categorisation resulting in the highest security outcome should be used as the basis for physical protection system design.

8. CONSIDERATIONS IN SETTING GRADED PROTECTION REQUIREMENTS BASED ON MATERIAL FORM

8.1 A three-factor methodology is initially used to categorise un-irradiated NM in order to determine the appropriate physical protection against theft. With this methodology, for any NM, the element, the isotopic composition, and the quantity, are the three factors considered to initially determine the level of physical protection required to protect against theft. This methodology is simple, but there are situations when it may result in overly conservative protection requirements for the material being protected and the form of the material also needs to be considered. In light of this, Table 2 of Annex A to SyAPs describes an alternative categorisation scheme that considers other attributes of the material which might provide additional impediments to an adversary aspiring to develop a NED, such as dilution or extensive material separation issues. Dutyholders may make a case for their inventory to be categorised according to this scheme where the associated criteria are fulfilled, noting that a degree of flexibility may be catered for under special arrangements as detailed above.

8.2 The IAEA recommendations recognise the need for consideration of other factors:

- For NM in general, “the categorisation is the basis for a graded approach for protection against unauthorised removal of nuclear material that could be used in a nuclear explosive device, which itself depends upon: the type of NM (e.g. Pu and U), isotopic composition (i.e. content of fissile isotopes), physical and chemical form, degree of dilution, radiation level, and quantity.”

- For waste, “Nuclear material which is in a form that is no longer usable for any nuclear activity, minimises environmental dispersal and is practically irrecoverable, may be protected against unauthorised removal in accordance with prudent management practice.”

- For irradiated fuel, the IAEA guidance allows reduction of category based on radiation level.

8.3 **Dilution -** Material that is in a dilute form will force an adversary to acquire much larger volumes and masses of material to obtain a significant quantity of NM. The adversary may also be faced with greater difficulty in recovering the NM such as a need to perform extensive processing to convert the NM to a form usable in a NED. Possible additional factors could be the concentration of NM and the homogeneity of the concentration within the material.

8.4 **Dispersion -** Material which is widely dispersed within a store, either in individual containers, or as part of a homogenous mass, will force an adversary to acquire larger volumes and masses of material to obtain a significant quantity of NM. The adversary then has greater difficulty in identifying and separating the NM from the other less attractive materials. These considerations form the basis of the criteria against which a dutyholder may make a case for their inventory to be categorised against Table 2 of Annex A to SyAPs.

8.5 **Form -** The processing and storage of NM may be beneficial as a control measure because the chemical and physical form of the material may have a significant impact on the attractiveness for theft. For example, materials that are bound into immobile matrices, such as cementitious grout or a vitrified product, will also create difficulties for adversaries. Table 2 incorporates these considerations by limiting the highest possible categorisation where the chemical and physical form is appropriate.

8.6 **Irradiation -** The CPPNM and NISR Schedule defines the term 'irradiated', in relation to any kind of material, means that the material has a total radiation output giving a dose rate exceeding 1 Gray per hour at one metre from the unshielded surface of the material. The categorisation of material meeting these criteria may be reduced based on the reduced attractiveness because of the high dose rate and hence danger to life. However, this rate may be insufficiently high to deter (neither will it incapacitate) modern threats where adversaries are unconcerned about preservation of their health. Therefore, inspectors should be cautious about dutyholder claims for reduced NM categorisation based on the irradiated criteria where the dose rate is close to the threshold. This is especially the case where the half-life of the material is relatively short in comparison to the life of the facility in which it is to be stored or processed. Further advice should be sought from specialists in SINS, health physics and/or radiation protection specialists as required.

8.7 The dutyholder should develop a fully documented characterisation of their NM inventory and make a case to categorise for theft against either Table 1 or Table 2 of Annex A to SyAPs. This will ensure that the basic three-factor methodology and other factors considered above are appropriately incorporated within the categorisation case.

9. ADDITIONAL CONSIDERATIONS BASED ON AGGREGATION OF NUCLEAR MATERIAL

9.1 Regulation 3(5) of NISR states that in determining the categorisation of material used or stored on nuclear premises, the quantities of all material of the kind in question (i.e. materials as specified in column 1 of the Schedule to NISR) that is being used or stored on the nuclear premises are to be aggregated. Therefore, careful consideration will need to be given to adding together, or aggregating, the total amount of NM contained within a nuclear facility, group of buildings or group of rooms when categorising nuclear material. The principle of aggregation is an important element in deciding (and potentially increasing) the appropriate categorisation on a site and facility basis.

9.2 In some facilities, NM of the same type may be located in several different buildings, for different purposes or at different stages of processing. For example, there may be Category II quantities of specific material in one building and a Category II quantity of similar material in another building within the same Protected Area. Considered individually, each quantity of material is Category II. However, if all the material could be taken during a single adversary attack, the material should be designated as Category I. Consideration should also cover the possibility that quantities of NM may be removed by a

single adversary from several locations or buildings (e.g. by an insider), which may include small quantities over an extended period of time.

9.3 NM of different types (e.g. Pu, Np and U with different levels of enrichment) may be co-located in the same nuclear facility. The total amount of NM in the facility should be considered in determining the categorisation of the NM in any specific location. There are several mathematical approaches for calculating the category for aggregated quantities of different NM, and the dutyholder should decide which approach is appropriate. The ONR SINS team can provide advice on the adequacy of the methodology adopted by the dutyholder.

10. NOTES ON PHYSICAL PROTECTION AND CATEGORISATION OF NUCLEAR MATERIAL

10.1 Inspectors should note that prior to the publication of SyAPs and the associated adoption of outcome focused security regulation, it was acceptable for dutyholders to make a case for reducing the categorisation of NM to take into account aspects of attack scenarios and physical protection. For example, cases were made for a Category III NM inventory to be protected as Category IV because of its location within robust vaults combined with the sheer volume and mass that would need to be removed. This was entirely appropriate under the previous prescriptive approach to regulation in order to avoid the application of disproportionate security measures driven by model standards, which were based on a worst case scenario of material attractiveness. Conversely, such an approach is not appropriate in an outcome focused regulatory regime where, in the absence of model standards, the previous motivation is no longer relevant and can lead to inadequate protective security.

11. CATEGORISATION OF RADIOACTIVE SOURCES

11.1 Radioactive sources are placed in security groups according to guidance issued by the IAEA. For the purposes of determining security protection these groups and categories of source are set out in Table 3 of Annex A of the SyAPs. Many of the sources referred to are typically used in medical or industrial applications, and the examples given here are intended to serve as a guide to source types and categorisation. The IAEA methodology for categorising radioactive sources, based on the A/D activity ratio, is set out in IAEA Safety Guide Ref RS-G-1.9 (Reference 8). Whilst the methodology is based on the A/D ratio, factors such as the physical and chemical forms, the type of shielding or containment employed, the circumstances of use and accident case histories are also taken into consideration within the categorisation for sources of specified types and practices in Table 3. Where a dutyholder possesses a source that does not fit within the specified types or practices, then it would be reasonable for categorisation to be based solely on the A/D ratio.

11.2 The categorisation system has five categories. Within this, sources in Category 1 are considered to be the most harmful because they can pose a very high risk to human health if not managed safely and securely. An exposure of only a few minutes to an unshielded Category 1 source may be fatal. At the lower end of the categorisation system, sources in Category 5 are the least dangerous; however, even these sources should be kept under appropriate control.

11.3 Where a number of radioactive sources are regularly used or stored together, or are in close proximity, their aggregation should be applied by summing the A/D values. Thus, the total radioactivity of the sources should be assessed using the IAEA methodology

(Reference 8) to identify the security grouping and level of security protection needed. Inspectors should take particular note of sources in IAEA Category 3, where aggregation of just two may cross a threshold resulting in a higher SyAPs security outcome to be achieved, which may not be possible with a physical protection system designed to achieve the lower outcome.

11.4 Dutyholders should also be able to demonstrate how they identify and manage potential planned or unplanned changes to operations at a site/facility that might affect its categorisation to ensure an appropriate PPS and outcomes are maintained at all times.

12. CATEGORISATION OF OTHER RADIOACTIVE MATERIAL

12.1 In addition to radioactive sources, dutyholders may have inventories of ORM, which should also be categorised because it may similarly be of use to adversary wishing to construct an RDD or RED. Given this similarity, Table 4 of the SyAPs annexes provides a categorisation scheme for ORM that reflects the radioactive source methodology. Dutyholders should determine the A/D value of any inventory of ORM to determine the appropriate security group. However, certain inventories of ORM may have extremely low concentrations of activity and in these cases it may be appropriate for dutyholders to make alternative cases for categorisation.

13. INVENTORY CHANGES

13.1 In many cases, site inventories may be subject to change, particularly during commissioning and decommissioning. Therefore, dutyholders should also be able to demonstrate how they identify and manage both planned or unplanned changes to operations at a site/facility that might affect its categorisation to ensure an appropriate PPS and security outcomes are maintained at all times.

Inspectors should consider:

- Has the dutyholder categorised all nuclear material in accordance with Table 1 and/or 2 of the SyAPs Annexes?
- Where Table 2 of the SyAPs Annexes is used, has the dutyholder made a sufficient case against the criteria?
- Have all sources been categorised in accordance with Table 3 of the SyAPs Annexes?
- Has all ORM been categorised in accordance with Table 4 of the SyAPs Annexes?
- Where material has been categorised against both Table 1 or Table 2 and Table 3 or Table 4 of the SyAPs Annexes, has the correct overall category and security outcome been identified?
- Has the dutyholder given appropriate consideration to aggregation within their categorisation methodology?
- Are there processes in place to identify and manage planned or unplanned changes to inventory and/or operations at a site/facility that might affect its categorisation?

14. REFERENCES

1. **Security Assessment Principles for the Civil Nuclear Industry.** ONR. http://www.onr.org.uk/syaps/security-assessment-principles-2017.pdf

2. **Nuclear Industries Security Regulations 2003**. Statutory Instrument 2003 No.403

3. **Convention on the Physical Protection of Nuclear Material (CPPNM)** https://ola.iaea.org/ola/treaties/documents/FullText.pdf

4. **IAEA Nuclear Security Series No. 20**. Objective and Essential Elements of a State's Nuclear Security Regime. http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1590_web.pdf

5. **IAEA Nuclear Security Series No. 13.** Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5). January 2011. https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1481_web.pdf

6. **HMG Security Policy Framework**. Cabinet Office. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/316182/Security_Policy_Framework_-_web_-_April_2014.pdf

7. **Classification Policy for the Civil Nuclear Industry.** ONR.– . http://www.onr.org.uk/documents/classification-policy.pdf

8. **IAEA Safety Guide Ref RS-G-1.9. Categorisation of Radioactive Sources.** http://www-pub.iaea.org/books/IAEABooks/7237/Categorization-of-Radioactive-Sources

Note: ONR staff should access the above internal ONR references via the How2 Business Management System.

15. ABBREVIATIONS

CPPNM	Convention on the Physical Protection of Nuclear Material
CS&IA	Cyber Security and Information Assurance
FSyP	Fundamental Security Principle
IAEA	International Atomic Energy Agency
NED	Nuclear Explosive Device
NISR	Nuclear Industries Security Regulations
NM	Nuclear Material
NSS	Nuclear Security Series
ONR	Office for Nuclear Regulation
ORM	Other Radioactive Material
PPS	Physical Protection System
RDD	Radiological Dispersal Device
RED	Radiological Exposure Device
SINS	Security Informed Nuclear Safety
SNI	Sensitive Nuclear Information
SPF	Security Policy Framework
SyAP	Security Assessment Principle
SyDP	Security Delivery Principle
TAG	Technical Assessment Guide