



Department for
Energy Security
& Net Zero



United Kingdom
National Nuclear
Laboratory

The United Kingdom Support Programme to IAEA Safeguards: 2021-2024



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Produced by: United Kingdom National Nuclear Laboratory (UKNNL)

Contact: Nuclear Safeguards Programme Manager

Location: United Kingdom National Nuclear Laboratory (UKNNL), 5th Floor, Chadwick House, Warrington Road, Birchwood Park, Warrington, WA3 6AE, United Kingdom

UK SUPPORT PROGRAMME TO IAEA SAFEGUARDS

The UK Support Programme to IAEA Safeguards (UKSP) was established in 1981, to provide technical support to the Department of Safeguards of the IAEA in verifying the peaceful use of nuclear technology.



2022 IAEA Safeguards Symposium – UK Support Programme Delegation with IAEA Deputy Director General and Head of Department of Safeguards Massimo Aparo in Vienna, January 2022

The UK Support Programme to IAEA Safeguards contributes:

- expertise and advice for the further development of safeguards strategies in new and existing activities and plants in the nuclear fuel cycle;
- services to support the IAEA in analysing nuclear material arising from samples taken in the course of safeguards inspections;
- access to facilities and experts for the training of Agency personnel in advanced techniques applied in safeguards inspections and on fuel cycle plants;
- development of techniques, methods and procedures for safeguarding facilities in the nuclear fuel cycle;
- development and assessment of equipment, instruments and methods for application in safeguarding the nuclear fuel cycle; and
- assistance through the provision of expert staff to complete specialised programmes of work that cannot be resourced through a permanent position with the IAEA.

During the period 1 April 2021 to 31 March 2024, the UK Support Programme has provided over £5 million of in-kind and financial contributions to over 35 tasks within the IAEA Department of Safeguards Development and Implementation Support (D&IS) Programme for Nuclear Verification. This report provides a summary of progress against tasks active during 2021-2024 within the framework of the UK Support Programme, including:

- routine analysis of safeguards inspection samples through two IAEA accredited Network of Analytical Laboratories;
- provision of open source information from two Regional Information Collection Centres and support to improving the analysis of trade data for safeguards-relevant proliferation activities;
- delivery of training events to IAEA inspectors, analysts and senior staff, including an expansion of support in the areas of negotiation skills and leadership training, whilst retaining a portfolio of courses utilising UK expertise and facilities of the nuclear fuel cycle;
- provision of expertise and software relevant to the assessment of data available to the Department of Safeguards, including the provision of three Cost-Free Expert positions;
- promotion of UK technology solutions to meet current and future safeguards challenges identified in the Department of Safeguards' Instrumentation Technology Foresight project;
- extra-budgetary financial contributions to key IAEA Safeguards projects, including:
 - Keeping Safeguards IT Updated; and
 - COMPASS to build State capacity on safeguards implementation;
- financial and in-kind support to key IAEA safeguards events including the 2022 Safeguards Symposium.

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IAEA Member State Support Programme Coordinators' Meeting held in Vienna, 20–22 February 2024

UK SAFEGUARDS SUPPORT PROGRAMME

INTRODUCTION

Nuclear safeguards are technical measures used to verify that States comply with their international Treaty obligations not to misuse nuclear materials for the manufacture of nuclear explosives. They are an essential part of the nuclear non-proliferation regime. The International Atomic Energy Agency (IAEA) is charged with establishing and administering an international safeguards system to provide assurances that civil nuclear material is used for peaceful purposes.

The United Kingdom Support Programme to IAEA Safeguards (UKSP) is part of the UK contribution to the maintenance of the international safeguards regime, with the aim to assist the IAEA in ensuring the continued and improved effectiveness of its safeguards system.

The UKSP is funded by the UK Department for Energy Security and Net Zero (DESNZ). The Programme is administered on behalf of DESNZ by United Kingdom National Nuclear Laboratory (UKNNL). A range of contractors undertake work on behalf of the UKSP, which was initiated by the UK Government in 1981 with the following formal objectives:

- to assist the IAEA in the provision of efficient and effective solutions to identified safeguards needs as set out in the Department of Safeguards Development and Implementation Support Programme for Nuclear Verification;
- to provide the IAEA with essential services and training which are not commercially available or cannot be provided from the Agency's own resources;
- to develop techniques and methods for safeguarding facilities in the fuel cycle, particularly reprocessing plants and enrichment plants;
- to develop techniques and methods for the application of safeguards in general situations; and
- to provide the IAEA with cost-free consultancy, particularly on systems analysis.

UK SUPPORT PROGRAMME TO IAEA SAFEGUARDS 2021-2024

In January 2013, the IAEA Department of Safeguards issued a Long-Term R&D Plan, covering the twelve-year period 2012-2023, setting out the capabilities that the Department of Safeguards needs in order to achieve its strategic objectives; and key milestones towards achieving those capabilities for which Member State support is needed. The Long-Term R&D Plan covers a wide variety of areas such as safeguards concepts and approaches; detection of undeclared nuclear material and activities; safeguards equipment and communications; information technology, collection, analysis and security; analytical services; new mandates; and training.

The specification of long-term capabilities provides a framework to assist Member State Support Programmes (MSSPs), including the UKSP, in deciding where their resources can best be used, and also helps the Department of Safeguards formulate the plans that make up a biennial programme and monitor progress towards the strategic objectives.

The IAEA's biennial Development and Implementation Support (D&IS) Programme for Nuclear Verification is composed of approximately 25 plans. These plans are themselves composed of over 300 'tasks'. Each plan contains objectives, targets and activities that are defined for the relevant two-year period. Both internal tasks, carried out by IAEA staff and consultants, and external tasks, carried out under MSSPs, are included in the plans; some of which are aimed at meeting shorter-term needs and others that are part of longer-term R&D efforts.

The UKSP is one of 24 MSSPs that provide support to the Department of Safeguards. The MSSPs work singly and in collaboration to fulfil the priority needs of the Department of Safeguards, taking into account their individual expertise, resources, national and international priorities.

The IAEA hold biennial Member State Support Programme Coordinators' Meetings which are multi-day events for the Department of Safeguards and MSSPs to focus on the future, highlight specific ideas and plans for next steps, and discuss how collaboration can help IAEA chart a successful course. During the reporting period, the UKSP participated in the 2022 Coordinators' Meeting 1-4 March 2022, and the 2024 Coordinators' Meeting 20-22 February 2024.



IAEA Member State Support Programme Coordinators' Meeting held in Vienna, 20-22 February 2024

Support is provided in response to specific 'Task Proposals', known as SP-1s, issued through the Support Programme Coordination Team of the Department of Safeguards. Within the UK, each SP-1 is assessed against capabilities and priorities before the UKSP's decision to accept or decline the Task Proposal is communicated to the Department of Safeguards. Appropriate arrangements are then made for a programme of work to be undertaken to meet the Department of Safeguards' need.

The UKSP currently provides support to the IAEA Department of Safeguards in six technical areas:

- Area A, Safeguards Strategies;
- Area B, Support for IAEA Analytical Services;
- Area C, Training Courses;
- Area D, Safeguards Procedures;
- Area E, Instrument Development and Assessment; and
- Area F, Consultants and Cost-Free Experts.

Each task undertaken within the UKSP is assigned to one of these six Task Areas and cross-referenced to the Department of Safeguards' Long-Term Capability and D&IS Project to which each task relates.

This report provides a summary of the progress against specific tasks in each of these six areas during the period 1 April 2021 to 31 March 2024.

AREA A – SAFEGUARDS STRATEGIES

Many of the requests for support to the IAEA are concerned with novel methods and techniques aimed at strengthening safeguards activities at all stages of the nuclear fuel cycle. As part of a strengthened safeguards system, the IAEA requires increased amounts and types of information on States' nuclear and nuclear-related activities. This information includes that provided directly by States (e.g. INFCIRC/540 Article 2 declarations), that collected by the IAEA (e.g. environmental sampling data) and other information available to the IAEA (e.g. open source literature and satellite imagery). The information is used to identify any inconsistency between a State's declaration and information available from other sources concerning a State's nuclear activities, and to optimise the strategy for safeguards implementation within the State.

Environmental Sampling

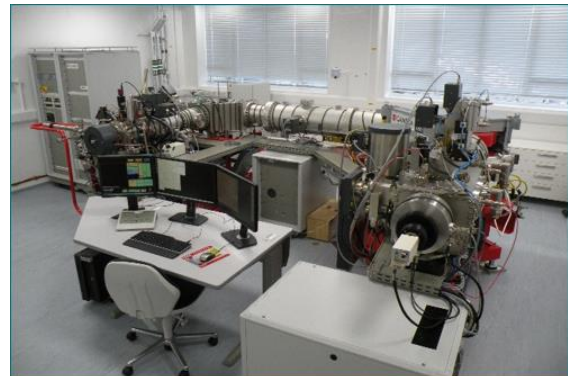
Environmental sampling was introduced in 1996 as an IAEA measure to contribute to safeguards conclusions on the absence of undeclared activities at facilities. Collection of environmental samples at nuclear sites by inspectors, combined with techniques for ultra-sensitive measurement and interpretation of results, can reveal signatures of past and present activities at locations where nuclear material is handled. These signatures can be used to corroborate the status of declared activities, or to detect undeclared activities. As such, the programme directly meets the strengthened safeguards objective of increasing the assurance of the absence of undeclared nuclear material and activities. Results and conclusions from environmental sampling contribute to the State evaluation process and have an impact upon revisions to the facility attachments and safeguards approaches.

Special Analyses of Environmental Samples Supplied by IAEA (UK X 1045)

Current implementation of environmental sampling for safeguards focuses primarily on the collection of swipe samples inside enrichment plants and hot cell facilities. Samples are analysed by either bulk or particle analysis techniques, depending on the sampling objectives and the activity levels of the swipes. A Network of Analytical Laboratories (NWAL) for environmental samples has been set up by the IAEA, consisting of Member States' laboratories with particular expertise in techniques suited to

environmental sampling. These laboratories complement the Agency's own in-house capabilities, and ensure sufficient analytical capacity to service the diversity of samples and analytical requirements received from inspectors. The NWAL also fulfils an important role by enabling routine inter-laboratory comparisons and cross checks on analytical results. This is of particular importance given the sensitivity of analytical techniques deployed and the need to eliminate the potential for false results due to cross contamination.

During the review period, the UKSP provided the services of AWE Aldermaston within the IAEA NWAL for environmental samples. AWE Aldermaston supported the Department of Safeguards' environmental sampling programme, through the provision of Fission Track Thermal Ionisation Mass Spectrometry (FT-TIMS), Large Geometry Secondary Ion Mass Spectrometry (LG-SIMS), and the application of other microanalysis techniques, including Scanning Electron Microscopy (SEM) combined with energy-dispersive X-ray microanalysis.



SIMS instrumentation at UK accredited IAEA NWAL member AWE Aldermaston

The Use of Commercial Satellite Imagery in Support of Safeguards

The UKSP has provided assistance in the development of techniques employing satellite imagery for safeguards purposes - particularly for the identification of undeclared facilities and the identification of change in activities within facilities. This work, in addition to that carried out by the US, Germany and Canada, has proven a range of techniques and has confirmed the availability of suitable images on the commercial market for safeguards use. Studies have shown that it is possible to develop sophisticated methods for detection of undeclared facilities or activities and to detect a change in activities in a declared facility.

Support for SGIM Analysis (UK D 1329)

On the basis of studies by the MSSPs, the IAEA decided to develop an in-house technical capability for satellite imagery analysis. The Satellite Imagery Analysis Unit (SIAU) commenced operation during 2001, using commercially available satellite images to gain information in support of safeguards.

The UK supported the work of the SIAU initially through the provision of an analyst experienced in the interpretation of satellite images pertaining to nuclear facilities. From 2003, the UKSP assisted in the procurement of commercially available satellite images and equipment, whilst further support from imagery analysts was provided under separate taskings.

For each year of the review period, the UKSP made a voluntary contribution to the Department of Safeguards: for the procurement of satellite images and equipment; or to support UKSP open source information collection tasks.

Strengthening/Integration of Safeguards

Strengthening safeguards is aimed at providing credible assurance of the absence of undeclared activities in States. Once an assurance has been gained, all of the measures available to the IAEA through traditional and strengthened safeguards systems can be reviewed and combined to produce an integrated safeguards regime. Integrated Safeguards is defined as the optimum combination of all safeguards measures available to the IAEA under a comprehensive safeguards agreement, including those from Additional Protocols, that achieves the maximum effectiveness and efficiency within available resources in fulfilling the Agency's safeguards obligations.

IAEA safeguards implementation is now evolving to an approach that makes greater use of the IAEA's ability to consider the State as a whole. It involves a comprehensive evaluation of all safeguards-relevant information regarding a State, and the use of objective State-specific factors to draw up a State-level approach (SLA) for each State. The implementation of SLAs will enable the IAEA to make best use of its resources and focus effort on areas of greater safeguards significance. The use of generic objectives common to all states with the same type of safeguards

agreement (and, where applicable, Additional Protocol) enables differentiation without discrimination.

Update of the Physical Model (UK C 2297)

A Physical Model was developed by the Department of Safeguards to identify, describe and characterise various components of the nuclear fuel cycle, providing a technical tool to aid enhanced information analysis. The Physical Model is used in analysing information on a State's nuclear and nuclear-related activities, and in developing integrated safeguards approaches. The Physical Model is subject to periodic review and update based on technical advances in nuclear fuel cycle activities, experience gained through its application practice and new requirements for implementing strengthened safeguards.

During the review period, the UKSP provided subject matter experts to IAEA consultancy meetings to update and enhance the IAEA's Physical Model.

Support to Instrumentation Technology Foresight (UK A 1599)

The Technology Foresight effort works to identify and evaluate technologies in various stages of development, focusing on commercially available technologies and those from non-traditional safeguards fields. The review is coordinated with stakeholders, both internally and externally, to identify and develop technologies with possible safeguards application in support of improving the efficiency and effectiveness of IAEA safeguards activities.

MSSPs are encouraged to continue the provision of scientific and technical information regarding methods and instruments of potential use for the effective and efficient implementation of nuclear safeguards. The IAEA encourages MSSPs to evaluate diverse advanced technologies for potential safeguards use and share their results with the IAEA.

The UKSP provides a contact point within the UK for the identification of appropriate expertise and resources, with the acceptance of individual sub-tasks considered on a case-by-case basis. The task has enabled UK expert participation in a number of technical meetings associated with novel technologies, together with preliminary evaluation of such technologies.

Information Evaluation in Support of a Strengthened Safeguards System

In support of the strengthened safeguards system, the IAEA Department of Safeguards requires broad access to geographically and linguistically diverse sources of relevant open source information. Information is required, in particular, on nuclear dual use technologies relating to industrial infrastructure and nuclear research and development, as well as information on security, economics, weapons of mass destruction and the politics surrounding such weapons. Detailed surveys are required of States' industrial and nuclear research infrastructure and issues that may induce a State to proliferate. The collection and analysis of such information, on scientific, technical, economic, political and nuclear-related developments, is now an integral component of the State evaluation process.

Regional Information Collection Centres (UK D 1728, UK D 1730)

The UKSP continued to operate two Regional Information Collection Centres (RICCs) throughout the review period.

The RICCs established methodologies for the collection of information to support the production of detailed surveys of States' industrial and nuclear research infrastructures extending the Agency's ability to identify relevant information, without which the Agency's confidence in safeguards conclusions would be reduced.

The RICCs supported the IAEA through provision of open source information, including monthly provision of scientific and technical original language abstracts, updated country profiles, ad-hoc reports and regular political updates on the security situation and associated issues.

Improving the Analysis of Trade Data for Safeguards-Relevant Proliferation Activities (UK D 1916)

This task supports the development of methods and skills for finding indications of non-declared safeguards-relevant proliferation activities. Through this task, work takes place on investigating the availability and feasibility of predictive analytical approaches, developing capabilities to improve the recognition of non-declared activities through the assessment of trade-related technical indicators, and

discussing methods for improving the acquisition of information.

Concepts and Approaches

Safeguards by Design for Small Modular Reactors (UK C 2698)

According to the IAEA Department of Nuclear Energy there are at least 50 small modular reactor (SMR) designs being considered for potential development. As each SMR design could introduce unique safeguards technical challenges, Member States and the IAEA would benefit from early engagement on SMR safeguards by design (SBD). This task is designed to facilitate this engagement and produce Safeguards Technical Reports (STRs), or other appropriate products, for each SMR design.

In March 2024, the UKSP formally accepted the task and will work closely with the IAEA to provide information and expertise necessary for: evaluating aspects of an SMR design that could impact safeguards, investigating safeguards implementation strategies, and identifying ways in which an SMR design may be modified to facilitate safeguards implementation.

AREA B - SUPPORT FOR IAEA ANALYTICAL SERVICES

Destructive Analysis (DA) provides the most accurate means to assay nuclear materials, and the methods play an essential role to verify the declarations of facility operators at bulk handling plants. For this purpose, safeguards inspectors take samples of process material for analysis of elemental and/or isotopic composition. The samples are sent for analysis to the IAEA's own laboratory, or to an accredited member of the IAEA NWAL in a Member State.

Since its inception, the UKSP has assisted with all aspects of destructive analysis, from on-site sampling trials through the development of analytical techniques and provision of equipment and standards to the assessment of processes for the treatment of analysis waste residues. The UKSP contributed support to the Agency project "Enhancing Capabilities of the Safeguards Analytical Services" (ECAS), and has now turned to assisting the IAEA Nuclear Material Laboratory and continuing environmental sampling capabilities.

Analytical Services

As bulk handling plants become larger, and material throughput increases there is a need for greater accuracy of analysis in order that diversion of material cannot be hidden within the uncertainty of measurement. The destructive analysis methods employed, and the standards used in their calibration and quality control, must therefore keep pace with developments in the fuel cycle. Safeguards inspectors are also interested in taking advantage of any advances in analytical techniques, so that independent verification of the operator's declaration can be carried out more effectively. In particular, the implementation of strengthened safeguards and environmental sampling requires the development and implementation of new and improved methodologies for sample collection, preparation and analysis.

The UKSP has two active tasks providing operational and implementation support to the IAEA Environmental Sample Laboratory (UK A 1776); and Nuclear Material Laboratory (UK C 1742).

Implementation Support to Nuclear Material Laboratory (UK C 1742)

In 2019, the IAEA completed its final assessment of the qualification of the UKNNL Preston Laboratory as a new member of the IAEA Network of Analytical Laboratories (NWAL). During the review period the UKNNL Preston Laboratory provided support through specialised analysis of samples against the relevant standards in response to analysis requests from the Department of Safeguards.



IAEA Accredited Network of Analytical Laboratories (NWAL) Members

AREA C - TRAINING COURSES

The IAEA has a long-term requirement for a wide range of safeguards-related training courses. New safeguards inspectors require training and practical experience on fuel cycle plants and the techniques and procedures to be applied during inspections. More advanced courses are required for senior inspectors, whilst specialised courses are desirable for other key personnel. To undertake this training, the IAEA needs access to appropriate expertise and nuclear facilities, which can only be made available by Member States.

Inspectors' Training Courses

The UKSP has provided training courses on a cost-free basis since its inception in 1981. These courses are constantly evolving to meet the changing needs of the Agency and are tailored to meet their specific requirements.

Design Information Verification at Bulk Handling Facilities Training Course (UK B 1990)

Courses on safeguards at bulk-handling facilities have been run for the benefit of IAEA inspectors by the UKSP since 1992. The current tasking supports an on-site training course in which inspectors will acquire relevant skills for performing Design Information Verification (DIV) at Bulk Handling Facilities (BHF). Inspectors are exposed to the technology applied at conversion, fuel fabrication and reprocessing plants to understand the functions of these facilities in order to assess that facilities are designed and operated as declared. Upon course completion, inspectors are able to perform the necessary safeguards verification activities at similar bulk handling facilities.

Training on the Nuclear Fuel Cycle, Indicators and Proliferation Pathways (UK B 1991)

The main objective of the IAEA strengthened safeguards system is to provide assurance of the absence of undeclared nuclear activities in Member States. Under an Additional Protocol, the Agency has wider access to information and facilities, intended to enhance its capability to detect such clandestine activities. In preparing for this extended role, the Agency developed a 'Physical Model' of the nuclear fuel cycle, drawing out a comprehensive set of indicators of nuclear fuel cycle activities.

In 1995, a training need was identified for more experienced inspectors, subsequently addressed by this task, to increase their awareness of the fuel cycle indicators and show them the items concerned, either in photographs or as models. This would assist them in identifying signs of any illicit activity during inspections.

The current task provides a training course on indicators of nuclear activities, covering each step of the nuclear fuel cycle, including R&D, with learning objectives for participants to be able to: identify indicators of nuclear activities, assess the significance of those indicators as related to safeguards implementation and evaluation; and identify key indicators for basic steps of acquisition paths, such that they could more effectively define technical objectives for further definition of implementation plans.

The course involves presentations to the Agency participants by a team of UK experts and specialists in the nuclear fuel cycle and proliferation indicators. The course was delivered twice a year during the reporting period.

Implementation of Safeguards at Enrichment Facilities (UK B 1797)

Enrichment plants are some of the most proliferation-sensitive nuclear facilities, and it is important for inspectors to be able to implement Limited Frequency Unannounced Access (LFUA) activities in an efficient and effective manner.

In 2008, the Agency requested access to the UK's gas centrifuge enrichment plants at Capenhurst, including their cascade halls, to enable in-situ training. The current task covers a training course on the preparation and implementation of LFUA activities at centrifuge enrichment plants. The course rotates between Urenco's European gas centrifuge enrichment facilities in Gronau, Almelo, and Capenhurst. The UKSP supported course delivery at Capenhurst in 2019.

Training in Negotiation Skills (UK B 1874)

To deal confidently with awkward situations arising from disagreements with local, regional and State authorities and facility personnel in planning, conducting and reporting safeguards inspections and other activities based on Safeguards Agreements, inspectors need to develop specific listening and negotiation skills.

During the review period, the UKSP provided training to senior inspectors in diplomatic negotiation skills, utilising a team of former diplomats with high-level experience in negotiation and professional mediation.

Advanced Training on NFC Facilities to Assist State Evaluation (UK B 1903)

Arising from the Agency's strengthened and integrated safeguards approach, advanced training was required: to provide increased knowledge of the process technologies associated with fuel cycle facilities; and an improved understanding and recognition of the equipment and processes, particularly proliferation indicators and dual use equipment and activities. Because a proliferator may choose to adopt old technology, the scope of any training course was required to cover both new and old equipment.

This task supports an advanced training course on nuclear fuel cycle facilities for IAEA safeguards staff, in particular inspectors and analysts, who hold significant responsibilities in the State Evaluation Process.

The course focuses on application of the field knowledge gained and competencies acquired during the "Nuclear Fuel Cycle and Indicators" training course. This course includes physical access to conversion and fuel fabrication plants, reactors and reprocessing plants. The objective of the course is to enable safeguards staff to analyse advanced nuclear sites in a complete and correct manner by making full use of nuclear fuel cycle related indicators. The UKSP successfully delivered the course on a twice-yearly basis during the reporting period.



IAEA participants on an UKSP Advanced Nuclear Fuel Cycle Training Course

Specialised Training and Visits to Nuclear Facilities (UK B 1936)

Agency staff require specialised skills and competences to implement effectively international safeguards. The Training Section of the Department of Safeguards provides systematic training for staff performing safeguards functions, and the identified training needs are addressed within the annual Safeguards Departmental Training Programme. However, urgent training needs may emerge that are not covered by planned training courses. These needs go first through the Department's internal committee, which oversees the overall training programme, to ensure consistency with the programme. A new course may then be designed at short notice, possibly requiring support from experts or access to nuclear facilities, laboratories or sites from Member States.

This task, functioning as an umbrella task, aims to give the required flexibility, reactivity and capacity for the Training Section to organise such courses under a formal arrangement with the UKSP but with the minimum delay. It is intended to provide flexibility for the Safeguards Training Section to request support from UK experts or access to UK nuclear facilities, laboratories or sites in order to provide training on a short timescale, to meet operational needs and deadlines.

Development of 3D Models for Critical Nuclear Facilities (17/OA3-001)

The UKSP has significant technical knowledge and capabilities with advanced state-of-the-art 3D modelling technology. Within the framework of current decommissioning activities across many areas of the nuclear fuel cycle, it has developed a strong technical expertise in the development and use of 3D modelling and visualisation techniques. Much of this experience and knowledge is of direct relevance and has been utilised to support the requirements of IAEA.

UKSP support has provided the opportunity to enhance the IAEA's ability to effectively and efficiently capture and integrate safeguards relevant information related to selected facilities, to prevent loss of critical knowledge due to staff turn-over, and to maintain its preparedness to respond to future changes in safeguards implementation.

Creation of e-learning modules, supporting the preparation of State declared information (UK D 2352)

In order to complement classroom training courses, the IAEA needs to introduce business-relevant e-learning for the State or regional authorities responsible for safeguards implementation (SRAs), for the stakeholders in-house involved in nuclear material accountancy and the preparation of reports and declarations to the IAEA. The UKSP has provided financial support to create interactive e-Learning exercises that lay the foundation for a better understanding of the IAEA reporting obligations, to enable States to make better use of relevant IAEA guidance documents, as well as to develop their knowledge base in this specific area.

COMPASS: Comprehensive Capacity Building Initiative for SSACs and SRAs (UK X 2595)

To help States carry out their safeguards obligations more efficiently and effectively, the IAEA launched an initiative called COMPASS to help them strengthen and sustain the effectiveness and efficiency of their State systems of accounting for and control of nuclear material (SSACs) and State and regional authorities responsible for safeguards implementation (SRAs).

In March 2023 the IAEA successfully concluded the implementation of COMPASS in seven States that participated in the initiative's two-year pilot phase. During the pilot phase activity, the UKSP provided a financial contribution to support the initiative and subject matter expert advice and mentorship from the UK Office for Nuclear Regulation (ONR) to support a pilot State in developing a national safeguards training plan.

AREA D - SAFEGUARDS PROCEDURES

Near Real Time Accountancy

A number of large-scale reprocessing plants were scheduled to come on-stream from the 1990s in Member States and, in view of the fact that such plants are capable of producing high quality separated plutonium, the way in which they would be safeguarded was the subject of much discussion. The IAEA continues to need assistance in areas such as design information verification, authentication and solution monitoring, if fully effective

safeguards are to be applied at such plants. Although aimed primarily at reprocessing plants, many of the methods apply equally to other types of facility in the fuel cycle.

Near Real Time Accountancy (NRTA) is a tool for safeguarding large-scale reprocessing plants. Due to the highly complex nature of such plants, it can be difficult to determine an accurate estimate of the account. Anomalies can lead to investigations that would impose substantial burdens on inspectors and plant operators. Solution monitoring, which tracks the transfer of solutions through the plant, complements NRTA and can not only enhance the estimation process, but can also be viewed as a contributor to containment and surveillance. The methodology of solution monitoring can be adapted to other stages of the fuel cycle, such as enrichment or fuel fabrication, where material flows require monitoring.

NRTA system documentation and requirements gathering (UK D 2308)

This task supports the writing of comprehensive documentation of the statistical methods underlying the NRTA systems which is required for maintenance and future enhancements. The future NRTA systems will be used in the Rokkasho Reprocessing Plant (RRP) and Japan Nuclear Fuel Limited (JNFL) MOX fuel fabrication plant (JMOX). The final version of the document is to be published as a Safeguards Technical Report (STR).

Statistical Methodology Development

Statistical Methodology Development (UK F 2716)

The Section for Nuclear Fuel Cycle Information Analysis (IFC) of the Division of Information Management (SGIM) is in charge of developing statistical and probabilistic methodologies in support of uncertainty quantification, random verification schemes, sample size calculations, random inspection planning and the assessment of safeguards effectiveness through the estimation of detection probabilities. Statistical methodologies for safeguards need to continually evolve to support the State-level concept and be enhanced to increase the effectiveness with which information is used to make safeguards assessments.

To enhance IAEA statistical methodologies, the UKSP has provided subject matter expertise in Bayesian methodological development to better use historical data in material balance evaluation (MBE).

AREA E - INSTRUMENT DEVELOPMENT AND ASSESSMENT

New types of nuclear plant, and facilities that handle increased throughput of nuclear material, require the development of new instrumentation and equipment in order to apply safeguards in an effective and efficient manner. The application of strengthened and integrated safeguards requires not only new equipment but improved computer systems in order to collate and assess data from a range of sources. Nuclear materials and the instruments used in their verification must be secure and not vulnerable to tampering. Manuals and procedures for the operation of safeguards instrumentation require updating on a regular basis.

Computer Systems

The Department of Safeguards relies upon computer systems for the storage, collation and retrieval of safeguards data for use in safeguards evaluations. Adoption of strengthened safeguards measures, the Additional Protocol and Integrated Safeguards has resulted in a dramatic increase in the amount of data and information received and analysed. Developments to existing systems and the introduction of new systems are therefore required in order that the Agency maintains its capability for effective assessment of safeguards-relevant information.

Keeping Safeguards IT Updated (UK D 2465)

The objective of the task "Keeping Safeguards IT Updated" is to improve existing IT products supporting IAEA Safeguards businesses, and identify opportunities for new software capabilities to be developed in support of Safeguards' strategic priorities. In 2021, the UKSP provided financial support to this task contributing to a regularly updated IT platform that supports Safeguards effectively, efficiently, and securely.

Integrated Lifecycle Management of Safeguards Asset (ILSA) (UK X 2475)

The integrated asset management seeks to create a Department-level framework for managing all Safeguards assets based on priority, and in alignment with the departmental and Agency strategy. In order for the timely identification of recapitalisation needs, and to feed this information into the budget preparation process, the Department requires a mechanism to prioritise reinvestment needs given its budgetary constraints. The Department also needs to make sound decisions based on the information available to it through existing information systems.

The UKSP provided IAEA with technical experts from a UK organisation with experience in managing large infrastructure assets with high-value equipment and technology to compare best practices and learn from experience. A series of interactive 'community of practice' approach sessions were delivered focusing on practical, collaborative learning covering core asset management themes, structured around the Institute of Asset Management's six-box model.

AREA F - CONSULTANTS AND COST-FREE EXPERTS

The IAEA cannot retain sufficient resources within its permanent staff to meet all requirements for highly specialised development and evaluation work. In addition to obtaining assistance from Member State Support Programmes to undertake specific tasks, the IAEA looks to States and Institutions to provide expert staff to fulfil a temporary position at the IAEA's premises in support of such activities. This may involve a full-time role as a Cost-Free Expert (CFE), or part-time as a Consultant.

Provision of Consultants and Cost-Free Experts

CFEs are persons provided by States at no cost to the IAEA to perform specific tasks for which no resources are available within the Secretariat. CFEs are employed as officials of the IAEA, but the cost of that employment, plus overheads, is provided to the IAEA by the donor State or Institution. In situations where the CFE mechanism is inappropriate, for example in cases where the expert does not attend the IAEA on a full-time basis, it may be

more appropriate to offer a Consultant to the Agency. In contrast to CFEs, Consultants are normally funded via the current employer of the staff involved, and not through transfer of funds to the Agency. Both mechanisms provide the means for the IAEA to attract expert staff for the limited period required to complete a specialised work programme.

Nuclear Fuel Cycle Specialist Assistance (UK D 1819)

During the review period, the UKSP has provided a range of expert assistance through nuclear fuel cycle technical studies and modelling developments in support of safeguards. The task has provided a framework for the UKSP to provide technical support in response to urgent and ad-hoc requests from the Agency during the review period.

Expert – Satellite Imagery Analyst (UK C 2005)

In response to the demands for imagery-derived products and services from the Operations Divisions within Department of Safeguards, the State Infrastructure Analysis Section (ISI) needs to maintain and grow its current analytical capabilities. An experienced satellite imagery analyst CFE, with a demonstrated familiarity of the nuclear fuel cycle, was requested to support SGIM-ISI.

Following selection by the Department of Safeguards, a Satellite Imagery Analyst commenced an initial two-year term as a cost-free expert within the IAEA Department of Safeguards in January 2020. The UKSP has subsequently extended the position for an additional three years through to January 2025. The expert has contributed to the collection and analysis of commercial satellite imagery and related geospatial information, and work to enhance the analytical processes within the Section.

Expert – External Communications Officer (UK F 2683)

The IAEA requested a CFE within the Section for Safeguards Programme Coordination to support the Department on external communication. The purpose of the position is to provide important contributions in the areas of media outreach, strategic communication analysis and research and drafting of public information materials for the Department of Safeguards, as well as to provide background

materials for speeches and talking points in order to promote the work of the Department to external parties and States and enhance collaboration.

Following selection by the Department of Safeguards, an External Communications Officer commenced an initial two-year term as a cost-free expert within the IAEA Department of Safeguards in March 2023.

Development of Advanced Nuclear Material Accountancy (NMA) Systems for SRAs (UK D 2638)

In 2022 the UKSP provided a financial contribution towards supporting the Development of Advanced Nuclear Material Accountancy (NMA) Systems for SRAs. The contribution was utilised by the Agency to support travel of an IAEA Safeguards Information Analyst staff member (with subject matter expertise in NMA and Reporting) to the United Kingdom to collaborate with the Office for Nuclear Regulation (ONR) on business rules and accountancy logic for the development of NMA reporting systems.

Expert – Nuclear Material Accounting (UK D 2707)

The IAEA requested a CFE within the Section SGIM Declared Information Analysis Section (ISD) to support the Department in the area of nuclear material accounting and reporting systems, and nuclear material accounting analysis. The purpose of the position is to act as a liaison between systems users in ISD and business analysts and developers within the Safeguards Office of Information and Communication Systems (SGIS) and contribute to the enhancement of solutions to improve the functionality and reliability of databases and reporting tools.

Following selection by the Department of Safeguards, a Nuclear Material Accounting expert commenced an initial two-year term as a cost-free expert within the IAEA Department of Safeguards in February 2024.

ADDITIONAL MEETINGS AND ACTIVITIES

The UKSP receives each year a small number of requests for members of the UK nuclear industry or associated experts and advisors to attend safeguards-related meetings convened by or contributing to the Department of Safeguards.

During 2021-2024, the UKSP facilitated expert participation in a number of Technical Meetings including:

- Particle Analysis of Environmental Samples for Safeguards Purposes 2021 and 2023;
- Statistical Methodologies for Safeguards 2023; and
- Proliferation Resistance of Research Reactors 2023.

The UKSP continued to provide funds to enable staff from the Department of Safeguards to undertake approved visits in connection with activities associated with the UKSP, including participation in training events.

2022 IAEA Safeguards Symposium (UK X 2665)

The IAEA holds a Symposium on International Safeguards every four years in order to engage the broader safeguards community in addressing challenges and seizing opportunities to strengthen the effectiveness of safeguards implementation.

The UKSP provided extrabudgetary financial support and in-kind assistance for the IAEA Safeguards Symposium, 31 October – 4 November 2022.

The Symposium Report was released in December 2023 as Safeguards Technical Report (STR-402). The report includes a set of ideas for potential action around innovation, partnering and improving communication as well as collaboration among States, industry, academia, non-governmental organisations and the IAEA.



2022 IAEA Safeguards Symposium, Vienna, Austria, 31 October – 4 November 2022