

## **Building Capacity and Capability within the Office for Nuclear Regulation (ONR) to Regulate Safeguards in the UK**

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### **Abstract**

The Office for Nuclear Regulation (ONR) has established and has the responsibility of maintaining a UK State System of Accounting for, and Control of, Nuclear Material (SSAC) as required by the UK's Voluntary Offer Agreement (INFCIRC/951) with the IAEA. To perform this role effectively, the ONR has implemented a structured approach to building its personnel capacity and capability. This structured approach recognised and utilised international good practices and involved an analysis phase, design phase, development phase, delivery phase and includes continuous evaluation. Using this approach, the ONR has been able to analyse the tasks involved in maintaining an SSAC; undertaken a training needs analysis to identify relevant skills/knowledge/experience and captured these within competencies; developed training plans with measurable outcomes; delivered those training plans; and continuously evaluates their effectiveness. Alongside developing a safeguards training framework, the ONR has also produced safeguards-specific guidance and modified existing cross organisational guidance where applicable to recognise safeguards as a regulatory purpose within the organisation. This allows for a proportionate, consistent, and transparent approach to safeguards regulation in the UK. This paper explains the structured approach ONR has taken to build and maintain its personnel capabilities and demonstrates how it supports a functional SSAC. This paper also comments on how this structured approach has been implemented and continues to be delivered in a responsive and adaptive manner during the Covid-19 pandemic and the challenges and restrictions that poses.

### **1 Introduction**

The Office for Nuclear Regulation (ONR) is responsible for the regulation of nuclear safety, security, and safeguards across Great Britain. Its mission is to provide efficient and effective regulation of the nuclear industry, holding it to account on behalf of the public. ONR independently regulates nuclear safety and security at 36 licensed nuclear sites, and transport by road and rail. Since 1 January 2021, ONR has also independently regulated nuclear safeguards at more than 180 material balance areas (MBAs) across main operator sites as well as small holders of nuclear material (SHNM, termed Location Outside of Facilities by the IAEA).

Following the 2016 referendum and the UK decision to leave the European Union (and as a result Euratom), the UK government announced that the UK would establish a safeguards regime to be implemented by ONR [1]. In response, ONR established the UK State System of Accounting for and Control of nuclear material (SSAC) Project to build a new SSAC in the UK and to take on the role as the UK's State Authority responsible for safeguards implementation (SRA). The UK SSAC Project involved (among other things) establishing data processing systems to receive, analyse and submit nuclear material accountancy reports [2]; establishing a regulatory framework for enforcing domestic safeguards legislation [3]; and

building capacity and capability within ONR to regulate safeguards and facilitate compliance with safeguards agreements.

This paper will discuss how the UK SSAC Project defined and delivered its human capacity and capability needs to ensure ONR can fulfil all the tasks required of an SRA for safeguards implementation. It will describe how ONR used a Systematic Approach to Training (SAT) to:

1. Understand the breadth and depth of skills, knowledge and experience required by the UK SRA;
2. Understand ONR’s initial capacity and capabilities to meet these requirements;
3. Design training approaches to address any shortfalls in capability;
4. Deliver those training approaches; and
5. Evaluate the delivery of that training and the resulting capability improvements.

In doing so, this paper demonstrates how a systematic approach to capacity and capability provides a methodical and structured approach to delivering the broad array of tasks that face an SRA. It also demonstrates how this approach can accommodate a range of training options (including e-Learning, coaching, mentoring, classroom teaching and on-the-job learning), providing flexibility and resilience in the face of delivery challenges presented by the Covid-19 pandemic.

## 2 Overview of the Systematic Approach to Training

The Systematic Approach to Training (SAT) is recognised as a model for assisting in identifying the training needs and for designing, planning, implementing and evaluating training programmes. It is widely used by states with major nuclear power programmes and is recognised by both IAEA guidance [4] and ONR guidance [5] as good practice for both regulators and operators. It provides a methodical, flexible and repeatable approach to ensuring all relevant capabilities are identified and delivered. It also provides transparent assurance that an organisation’s training framework is appropriate and effective over time. A SAT generally involves five phases: an analysis phase, a design phase, a development phase, a delivery phase and an evaluation phase as shown in Figure 1. The implementation of these five phases as part of the UK SSAC Project is detailed in the following sub-sections.

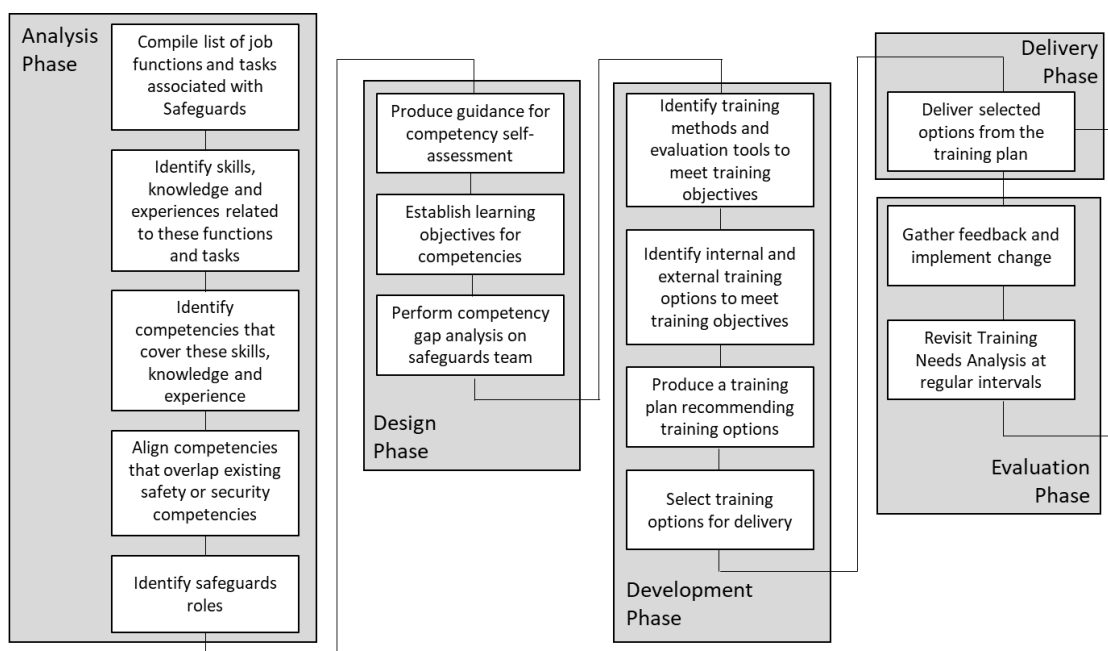


Figure 1: The five stages of a systematic approach to training

## 2.1 SAT – Analysis Phase

ONR drew on existing strategic documentation for ONR’s other purposes (Safety and Security) as well as IAEA guidance for establishing SRAs [6] to understand the functions and activities associated with regulating safeguards in the UK and meeting its international safeguards obligations. From these resources, ONR defined a set of core SRA functions (such as “collect, store and analyse reports, notifications and declarations”), with associated sets of activities (such as “validate reports, declarations and notifications from operators”). In total, the ONR defined eight core functions each with approximately four or five underpinning activities.

Having established a comprehensive list of activities, ONR then described what Skills, Knowledge and Experience (SKE) a person would need to be able to carry out each activity effectively. In many cases, the SKE required to fulfil one activity were naturally similar to those required to fulfil another similar activity (such as “knowledge of the requirements of safeguards reporting to the IAEA”). In other cases, they were unique to a particular activity (such as “current safeguards technologies”).

These SKE were then grouped together into common theme groups to create a set of 12 broader competencies, each explained with a description of the underlying hierarchy of functions, activities and SKE. These competencies are laid out in Figure 3 below. At this stage, ONR compared these 12 competencies against those established in other ONR regulatory purposes, against those provided in IAEA Guidance [7] and against relevant industry competence standards [8]. This mapping of Function, to Activity, to SKE, to identifying Competencies is shown in Figure 2.

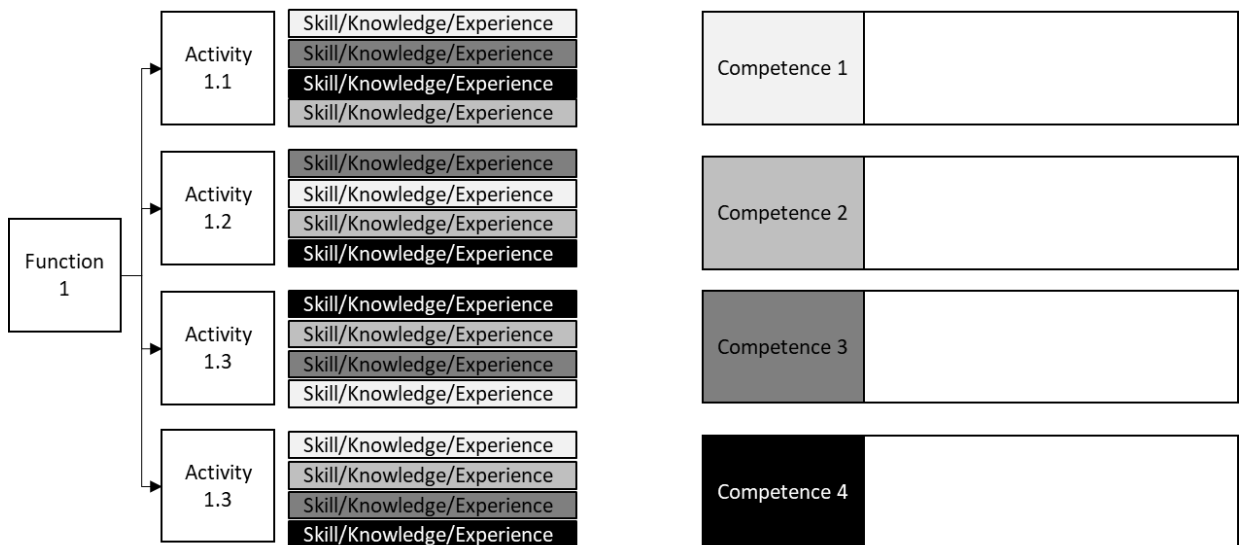


Figure 2: Illustration of Competence Framework

These competencies fell into one of two broader groupings:

- Safeguards-specific competencies relating to nuclear material accountancy and control, safeguards legislation, and interactions with international safeguards stakeholders; or
- Regulatory-specific competencies relating to generic regulatory SKE, such as carrying out or reporting on regulatory interventions.

Where possible, regulatory-specific competencies were adjusted to align with ONR’s broader regulatory competence framework. This ensured the description, the delivery and the measurement of these competencies were aligned across ONR and took advantage of ONR-wide delivery mechanisms. For example, any ONR inspector must achieve a certain level of regulatory competence to be appointed as an inspector (i.e. obtain an instrument in writing,

often called a “Warrant”) which specifies the legal powers that inspectors can exercise in order to carry out regulatory activities on ONR’s behalf.

Four levels within each of the 12 competencies were established to recognise that not all ONR safeguards roles or staff needed to be equally competent to fulfil ONR’s SRA functions:

- Level 0 = no or negligible competence
- Level 1 “Understand” = comprehends relevant knowledge/can carry out a task with supervision
- Level 2 “Apply” = can use relevant knowledge/can carry out a task independently
- Level 3 “Create” = can use relevant knowledge and skills to shape or create activities

In an ideal delivery of this five-phase approach, ONR would have produced role profiles and estimated the required capacity to deliver safeguards regulation in the UK based on the result of the Analysis phase, prior to recruitment of personnel. Due to the short timescale afforded by the requirement to establish the SSAC to be ready for when the UK exited Euratom, as well as the fact that fully competent safeguards inspectors and other safeguards competent personnel are not readily available in abundance in the UK, this was not possible.

Instead, ONR carried out a baseline estimate of capacity and role requirements at the start of the UK SSAC Project and began recruitment on this basis. This estimate drew on comparisons and benchmarks with other international partners, including Euratom. It also established a rough structure of delivery roles. A Professional Lead provides technical oversight of the quality of regulatory judgements and maintains the capacity and capability of the safeguards team. A Delivery Lead defines and monitors the delivery of safeguards tasks (such as inspections and submission of reports and declarations), with support from an Inspection and Assessment Lead and an Accountancy and Reporting Lead. These two supporting delivery leads oversee respective teams of inspectors and nuclear material accountancy specialists.

While these different roles require different competency requirements, the competency framework was broad and robust enough to accommodate these differences. As such a decision was made to apply these 12 competencies to all members of the safeguards staff, but the competency level expectations vary by role according to the capability required.

A: The UK’s safeguards policy and non-proliferation	B: Nuclear material measurement and safeguard equipment	C: UK nuclear safeguards obligations and their legal origins
D: The UK’s domestic legal framework for safeguards	E: Forming judgements on nuclear material accountancy and control arrangements	F: Nuclear material accountancy
G: Safeguards Information Management and Reporting System (SIMRS)	H: Performing regulatory interventions	I: Promoting, achieving, and sustaining compliance with regulations
J: Liaising with safeguards inspectorates and international stakeholders	K: Effective writing and communication skills	L: Working across ONR

Figure 3: ONR safeguards competencies

## 2.2 SAT – Design Phase

The 12 competencies, each with four levels, could now be used to consider the current safeguards capabilities and capacities and identify any shortfalls that needed to be addressed. This could have been performed through interviewed assessment, formal examination, manager determined or self-assessment. To drive ownership and transparency of personnel’s own competencies, ONR designed a competency self-assessment mechanism. This mechanism

provided guidance on the competencies and their levels to the safeguards team and allowed staff to self-assess against the 12 competencies and levels.

To ensure ONR safeguards staff could accurately and consistently rate themselves against the twelve levelled competencies, guidelines were provided for how to undertake the self-assessment and a set of illustrative examples were provided for each competency level. Considering the competence “Nuclear Material Measurement and Safeguards Equipment” as an example:

- Staff at level 0 have less competence than those at level 1
- Staff at level 1 understand what safeguards-relevant measurement tools and techniques are typically used by operators and the IAEA, and the basic principles of measurement control. For example, they could “understand the purpose and role of common containment and surveillance tools”
- Staff at level 2 can form a judgement as to whether or not measurement equipment or measurement systems are fit for purpose. For example, they could “identify warning and action levels for material balance performance based on overall system measurement uncertainty”.
- Staff at level 3 can develop strategies, policies and procedures for nuclear material measurement. For example, they would “be a recognised subject matter expert for attendance at measurement-related technical working groups”.

To help ONR safeguards staff substantiate their self-assessment, they were asked to provide a short (<100 words) explanation of their rating with reference to any specific SKE that would help justify their level. The self-assessment pack also contained a completed hypothetical example to demonstrate how one might substantiate a rating. The pack was then rolled out to ONR safeguards staff with accompanying guidance and outreach from senior staff, emphasising the function and scope of the self-assessment. Completed self-assessments were then moderated by a panel of senior staff (including an independent representative outside ONR safeguards) to ensure competence levels were interpreted consistently.

The output of this self-assessment process informed individual staff members’ professional development plans and provided a broader anonymised breakdown of competence levels across all ONR safeguards staff – giving the team an overview of trends and themes of current capability. Based on the initial safeguards task analysis, the ONR safeguards professional lead established internal expectations for the overall team competency levels, as well as numbers of individuals at each competency level, based on the delivery of the ONR safeguards programme of work. With this, ONR safeguards were able to ‘rate’ each competence on a Red, Amber, Green (RAG) scale to identify where further training or competence development was required within the team. A competence was rated red if ONR lacked both capability and resilience, amber if ONR had capability but lacked resilience, and green if ONR had both capability and resilience. For example, this self-assessment mechanism suggested ONR safeguards needed to strengthen its capacity to operate ONR’s new Safeguards Information Management and Reporting System (SIMRS) as well as its regulatory enforcement skills to meet its new international safeguards obligations by its target deadline.

### **2.3 SAT – Development Phase**

The Analysis and Design phases of the SAT helped ONR understand where to focus its training efforts and what these training efforts needed to achieve in terms of competency level improvements. The next phase of the SAT involved developing training approaches to deliver the required capacity and capability in the right areas and in the right timeframes. To achieve this within the short timeframes of the UK SSAC Project, ONR safeguards carried out a systematic survey of all relevant routes for developing our capabilities. This considered the

broadest possible range of delivery options and drew on peer learning of safeguards training programmes implemented by the SRAs in Canada, France, and Finland.

First, ONR identified existing classroom-based learning options available both internally and externally. ONR's existing core and specialist regulatory training courses provided a ready-made delivery mechanism already aligned to ONR's broader personnel development programme. Academic institutions also offer both generic safeguards modules and technical courses relevant to safeguards (such as measurement and non-destructive assay). Most notably, the International Atomic Energy Agency (IAEA) offered bespoke training for the UK's SRA to strengthen its ability to facilitate IAEA activities.

Second, ONR identified mechanisms to support "on-the-job" learning. Coaching, mentoring, and tutorial workshops provides a structured approach to developing skills through first-hand experience guided by skilled colleagues. To pass through ONR's existing inspector warrant process, inspectors develop an array of coaching relationships with experienced inspectors who guide them towards achieving and demonstrating pre-defined experiential learning targets. Tutorial workshop sessions also allowed developing inspectors to present and discuss "on-the-job" tasks and challenges with experienced colleagues.

Finally, ONR identified online "e-Learning" options that could be deployed flexibly to meet certain learning objectives. Academic institutions, think tanks and research centres offer a variety of short e-Learning courses that are relevant to safeguards, and include short quizzes to demonstrate the achievement of learning objectives. The IAEA Learning Management System (CLP4NET) also provides online courses on both general safeguards knowledge and the implementation of SSACs.

ONR mapped these training delivery options to the competence analysis above (Section 2.1) by extracting content summaries and learning objectives from the training and associating each delivery option with a range of relevant competencies. This translated the training survey into a catalogue of options for building capability in specific areas or competencies. It also demonstrated where an absence of existing training would require the development of bespoke safeguards training to deliver ONR's competency needs.

These SAT Analysis, Design, Development and Evaluation phases were captured in an ONR safeguards "Training Needs Analysis" document (TNA). This document is owned by the Professional Lead for ONR safeguards and continues to be a live document that is reviewed, updated, and amended on an annual basis to support performance management and continued professional development.

With an understanding of the competency gaps of individuals and of the overall team and what options were available to address these, ONR safeguards developed a Training Plan. This Training Plan set out a set of detailed recommendations for delivering capacity and capability requirements, bearing in mind in-house capability, timeframes and resourcing, efficiency and scope, and delivery methods. The recommendations – that were subsequently agreed and implemented – are discussed in the delivery phase below.

## **2.4 SAT – Delivery Phase**

The Training Plan made eight groups of recommendations:

### Existing internal training

Existing internal training options, including those denoted as core training modules for obtaining an inspector warrant, were identified that would address some of the team's

competency gaps relating to regulating the nuclear industry. These modules included for example Effective Regulation, Inspection Basics and an Introduction to Law. These modules provided an efficient and measurable route to reducing and removing that competency gap and the plan made recommendations about mandatory and optional attendance on these courses.

#### External training

The plan recommended taking advantage of training opportunities offered by the IAEA. ONR worked with the IAEA to design three bespoke in-depth courses for the ONR safeguards team: one on nuclear material accountancy (NMA) and the legal basis for safeguards, another on NMA, commitments associated with the UK VOA with the IAEA, the Additional Protocol and facilitating IAEA in-field activities, and a final course covering these topics with UK operators in attendance. The plan further recommended keeping in touch with the IAEA to benefit from their on-going e-learning module development. The plan also recommended taking advantage of the European Safeguards Research and Development Association (ESARDA) course on Nuclear Safeguards and Non-Proliferation and the IAEA International SSAC Training Course.

The plan further recommended taking advantage of training offered by the contractor providing ONR's Safeguards Information Management and Reporting System (SIMRS) [2]. In particular, the Training Plan recommended in-depth training of several ONR safeguards team members to be "super-users" as well as broader process-led training for the wider ONR safeguards team.

#### Development of internal training courses

While there were a broad range of external training options that, taken together, would address many competence gaps, ONR determined that it would be more efficient and effective to develop and deliver bespoke internal safeguards training. As such, the plan recommended drawing on in-house capabilities and expertise to deliver internal training resources, including:

- Working with other ONR training course leads to develop their training material to incorporate relevant safeguards aspects where appropriate – the intent being to raise awareness of safeguards across the ONR and promote cross-purpose working where applicable;
- new classroom-based courses: introducing safeguards for new starters within the organisation and for non-safeguards specialists working in other areas of ONR, the domestic and international legal frameworks for safeguards, and the properties and verification of safeguards-relevant nuclear materials; and
- e-Learning courses on nuclear material accountancy reporting, nuclear cooperation agreement (NCA) reporting, Additional Protocol (AP) reporting, and the regulation of small holders of nuclear material.

#### On-the-job training and coaching guides

As part of the UK SSAC project, the UK operator community agreed to allow ONR safeguards staff to undertake trial inspection and assessment activities during the Euratom-exit transitional period. This on-the-job training as well as learning from other ONR colleagues performing inspections and assessments was recognised by the Training Plan and actively encouraged. ONR has a mentoring and coaching guide to support on-the-job training with a structured approach to competency development in partnership with appropriate experienced staff. To maximise the benefit of this, the Training Plan recommended production and utilisation of a Nuclear Material Accountancy coaching guide, a SIMRS coaching guide and a Process and Procedure coaching guide.

#### For non-safeguards ONR personnel

As well as delivering training to bridge the ONR safeguards team competency gap, the Training Plan also aimed to develop the understanding of safeguards for personnel in the other

purposes of ONR such as Safety and Security. This is essential in fostering an aligned approach for a regulator which covers multiple purposes. The plan recommended personnel from other ONR purposes therefore attend the Introduction to Safeguards course identified in the paragraphs above, as well as ONR safeguards input/update of content to the existing internal training modules, such as those for all warranted inspectors. The ONR Safeguards team also held drop-in sessions to explain ONR's new safeguards role to colleagues and presented on this topic to meetings of safety and security specialists and ONR's Chief Nuclear Inspector.

#### Retention and Knowledge capture

Recognising that safeguards is a niche and scarce specialism, the Training Plan recommended development of a retention strategy and knowledge capture process to maintain and provide resilience to, the team's the capacity and capability. The retention strategy sets out the requirement for regular succession planning, regular reviews of the organisational structure taking into consideration prospective changes (e.g. upcoming departures) and opportunities available both within the broader ONR and external to ONR. The knowledge capture process requires that when an individual departs the safeguard team (either for retirement, leaves ONR, changes roles within ONR), or is operating in a role which lacks resilience, as a minimum, they should:

- Produce a career timeline capturing key roles and responsibilities with approximate dates;
- Produce a network map capturing key relationships, contacts and usual communication routes;
- Hold structured conversations with identified individuals/teams;
- Where applicable, arrange for job shadowing or mentoring to allow for a more efficient transition.

#### The impact of Covid-19

The Covid-19 pandemic presented significant challenges to the delivery of these recommendations. As UK nuclear sites reduced their activities or restricted access to protect their operations, ONR adjusted its regulatory approach to reduce its on-site activities. There were very few opportunities for inspectors to learn on the job. Instead, ONR produced a series of virtual coaching sessions and workshops with experienced inspectors to take safeguards staff through the practicalities of regulatory business. With travel and social gatherings restricted, ONR moved its classroom courses online and external training providers (including the IAEA) did the same. Thanks to these mitigations, many of the recommendations in the Training Plan were successfully delivered.

### **2.5 SAT – Evaluation Phase**

ONR evaluated and improved the effectiveness of the Training Plan throughout its delivery by establishing primary and secondary metrics. By redeploying the competency self-assessment and gap analysis process (described in 2.2 above) on a six-monthly basis, ONR monitored the primary metric of staff competence. This provided assurance at six-monthly intervals as to whether the Training Plan was having the desired effect and would deliver to time the required team and individual competency levels (see Figure 4 below). ONR also gained a more frequent and less burdensome (albeit less direct) understanding of training progress by monitoring secondary metrics, such as training and conference attendance. ONR took mitigating action where primary or secondary metrics suggested that training was ineffective or delayed, particularly when the Covid-19 pandemic affected both these goals (as discussed in section 2.4 above).



	Competencies											
	A	B	C	D	E	F	G	H	I	J	K	L
Mar-19	Green	Yellow	Yellow	Red	Yellow	Green	Yellow	Red	Red	Yellow	Red	Red
Nov-19	Green	Yellow	Green	Yellow	Yellow	Green	Green	Yellow	Yellow	Green	Yellow	Yellow
Apr-20	Green	Green	Green	Yellow	Yellow	Green	Green	Green	Yellow	Green	Yellow	Green
Jul-20	Green	Green	Green	Yellow	Yellow	Green	Yellow	Green	Yellow	Green	Yellow	Green
Oct-20	Green	Green	Green	Yellow	Yellow	Green	Green	Green	Yellow	Green	Yellow	Green
Apr-21	Green	Green	Green	Yellow	Yellow	Green	Green	Green	Yellow	Green	Green	Green

Figure 4: RAG rating of competence over time

By capturing feedback and experiences directly from the ONR safeguards team, ONR also gained a broader, more intelligent picture of training delivery. For example, feedback from the team suggested that involving line managers in the self-assessment questionnaire (see 2.2 SAT – Design Phase) at an earlier stage would improve the consistency and accuracy of results. As such, the results of each subsequent self-assessment were discussed with line managers prior to submission for moderation and used to formulate individual development plans.

Taken together, this oversight formed a positive feedback loop (see Figure 1) where insights gained from the evaluation phase drove - and continues to drive - improvements to the delivery phase and ultimately to the capacity and capability of the ONR safeguards team.

### 3 Ongoing Use of the Systematic Approach to Training

The ONR safeguards team plans to repeat the delivery and evaluation phases of the SAT on an annual basis, to ensure the team’s training needs are met in the longer term. ONR also plans to repeat or update the analysis, design, and development stages at routine intervals, or when prompted by the evaluation phase. Ongoing delivery of the retention strategy, knowledge capture process and recruitment in-line with this SAT will be undertaken as appropriate.

### 4 Conclusions

By following a Systematic Approach to Training (SAT), ONR safeguards developed a set of 12 safeguards competencies based on identified Skills, Knowledge and Experience required to deliver the activities involved in the role of an SRA in the SAT Analysis Phase. Through use of a self-assessment and team competency gap analysis in the SAT Design Phase it was possible to identify the competency gaps for the safeguards team before identifying options as methods to address such competency gaps in the SAT Development Phase. ONR safeguards then developed and implemented a comprehensive Training Plan in the SAT Delivery Phase to address these competency gaps, as well as provide ongoing assurances regarding the capacity and capability of the safeguards team. A SAT Evaluation Phase provided a feedback loop to monitor progress and improve the implementation of the Training Plan. This ultimately led to the successful and ongoing delivery of the identified safeguards team capacity and capability.

Despite challenges to the delivery of the Training Plan - particularly COVID19 - the use of the SAT Evaluation Phase permitted early detection of threats to delivery and implementation of mitigating factors. By implementing a structured and logical approach, ONR concentrated their efforts on development of specific in-house training while benefiting from available international training and other learning and development opportunities. The use of such international training and e-learning training was noticeably successful. While ONR plan to continue to build on and refine this structured approach, the results have been successful in

enabling the appropriate capacity and capability required for the UK to deliver a comprehensive State System for Accountancy for and Control of nuclear material (SSAC).

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