



ONR GUIDE			
<b>CATEGORISATION FOR SABOTAGE</b>			
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### 1. INTRODUCTION

- 1.1 The Office for Nuclear Regulation (ONR) has established a set of Security Assessment Principles (SyAPs) (Reference 7). 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 1).
- 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 the exercise of their regulatory judgement during intervention activities relating to assessment of a dutyholder's processes for target identification for sabotage of their site and facilities. It aims to provide general advice and guidance to ONR inspectors on how dutyholders' Vital Area Identification (VAI) submissions should be assessed. It does not set out how ONR regulates the dutyholder's arrangements. It does not prescribe the detail or methodologies for dutyholders to follow to demonstrate they have addressed the SyAPs. It is the dutyholders responsibility to determine and describe this detail within their submission and for ONR to assess whether the arrangements are adequate.
- 2.2 Annex B to this guide contains details on the type of information that will need to be considered by a dutyholder and covered in a VAI submission. As the content of this Annex is primarily concerned with technical issues associated with nuclear safety, responsibility for the content and the ownership of this Annex rests with ONR Safety Assessors employed in the Security Informed Nuclear Safety (SINS) team.

### 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.

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### 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 4) and the IAEA Nuclear Security Fundamentals (Reference 3). Further guidance is available within IAEA Technical Guidance and Implementing Guides.

4.2 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 the sabotage against nuclear material or nuclear facilities. The importance of issues relating to the graded approach is also recognised in the Nuclear Security Fundamentals, specifically:

- 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.

4.3 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 2). 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 sabotage, the state should establish its threshold(s) of Unacceptable Radiological Consequences (URCs) in order to determine appropriate levels of physical protection taking into account existing nuclear safety and radiation protection.

4.4 The IAEA also publish Technical Guidance documents NSS 16 'Identification of Vital Areas at Nuclear Facilities' (Reference 9) and NSS 4 'Engineering Safety Aspects of the Protection of Nuclear Power Against Sabotage' (Reference 10) where further relevant information can be found.

### 5. RELATIONSHIP TO NATIONAL POLICY DOCUMENTS

5.1 The Department for Energy and Industrial Strategy is responsible for producing the UK Design Basis Threat. This document refers to the assumed malicious capabilities against which the site's inventory and other characteristics are assessed in order to

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carry out VAI. The Cyber threat defined within the DBT is not considered within this TAG, instead the Cyber threat and a potential for it to cause a radiological release is considered within the Cyber Security and Information Assurance Principle (FSyP7) suite of TAGs.

- 5.2 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 6.2 – Categorisation for Sabotage, in support of FSyP 6 – Physical Protection Systems (PPS). The TAG is consistent with other TAGs and associated guidance and policy documentation.
- 5.3 The HMG Security Policy Framework (SPF) (Reference 5) 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.
- 5.4 The Classification Policy (Reference 6) indicates those categories of SNI, which require protection and the level of security classification to be applied.

## 6. ADVICE TO INSPECTORS

- 6.1 ONR inspectors make judgements on how sites and facilities are categorised for sabotage. Due to the technical nature and complexity of the process, advice can be sought from the ONR SINS team, and engagement with the dutyholder is essential to fully understand the process. This guidance informs regulatory assessment of the dutyholder's target identification for sabotage and will inform the design and management of the PPS whilst recognising that target identification, including categorisation for sabotage in accordance with the table in Annex B to the SyAPs, is only the start point for designing PPS measures. PPS is defined as an integrated set of physical protection measures intended to prevent the completion of a malicious act.
- 6.2 The judgment of the ONR SINS team can be sought when deciding the adequacy of a dutyholder's submission relating to potential Vital Areas (VAs). The ONR SINS team will make an assessment of the technical adequacy of each VAI submission, taking the respective parts of the DBT and the graded approach to sabotage into account. The ONR SINS team will provide specialist advice to security inspectors and dutyholders relating to each VAI submission as required. However, the relevant key features described below should be found in all VAI submissions developed by dutyholders.

### Regulatory Expectation

- 6.3 The regulatory expectation placed on the dutyholder is that they should demonstrate within their security plan how site and/or facility categorisation for sabotage has been implemented through the conduct of a VAI study. They should also demonstrate how they identify and manage potential planned or unplanned changes to 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.

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<b>FSyP 6 - Physical Protection Systems</b>	Categorisation for Sabotage	SyDP 6.2
Dutyholders should undertake a characterisation of their site and facilities in order to determine the categorisation for sabotage.		

- 6.4 Once accepted, the VAI submissions will provide information which is to be used as a basis for the VA protection detailed in security plans. The security plan should refer to the current VAI submission and list the VA protection supporting assumptions/commitments.

## 7. VITAL AREA IDENTIFICATION SUBMISSIONS

### Vital Area Criteria

- 7.1 A VA is defined as ‘an area containing nuclear material and/or other radioactive material (including radioactive sources) or equipment, systems, structures or devices the sabotage or failure of which, alone or in combination, through malevolent acts as defined in the extant DBT document, could directly or indirectly result in Unacceptable Radiological Consequences (URCs), thereby endangering public health and safety by exposure to radiation’.
- 7.2 To ensure that VAs are provided with a proportionate level of protection, each is to be categorised as a Vital Area or a High Consequence Vital Area in accordance with the table in Annex B of the SyAPs. Each VA must be considered on a case-by-case basis, to take account of the relevant threats contained in the DBT document.
- 7.3 Any consideration of nuclear material and other radioactive material including sources is additional to those requirements for theft defined in TAG 6.1 and associated reference IAEA Safety Guide RS-G-1.9, (Reference 8).

### General Features of a VAI Submission

- 7.4 General features of a good VAI submission should include the points summarised below. Subsequent sections of this guide translate these into more specific points. In general submissions should be:
- **Complete** - Submissions should assume the loss of off-site power (LOOP) as this cannot be protected by a dutyholder. They should also take into account all plant states and consider both the active and passive systems required to maintain plant safety. They should detail how the malicious capabilities in the DBT could bring about an URC and take into account the graded approach identifying for example where a VA is High Consequence.
  - **Clear** - A submission should identify the PPS outcomes given in the SyAPs document that need to be met, relevant malicious capabilities in the DBT that need to be addressed, and the radiological consequences that could result. The submission should be clear, logical and understandable. The basis for all assumptions, conclusions and recommendations in the submission, and unresolved issues, should be explained and justified. Clarity should extend to the correct referencing of supporting information. The results of the VAI need to be deterministic; there is, or is not, a vital area.

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- **Accurate** - A submission should accurately reflect the plant, equipment and components. For a plant in design, the submission should accurately reflect the proposed build, with due consideration given to the state of the design development at that time.
- **Objective** - The arguments developed in a submission should be supported with factual evidence, and the necessary understanding of the behaviour of associated systems or processes should be established. In the absence of directly relevant information, the use of inferred or extrapolated detail should be carefully substantiated. There is also a need to provide visibility of the sensitivity to assumptions that validate the robustness of associated claims. The adequacy of respective operational procedures, managerial controls and resources should all be demonstrated to an appropriate level.
- **Appropriate** - Any analytical methods, such as Deterministic Safety Analysis (DSA) used by the dutyholder to substantiate safety arrangements in a VAI submission should be shown to be fit for purpose with adequate verification by the ONR SINS Team in conjunction with other safety inspectors. Any assumptions that have been made should be identified and shown to be appropriate.
- **Integrated** - A submission should be holistic, with clear links between any engineering/technical substantiation or analysis. It should also define where VA protection depends on external facilities and services, and clearly substantiate any associated assumptions that are made.
- **Current** - A submission should be current, concise and relevant. The content of a VAI submission may change if the plant/area concerned undergoes a major modification, or a series of minor modifications, which could also have a significant cumulative effect on radiological consequences. The VAI process should also be repeated when design changes are being considered prior to their implementation, and whenever the DBT has been updated. Where possible this process should be applied in the design phase of a new facility to help 'engineer out' potential VAs.
- **Forward looking** - A submission should demonstrate that VAs, and the processes involved to identify them, will be regularly reviewed throughout the lifetime of the site/plant/area to ensure the analysis remains valid and appropriate.

### Preparation of a VAI Submission

- 7.5 A graded approach to the assessment of VAI studies will consider the outcome and its proximity to each of the dose thresholds. Inspectors should subject those which are close to the boundaries to greater review and assessment to confirm that the assumptions and uncertainties have been considered appropriately by the dutyholder. Particular attention will be given to the sensitivity studies and validation and verification of calculations.
- 7.6 Dutyholders should carry out VAI, aimed at identifying those targets that are vulnerable to sabotage that could potentially cause URCs. This work should be carried out by suitably qualified and experienced specialist safety and operational staff with advice from the security department concerned. Where a dutyholder does not develop all aspects of the submission and uses contractors for this purpose, the dutyholder must

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demonstrate that a technical review has been undertaken independently of the contractor producing the submission. During the process, these specialists should also consider how a potential VA can be 'engineered out' from a safety perspective or through application of 'security by design' principles. This could involve the provision of additional safety systems or further diversification and is an important aspect of VAI that should be considered before a decision is made to apply physical protection.

- 7.7 Preparation of a VAI submission should be based on a number of factors. These include the graded approach against sabotage and potential radiological consequences resulting from a successful attack. It should also be based on a thorough review of plant structures, systems and components (SSCs) taking account of their location, physical separation, vulnerability to the threats detailed in the DBT and the potential for the loss of protection they provide to result in an URC. In all cases the calculation of radiological consequences should be based on conservative, but realistic assumptions, and on up-to-date data and information, including best estimate data where appropriate. This should be undertaken without consideration of the active protection and mitigation measures at the site.
- 7.8 An example process map for VAI is provided at Appendix A. The key elements of this process map should be employed by all sites in their VAI studies. Any ONR inspection of the process by which VAI studies are undertaken would look for all the key features of this sample process map.

### **VAI Submission**

- 7.9 Some examples of points that need to be considered in a VAI submission are detailed in Appendix B to this TAG.

### **Review and Production of a Revised VAI Submission**

- 7.10 It is important that a VAI is up to date and reviews are undertaken when any changes take place that could reduce, increase or change the status of VAs on site. Significant changes may also occur during operations, such as modification, incidents, revised lifetime plans, operational experience etc, or as a result of any changes to the DBT or SyAPs. Such changes should be recorded and taken forward as necessary in an updated VAI, which accurately reflects the current situation.
- 7.11 The responsibility for reviewing and producing a revised VAI submission, together with document control arrangements, should be clearly defined and detailed in the security plan, as part of a dutyholder's assurance arrangements. This will include an appropriate timescale in which any submission will be reviewed. Suitably qualified and experienced staff should discharge these responsibilities.
- 7.12 Documentation which no longer forms part of a current VAI submission, or which has been superseded, should be archived and securely stored. This information still forms part of the formal audit trail, and should remain available for reference by the dutyholder and ONR.

### **VAI – Peer Review, Assurance and Governance**

- 7.13 As part of the pre-submission process, a VAI should undergo an internal peer review by the dutyholder and be subject to an assurance and governance process. This process should ensure that:

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- Appropriate methods and relevant safety and security standards and specifications have been used, and that the calculations used are correct.
- The site/plant and operational details as documented are consistent with the actual site/plant and its operations.
- Where necessary, there has been independent verification or advice provided by suitably qualified and experienced staff.
- Where there has been any third party involvement, there is evidence of their competence to undertake the work, and evidence that challenges raised have been addressed and the VAI amended accordingly.
- Any evidence available from the dutyholder's internal audit function should confirm the VAI submission has been produced in compliance with relevant company procedures.
- The VAI is complete, all key security and safety assumptions are considered to be valid, and the Board member (or equivalent) with responsibility for security has been briefed on all aspects of the submission and endorsed the approach used for its production.

### **Inspectors should consider:**

- Is the sabotage categorisation of facilities consistent with the thresholds detailed in Annex B of SyAPs?
- Are uncertainties, assumptions and sensitivity analysis appropriate, particularly where a potential VA is close to a dose threshold?
- Does the VAI submission appropriately incorporate each of the eight general 'good features'?
- Does the dutyholder provide for effective training on sabotage categorisation and the VAI process?
- Has the VAI been conducted by SQEP personnel?
- Where a contractor has been used to assist preparation of the VAI submission, has their work been subject to independent, technical review?
- Has there been effective liaison and cooperation between safety, operational and security staff in production of the VAI submission?
- Has the VAI submission been subject to appropriate internal review and governance arrangements?
- Are there processes in place that identify potential planned or unplanned changes to inventory and/or operations at a site/facility that might affect its sabotage categorisation and trigger a review of the VAI?

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### 8. SUBMISSION OF A VAI DOCUMENT

- 8.1 Once completed, dutyholders are expected to submit a VAI to ONR CNS who will arrange an assessment of the technical content of the VAI to an agreed programme. The scope and extent of the assessment will be subject to any extant sampling and selection criteria within ONR.

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## 9. REFERENCES

1. **Nuclear Industries Security Regulations 2003.** Statutory Instrument 2003 No. 403
2. **IAEA Nuclear Security Series No. 13.** Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (**INFCIRC/225/Revision 5**). January 2011. [www-pub.iaea.org/MTCD/Publications/PDF/Pub1481\\_web.pdf](http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1481_web.pdf).
3. **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](http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1590_web.pdf)
4. **Convention on the Physical Protection of Nuclear Material (CPPNM)**  
<https://ola.iaea.org/ola/treaties/documents/FullText.pdf>
5. **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](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/316182/Security_Policy_Framework_-_web_-_April_2014.pdf)
6. **Classification Policy for the Civil Nuclear Industry.** ONR.  
<http://www.onr.org.uk/documents/classification-policy.pdf>
7. **Security Assessment Principles for the Civil Nuclear Industry.** ONR.  
[www.onr.org.uk/syaps/security-assessment-principles-2017.pdf](http://www.onr.org.uk/syaps/security-assessment-principles-2017.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>
9. **IAEA Nuclear Security Series No 16** 'Identification of Vital Areas at Nuclear Facilities' <https://www.iaea.org/publications/8592/identification-of-vital-areas-at-nuclear-facilities>
10. **IAEA Nuclear Security Series No. 4.** Engineering Safety Aspects of the Protection of Nuclear Power Plants against Sabotage.  
<https://www.iaea.org/publications/7574/engineering-safety-aspects-of-the-protection-of-nuclear-power-plants-against-sabotage>
11. **UK Design Basis Threat**

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

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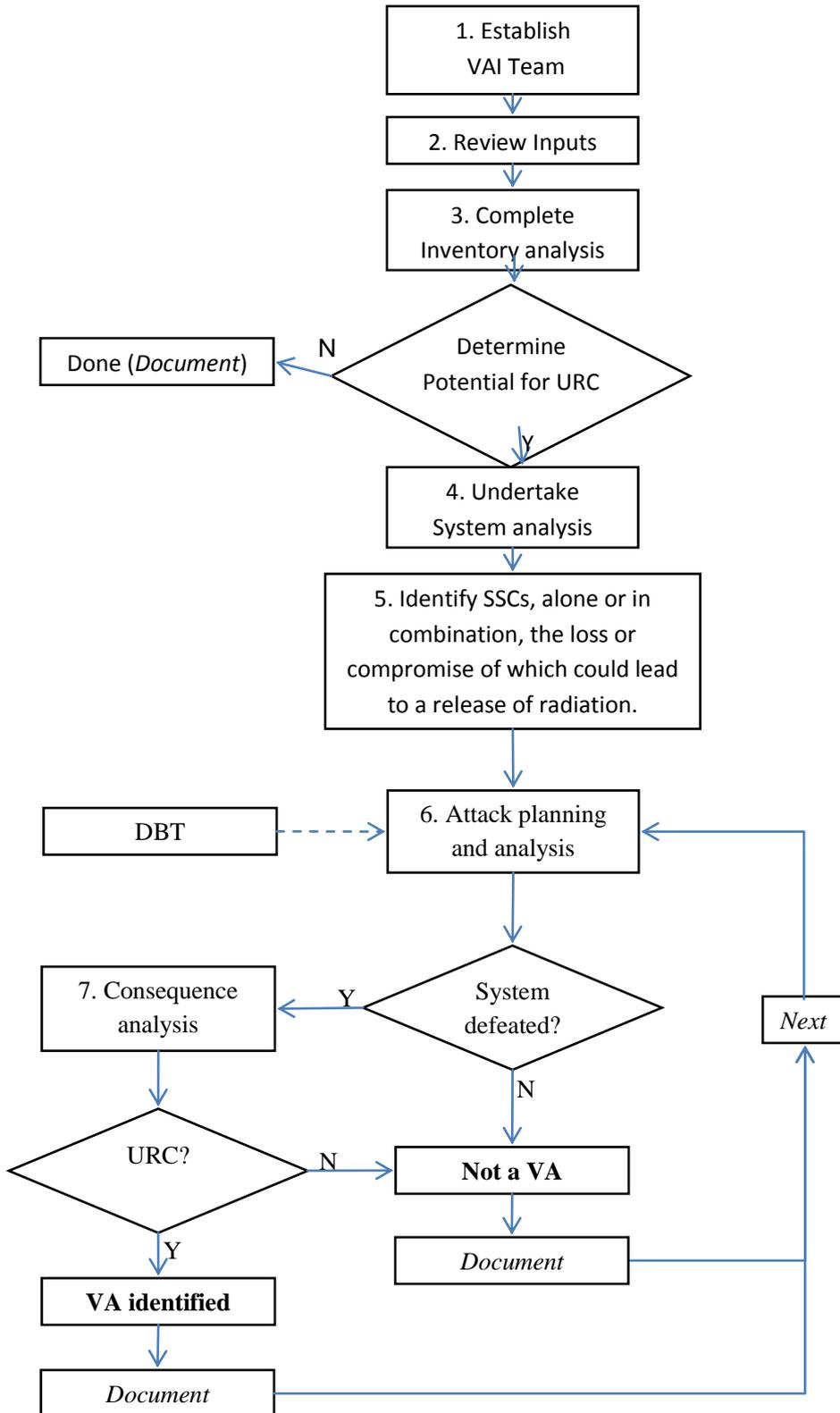
**OFFICIAL****10. GLOSSARY AND ABBREVIATIONS**

CPPNM	Convention on the Physical Protection of Nuclear Material
CS&IA	Cyber Security and Information Assurance
DBT	Design Basis Threat
DSA	Deterministic Safety Analysis
FSyP	Fundamental Security Principle
IAEA	International Atomic Energy Agency
LOOP	Loss of Off-site Power
NIMCA	Nuclear Industries Malicious Capabilities Planning Assumptions
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
SINS	Security Informed Nuclear Safety
SNI	Sensitive Nuclear Information
SPF	Security Policy Framework
SSC	Structures, Systems and Components
SyAP	Security Assessment Principle
SyDP	Security Delivery Principle
TAG	Technical Assessment Guide
VA	Vital Area
VAI	Vital Area Identification
URC	Unacceptable Radiological Consequence

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**APPENDIX A: Example Vital Area Identification Process Flow Chart**



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**OFFICIAL****Notes to Appendix A: Example Vital Area Identification Process Flowchart**

Appendix A illustrates a typical process for the identification of vital areas. It is not necessary for a dutyholder to utilise this exact process but whatever approach is taken, the key features in this example should be involved and evident.

1. The identification of vital areas is a multi-disciplinary process that should involve security managers, safety case authors, radiation protection specialists, relevant engineering disciplines and any other expertise that may be necessary.
2. Inputs to the VAI process include:
  - a. Policy considerations
  - b. Standards and guidance
  - c. Safety documentation
  - d. Regulatory information
3. An analysis of the total accessible inventory should be carried out to determine if, on the basis of complete dispersion, there is the potential for URCs.
4. A system analysis should be conducted that identifies all installed safety and non-safety systems, structures and components (SSCs), and inherent features of the plant, facility and site which, in the event of an act of sabotage, may act to prevent or mitigate any radiological consequences. A pragmatic approach that takes account of the vulnerability of the system should be taken when determining the level of granularity to consider when identifying SSCs.
  - a. Safety SSCs should be identified by considering each of the plant's nuclear safety functions, the safety systems that deliver those safety functions, and the individual SSCs that comprise those safety systems.
  - b. Non-safety SSCs are those that provide a level of protection to nuclear or radiological material from malicious acts but are not identified in the plant safety case as providing a nuclear safety function. For example, passive physical structures or topographical features that provide stand-off or deny line-of-sight, layers of protection (various layers of packages, transport containers and flasks), barriers (permanent structures such as over-buildings that don't provide a nuclear safety function)
5. A complete list of SSCs or combinations of SSCs, the loss or compromise of which could lead to a release of radiation should be generated. This list could range from a single SSC to a combination of a dozen or more. No attempt should be made at this stage to eliminate any combinations unless they can be demonstrated to be unreasonable by virtue of being incredible.
6. For each SSC or combination of SSCs all possible sabotage scenarios should be identified based on the full suite of threats described in the DBT. The most effective selection and allocation of threats should be considered rather than considering an exhaustive list of all possible combinations. Due account should be taken of the physical proximity of components where, for example, a single DBT threat could affect more than one SSC. For each credible scenario identified, the effects of the DBT threats should be analysed in relation to the SSCs to which they have been attributed.

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7. If Step 6 determines that all SSCs in the identified sequence are defeated by the specified DBT threats, a consequence analysis should be undertaken to determine the dose up-take at the site fence. If the sabotage event results in a URC, a vital area has been identified and the graded approach should be applied to determine whether the area should be categorised as a Vital Area or a High Consequence Vital Area.

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### APPENDIX B: Examples of the types of information for inclusion in a Vital Area Identification submission

#### Introduction

1. It should be noted that once detailed information is provided as part of a VAI submission, the security classification will be determined by the SNI contained in the submission.
2. This Annex contains examples of the types of information that should be considered by a dutyholder and covered in a VAI submission.
3. The aim of this Annex is to help ensure a consistent approach is maintained across the inspection and assessment regime with regard to VA identification and it provides:
  - Information on the approaches that a dutyholder may use in developing their VAI submission.
  - Guidance to ONR safety assessors and security inspectors on the information likely to be contained in a VAI submission.
4. The first step in performing a VAI is to determine if the potential exists for a URC. If the potential exists it must then be determined whether it could be realised by a sabotage attack based on the threats given in the DBT. The inventories of NM or ORM, including radioactive sources, present on the site, its potential hazard and its ease of dispersion will all need to be considered as part of this process. The following should be considered in a VAI study:
  - The site (area in which the facility is located).
  - Site characteristics to determine the consequences of a potential radiological release.
  - The locations, inventory, form, characteristics and quantities of associated NM and ORM.
  - The relevant plant/facility safety functions (e.g. shielding, criticality prevention, cooling, confinement, fire prevention, structural integrity).
  - The detailed design information on process and safety systems, and their supporting equipment, systems, structures, components, (SSCs) and devices, that require protection to prevent URCs.
  - The actions taken by a member of the site staff, or someone with authorised access, which could make a contribution to, or give rise to, a URC.
5. The onus is on the dutyholder to explain, demonstrate and, where appropriate, provide evidence that the VAI submission is the result of a detailed analysis of the plant/facility's SSCs and takes account of the threat from sabotage.

#### Review of safety documentation

6. In the early stages of the VAI process, the dutyholder must identify which functions and services are required to maintain a safe operating state, the loss of which could give rise to an

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URC. A good understanding of the function and requirements of the plant/facility should be demonstrated in the VAI submission.

### Site Specific Considerations

7. The dutyholder should produce a VAI submission based on site-specific considerations. These should for example include the normal operating, shutdown and maintenance conditions, and consider how vulnerabilities might be exploited in one plant condition to affect a subsequent plant condition. For example, a device could be planted during maintenance and activated when the plant is operating.
8. A VAI submission should focus on identifying whether a potential VA exists at a site and how the threats given in the DBT could be used to achieve a URC.
9. Both the dutyholder's team that produces the VAI study and the ONR SINS team assessing it must have a good understanding of the effects the DBT threats can produce. This understanding should be used to determine where systems which are functionally separate could be affected by a single event, and where damaging a structure could directly or indirectly cause a URC. Where diverse and redundant systems are used to prevent a URC, the number of potential threats detailed within the DBT, and their effect, should be considered.
10. A dutyholder's VAI team should determine the potential radiological consequences of the scenarios which give rise to each VA. The application of this information will determine the categorisation of the VA using the graded approach. In all cases the calculation of radiological consequences should be based on conservative, but realistic assumptions, and on up-to-date data and information, including best estimate data where appropriate. This should be undertaken without considering the active protection and mitigation measures at the site. Sensitivity studies should be carried out in order to substantiate the robustness of assumptions, particularly where a VA Criteria dose threshold is challenged.
11. For all sites, Loss of Offsite Power (LOOP) should be addressed as part of the identification process, independent of the DBT threats.

### Principal functions which may be used to prevent a URC

12. The VAI process should identify whether any, and if so which, malevolent act using the threats detailed within the DBT has the potential to cause a URC. As part of the VAI process it should be recognised that to prevent a URC, nuclear plant design employs systems to preserve all three radiation safety functions – confinement, cooling and control. Where the risk of a URC can be designed out by upgrading, or through the resilience of any of these functions a case can be made for not identifying something as a VA. However, security measures that protect a site and/or facility cannot by themselves justify a facility not being classified as a VA.

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### **Nuclear Material and Other Radioactive material**

13. All sources of NM and ORM should be identified and their properties, parameters and physical quantities should be estimated for all nuclides and their contribution to the overall activity, where large variations of material properties are identified best estimates should be made to determine the nuclides and conservative estimations should be made on the materials state.

### **Material state and Dispersibility - Release Fractions (RFs)**

14. NM and ORM can be found in various states and forms across a nuclear facility. When assessing the potential for a URC the assessment will consider the contribution of NM/ORM to a URC is highly dependent on the physical state of the material (e.g. Solid, liquid, gas) and its form (e.g. powder, crystal, aerosol etc) both of which will be considered as part of the assessment for all the NM/ORM under consideration. The material form is fundamental in determining both the dispersibility of the material and its potential effects to the public. A fundamental part of assessing a material's dispersibility is determining its appropriate release fraction, which is dependent upon both the material state and form.

15. The VA assessor will assess if the submission recognises that a material's state and form can be changed, specifically when subject to energetic insult and as a result the form may change to a more onerous form, i.e. becomes more dispersible. In this instance the release fractions used in the case should consider the insult as a result of the malicious scenario to which the material is exposed. Such insults include but are not limited to, shock effects, blast effects, venting of pressurised liquid, depressurisation and spillage. For each insult the various mechanical processes that could give rise to a material state/form change and dispersion should be identified and accounted for in the assessment.

16. Consideration should be given to the assumptions made in the analysis of the release fractions to ensure that they are appropriate to the data being applied. There are a number of data sources available to aid the VA assessor in determining radiological consequences, such as proprietary licensee databases and the DOE handbook of release fractions, these sources provide information and data to underpin dispersion estimations providing release fractions for various materials and material states from experimental data. Care must be taken to interpret this information correctly to ensure that the data is reflective of the correct mechanism (e.g. shock or entrainment) for dispersion and form change, in order to provide a valid estimate of the radiological consequences.

### **Decontamination Factors**

17. When undertaking dose consequence calculations Decontamination Factors (DFs) are often used. The impact of the sabotage scenario being considered must be taken into account as it could degrade the containment of an SSC or provide an initial pressure increase that would enhance the dispersion of the material under consideration. The potential for the sabotage scenario to negate multiple layers of defence/containment should also be recognised when presenting consequence calculations.

### **Confinement/Containment/Shielding**

18. The confinement function on nuclear facilities is designed to confine NM/ORM within the facility and prevent its leakage into the environment in normal operation or fault conditions. Confinement is often achieved by some form of containment system. Containment systems

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encompass a range of structures and plant, from massive buildings surrounding power reactors to glove boxes, individual packages and containers.

19. Containment systems provide shielding to protect both the operators and public from the direct effects of radiation.

### **Cooling (or heat removal)**

20. The heat removal systems on nuclear facilities are designed to ensure that temperatures remain within the safe limits for normal operation or fault conditions. A dutyholder's VAI team should identify potential vulnerabilities to cooling/heat removal systems from DBT threats. Within the site security plan, the time and resources available to initiate a cooling system and the recovery "grace" time may need to be confirmed in support of any VA mitigation arguments.

### **Control of reactivity (including criticality)**

21. The VAI study must consider the possibility of a malicious act affecting the control of reactivity, including criticality, where this could give rise to a URC.

### **Malicious Acts**

22. The dutyholder's VAI team should determine which malicious acts require consideration and justify those that are not included. The use of bounding cases may also be appropriate, and if so these should also be justified and documented. The study should show that the potential effects produced by the DBT have been recognised and considered appropriately (whether separately or in combination as defined in the DBT).

23. Inspectors should assure themselves that the dutyholder has adequately applied the DBT in defining the threats to those SSCs that support a nuclear safety function or act to eliminate or mitigate the consequences of a radiological release.

In particular, inspectors should determine that the duty holder:

- a. is suitably qualified and experienced to understand and apply the threats defined in the DBT; or
  - b. has sought advice from the relevant government bodies (e.g. CPNI) on the application of the DBT, if needed; or
  - c. has engaged a third party to undertake this aspect of the analysis.
24. Where a third party is engaged, the dutyholder should seek independent assurance that the work undertaken by the third party is technically correct. This may be from CPNI, a dutyholder SQEP/intelligent customer, or similar.
25. Further guidance on the interpretation of the DBT should be sought from the CNS threat inspector if necessary.

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### Functional analysis

26. The VAI submission must consider whether any of the DBT threats have the potential to disrupt any function which is required to prevent a URC. It must consider the possibility of separate and/or diverse systems being affected by a single threat if they are all located within the damage radius of that threat. This also applies to systems which are dependent on the supply from utilities, as these must be considered from end-to-end.

### Engineering analysis

27. The engineering analysis approach uses a methodology that considers where the materials that can cause a URC are located and then identifies how material might be dispersed. This will identify the safety measures or functions that if removed, bypassed or made to fail would lead to a URC.

28. The engineering analysis should consider the extent of damage which can be suffered by the systems, structures and components on the site as a result of the threats within the DBT and determine at what point these would no longer fulfil their function.

29. The use of 'event trees' can help to demonstrate the interdependence and interaction between systems and/or elements required to prevent a URC. Reviewing these event trees against the effects of the threats given in the DBT can highlight potential VAs. Where this approach is adopted the potential for more than one system to be impaired by each of the DBT threats must be considered. Understanding the effects that the DBT threats can generate and the location of the systems being considered is needed to undertake this part of the review. A key part in understanding this is the VA walkdown (see paragraphs 35 and 36).

### Calculations for Radiological Consequences – Additional Sensitivities

30. Dose consequence calculations are undertaken as part of the VA identification study in order to allocate the appropriate grading to any VA. In addition to this information, the study can also present information relating to the duration and nature of any consequence of a sabotage scenario together with the potential impact it could have. This information will help to inform any judgements which are subsequently made and presented within the security plan regarding the level and type of security arrangements appropriate to a particular scenario. For example, a single short term and one off "puff" type dispersion giving rise to a dose uptake could be considered differently from a long duration lower level dispersion which could give the same dose over a long time frame, but for which mitigatory measures both on and off site, could be employed to reduce or stop the release during that long time frame.

### Assurance of Validity of Data and Models

31. The VA assessment should ensure that the data and calculation methods applied are appropriate to the scenario, and are verified and validated using independent means. Where there are areas of uncertainty both in data and determining effects as a result of a malicious act, appropriate sensitivity analysis should be conducted. Further guidance on ONR expectations on the assurance of the validity of data and models can be found in the Safety Assessment Principles specifically principles AV1 to AV8.

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### Site maps and building plans

32. The inclusion of site maps, detailing the location of critical SSCs is needed in submissions to help confirm the segregation of key features to be confirmed rather than just their separation and redundancy.

33. The inclusion of service runs, pipe work and cable routes can also aid understanding, as there is the potential for multiple systems to be lost through one action.

### Equipment Unavailability

34. Although the VAI process focuses on the consequences of malicious acts, equipment unavailability could conceivably occur by chance, or as a result of maintenance outages, concurrent with a malicious act. The results of the VAI need to be deterministic; that is, an area is either vital or it is not. Therefore, the VAI study should consider all recognised plant states and be revised should there be any significant changes to the plant or its status.

### Walkdown

35. Information should be verified by the dutyholder's VAI Team through a VAI plant walkdown, in order to:

- verify arguments made within the study and determine whether any additional vulnerabilities exist;
- verify the areas from which relevant DBT threats could cause direct dispersal;
- verify those areas from which the DBT threat could disable equipment, SSCs, and devices or prevent key operator actions from taking place; and
- assess the potential for spatial interactions between adjacent areas.

36. Additional consideration is required in addressing spatial interactions between adjacent areas. There may be cases in which a malicious act in one area can disable equipment, components, or devices in one or more adjacent areas. This requires a sound understanding of the potential damage which could result from the threats within the DBT. The SINS assessment of the VAI study may include a walkdown of the plant with the dutyholder to confirm the validity of the arguments presented.

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