SRDP-PR31

UK SAFEGUARDS SUPPORT PROGRAMME

Report on Activities and Progress during the period 1 April 2010 to 31 March 2011

J W A Tushingham

August 2011

UK Safeguards Support for the IAEA

The Nuclear Safeguards Programme is managed on behalf of the UK Department of Energy and Climate Change by the National Nuclear Laboratory. Further information on the Programme may be obtained from the Manager, Nuclear Safeguards Programme, National Nuclear Laboratory, Building 168, Harwell Science Campus, Didcot, Oxfordshire OX11 0QT, United Kingdom.

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The results of this work may be used in the formulation of UK Government policy, but the views expressed in this report do not necessarily represent UK Government policy.

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EXECUTIVE SUMMARY

The UK Safeguards Support Programme (UKSP) was established in 1981, to provide technical support to the Department of Safeguards of the International Atomic Energy Agency (IAEA) in ensuring the peaceful use of nuclear energy. The UKSP contributes to the Department of Safeguards:

- expertise and advice for the further development of safeguards strategies in new and existing activities and plant 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 2010 to 31 March 2011, the UK Support Programme contributed to 31 active tasks within the Department of Safeguards R&D Programme, completing work on 2 of these. 19 task proposals were considered during the year, of which 6 were accepted and 12 remained pending at the year-end. Activities undertaken included:

- providing support to inspection activities through the analysis of 37 environmental swipe samples and the development of libraries of isotopic compositions for fuel and cladding materials of different reactor types;
- continued development of open source information capabilities, including the collection of regional information, and technical and financial support to the Satellite Imagery Analysis Unit;
- delivery of training to 70 IAEA inspectors and safeguards analysts;
- development of improved signal processing for scintillation-based neutron detection; and
- expert support on the nuclear fuel cycle.

This report provides a summary of the progress on those tasks active during 2010/2011 within the framework of the UKSP.

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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 of Energy and Climate Change (DECC) and is administered on its behalf by the National Nuclear Laboratory (NNL). 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 IAEA's Safeguards Research and Development Programme;
- 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.

Assistance is provided to the IAEA Department of Safeguards in six areas of technical support:

- 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.

This report provides a summary of the progress against specific tasks in each of these six areas during the period 1 April 2010 to 31 March 2011.

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. 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.

Task Area A5 - 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 ultra-sensitive measurement techniques, 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.

Task A5(b) - Special Analyses of Environmental Samples Supplied by IAEA

IAEA SP-1 No:	96/XXX-010	**UK Sub-contractors:**	a) AWE Aldermaston b) QinetiQ
IAEA SPRICS No:	UK X01045	**UK Task Manager:**	a) P Thompson
IAEA Task Officer:	R Lafolie		b) M R Houlton/ A J Pidduck

Background to Task

Current implementation of environmental sampling for safeguards focuses primarily on the collection of swipe samples inside enrichment plants and hot cell facilities. Environmental swipes are taken by inspectors using cotton or cellulose wipes, the latter designed for use with remote manipulators and used exclusively within hot cells. In either case, the Inspector wipes surfaces that may have been exposed to nuclear material, removing a portion of any surface contamination on the wipe for subsequent analysis. 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. The NWAL also fulfils an important role by enabling routine inter-laboratory comparisons and cross checks on analytical results.

In recent years, the UK Support Programme has provided the services of two laboratories within the IAEA NWAL for environmental samples. AWE Aldermaston provides Fission Track Thermal Ionisation Mass Spectrometry (FT-TIMS) analysis of particles, whilst QinetiQ has provided a fast-turnaround particle analysis service using Resistive Anode Encoder - Secondary Ion Mass Spectrometry (RAE-SIMS). The two techniques are complementary, and both are routinely requested by the IAEA.

Summary Report on Activities in 2010/2011

AWE completed the analysis of 10 samples, with a further 4 undergoing TIMS measurement at the year-end. Using fission track analysis, particles containing fissile material were detected and selected for measurement by TIMS. The procedure involved removal of the particles from the swipe material, transfer onto a polycarbonate or lexan frame and irradiation with neutrons in a reactor. Particles containing fissile material were identified from the fission tracks that they produced.

Because fission-track analysis detects fissile material, the technique is more sensitive towards particles with a higher fissile content (for example, high enriched uranium). This is desirable to the IAEA, because it enables the highest uranium enrichment on a swipe to be identified through measurement by TIMS of only a small number of particles. Particles selected on the basis of their fissile content were subsequently placed upon TIMS filaments and the isotopic composition of uranium and/or plutonium within the particles was determined by mass spectrometry. Up to 20 particles were measured per sample, with additional information on particle morphology derived from measurements using Scanning Electron Microscopy (SEM).

QinetiQ received 8 batches of samples during 2010/2011, a total of 27 swipes including 15 “high priority” samples, for measurement of the uranium isotopic composition of individual particles. Analysis involved the recovery of particles from swipes using an impactor particle extraction technique, transfer of the particles to SIMS planchets and measurement. The measurement included an initial scan of all uranium-containing particles by RAE, often providing thousands of results, followed by a more detailed and accurate measurement of the uranium isotopic composition of individual particles of interest by Ion Microprobe (IM). During the initial scan, particles of uranium were identified and recorded with their size, relative locations and individual uranium isotope ratios using specialist software and hardware. More accurate measurement of individual particles was then undertaken using a tightly-focussed primary ion beam (microprobe operating mode) and an electron multiplier for the detector. Additional analytical techniques were applied to a number of high-priority samples. A uranium swipe standard and sample blanks were analysed as part of the quality control procedure applied to each batch.

It is anticipated that the IAEA will continue to require the analysis of environmental swipe samples by both FT-TIMS and SIMS in 2011/2012. However, in November 2010, QinetiQ announced that it was closing its analytical facilities and relinquishing its role as a Network Laboratory. The UK Support Programme subsequently worked with QinetiQ and AWE to transfer the existing SIMS capability to AWE’s laboratory, and the UK Support Programme hopes to resume the provision of a SIMS analytical service to the Agency later in 2011/2012.

Task A5(h) – Review and Assessment of Air-Particulate Sampling Field Trials

IAEA SP-1 No:	09/IDS-001	**UK Sub-Contractor:**	Nicholson Environmental
IAEA SPRICS No:	UK A01822	**UK Task Manager:**	K Nicholson
IAEA Task Officer:	A Axelsson		

Background to Task

From 1997-1999, the UK Support Programme was involved in a detailed theoretical study, performed by experts from six Member States and coordinated by the Department of Safeguards, to determine the potential feasibility, practicability, and costs of wide-area environmental sampling (WAES) techniques to detect undeclared reprocessing and/or enrichment activities on a countrywide or large-area basis. The study identified atmospheric sampling as one of the most promising measurement techniques.

Three field trials of air particulate sampling were subsequently undertaken, from 2001 to 2005, to enable the Agency to make an initial evaluation of the potential of the technique as a means to detect undeclared nuclear activities. The first trial was undertaken around a large-scale reprocessing plant (Sellafield, UK), with subsequent trials around a large-scale enrichment plant (Capenhurst, UK) and a small-scale reprocessing operation (Gatchina, Russia). As the three trials were conducted independently and reported over a period of several years, the Agency considered there to be benefit in undertaking a review to integrate and summarise all the findings, the recommendations and the lessons learnt.

The UK Support Programme commenced preparation of the required report in 2009. The report was intended to identify the steps that remained to be taken before WAES might be deployed as an effective safeguards verification measure, including an assessment of the status of techniques.

Summary Report on Activities in 2010/2011

Feedback on a draft report, and measurement data received from the Agency, were collated and incorporated into a revised draft, which was subsequently issued during November 2010. Further detailed comments were received from the Task Officer in January 2011, and these will be incorporated into a final report by end-June 2011.

Based upon the findings of the report, the Agency and UK Support Programme will decide upon what additional work, if any, should be undertaken to maximise the value of the earlier field trials.

Task A5(i) – WIMSD I/O Processor/GUI Development and Training

IAEA SP-1 No:	09/IDS-002	**UK Sub-Contractor:**	Serco Assurance
IAEA SPRICS No:	UK A01853	**UK Task Manager:**	N Davies
IAEA Task Officer:	A Axelsson		

Background to Task

Neutronics codes are used by the Department of Safeguards in the evaluation of results from inspection samples. Sample analysis results are compared with results from calculations, to judge whether they are consistent with declared or expected irradiation scenarios. The Agency requested the development of an updated version of an existing neutronics code, WIMSD, to enable staff to run quick generic calculations for typical representations of major reactor types.

The UK did not retain sufficient expertise in the development of WIMSD, whilst transfer of the commercially available WIMS9A code was considered to be too expensive. As an alternative, the Agency and UK Support Programme agreed upon the provision of libraries of isotopic data for different reactor and fuel types, based upon calculations to be performed using the state-of-the-art WIMS9A. Data on the isotopic composition of both reactor fuel and cladding and construction materials was to be provided in stages, during a task that was anticipated to be of one year's duration.

Summary Report on Activities in 2010/2011

Practical work on the task commenced in September 2010, using a combination of WIMS9A and the FISPIN fuel inventory code. Results from the first series of calculations, covering isotopic compositions for fuel and cladding/structural materials for eight different fuel enrichments ranging from 1.5% to 5% for a typical Western PWR, were completed and work then proceeded with the creation of similar data files covering Soviet PWRs, CANDU, MAGNOX and AGR reactor types. Completed files were transmitted to the Agency together with details of the modelling parameters including: core and fuel geometry; fuel and moderator temperature and density; specific power; and the application of burnable poisons.

Work then proceeded with a review of plutonium production and research reactors, to assess the availability of sufficient data to construct a practical model for eight selected reactor types. Calculations of isotopic compositions for fuel and cladding/structural materials for four reactor types, covering NRX (LEU and HEU); HIFAR; TVRs and TRIGA research reactors, were completed and passed to the Agency during March 2011.

Subject to the efficacy of the data being confirmed during independent review by the Agency, the task will proceed during 2011/2012 with:

- completion of calculations for the remaining plutonium production and research reactors, namely ISPRA, MTR, IRT and plutonium-production based upon Hanford N;
- gathering of data on irradiation facilities; and
- the completion of calculations for agreed irradiation facilities.

Task Area A6 - Satellite Imagery in Support of Safeguards

The UK Support Programme 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.

Task A6(d) - Commercial Satellite Imagery Analysis and Photo Interpretation Support

IAEA SP-1 No:	00/IIS-002	**UK Sub-Contractor:**	-
IAEA SPRICS No:	UK D01329	**UK Task Manager:**	J Tushingham, NNL
IAEA Task Officer:	S Robb		

Background to Task

On the basis of studies by the Member State Support Programmes, 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 UK Support Programme assisted in the procurement of commercially available satellite images and equipment, whilst further support from imagery analysts was provided under Task Area F.

Summary Report on Activities in 2010/2011

A voluntary contribution under this task is offered each calendar year. In January 2011, the Agency responded by requesting that the funds be assigned to support open source information collection, and funds were duly utilised for this purpose from the 2010/2011 budget.

The UK Support Programme anticipates that a further contribution to open source information collection/satellite imagery will be offered in 2011/2012.

Task Area A7 - Strengthening/Integration of Safeguards

Strengthening safeguards has 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.

Task A7(e) – Conceptual Development Support for Integrated Safeguards

IAEA SP-1 No:	99/PSS-006	**UK Sub-contractor:**	Wind River Consulting Inc
IAEA SPRICS No:	UK C01265		
IAEA Task Officer:	J Cooley	**UK Task Manager:**	R Hooper

Background to Task

Strengthened and integrated safeguards has changed the nature of safeguards and the knowledge required of those responsible for its implementation. An appreciation is required of safeguards concepts and how these concepts have become manifest in the legal framework and Agency practice. In 2004, a need was identified to provide a paragraph-by-paragraph commentary on INFCIRC/153, and an article-by-article commentary on INFCIRC/540. The commentaries were intended to draw from negotiating histories, but would also include Secretariat assertions to the Board on how the measures included in agreements should be interpreted after 30 years of practice. Late in 2004, the Task Manager commenced work to compile the extensive reference material needed for the development of the commentaries.

It had been intended that the first draft would be completed by the end of 2005. However, difficulties encountered in reaching agreement on the scope and level of detail of the commentary, together with priority being given to assisting the Secretariat with preparations for a new Committee of the Board of Governors, delayed progress and work halted in 2007. In 2009, the Agency renewed its interest in receiving a commentary, and the task resumed as a joint undertaking with the IAEA, principally the Section Head for Non-Proliferation and Policy Making within the Office of Legal Affairs.

Summary Report on Activities in 2010/2011

The INFCIRC/153 and /540 commentary is intended to be a highly accessible description of the evolution of safeguards concepts, legal instruments and Agency practice: an internal working document to assist safeguards implementers.

Work on the commentary was progressed during 2010/2011 with completion of introductory and background material addressing the IAEA safeguards system and its evolution, the nature of safeguards conclusions and the negotiation of the comprehensive safeguards requirement contained in the NPT. Sections dealing with the implementation of comprehensive safeguards agreements and the process of strengthening safeguards were also completed, and work commenced on a number of overarching implementation issues. These included:

- Undeclared nuclear materials;
- Independent verification;
- Definition of a facility;
- Open source information;
- Third party information;
- Environmental sampling;

- Special inspections;
- Unannounced inspections;
- Cooperation and access to individuals; and
- Confidentiality.

It is hoped that continuing support from the Office of Legal Affairs, and an extended period of research in Vienna, will see completion of a first draft of the commentary during 2011/2012.

Task A7(h) - Support for Novel Technologies (Umbrella Task)

IAEA SP-1 No:	06/TDO-07	**UK Sub-Contractor:**	-
IAEA SPRICS No:	UK A01599	**UK Task Manager:**	J Tushingham, NNL
IAEA Task Officer:	J Whichello		

Background to Task

Following the 2004 IAEA General Conference, Project SGTS-08, "Novel Techniques and Instruments for Detection of Undeclared Nuclear Facilities, Materials and Activities", was established within the Department of Safeguards to:

- monitor and address observed deficiencies or vulnerabilities in safeguards approaches, equipment and technology;
- acquire new, or improved, equipment or technology where appropriate; and
- develop and/or use new concepts, approaches, techniques and technology for information analysis and verification activities, in particular with regard to enhanced capabilities to detect undeclared nuclear material and activities.

In 2006, the UKSP agreed to contribute to the project through an umbrella task, initially to provide a contact point for the identification of appropriate expertise and resources. Since then, the UKSP has participated in Technical and Advisory Meetings on laser spectrometry techniques and has funded a visit by the IAEA Task Officer to the UK, in addition to assisting in the identification of appropriate expertise within the UK.

Summary Report on Activities in 2010/2011

The UK Support Programme solicited expertise to support a series of meetings intended to discuss laser-induced breakdown spectroscopy (LIBS) for hot cell, glove box and solution monitoring applications; muon detection; and antineutrino detection. The field-testing of portable raman and gas mass spectrometers was explored, with the UK Support Programme seeking to assist Urenco in facilitating the testing of a portable gas mass spectrometer developed by Kore Technologies Ltd. These activities are expected to be completed during 2011/2012.

An expert in antineutrino detection from Imperial College, London, attended the IAEA Safeguards Symposium in November 2010, providing the opportunity for discussions with the Agency and other research groups, whilst the UK Support Programme also liaised with a second research group, from Liverpool University.

The UK Support Programme intends to continue to provide a point of contact with the Agency, to liaise with the Task Officer to identify appropriate UK expertise, and to consider requests for support within the framework of this task.

Task A7(k) - Acquisition Path Analysis Methodology and Software Package

IAEA SP-1 No:	10/CCA-004	**UK Sub-Contractor:**	Tessella plc
IAEA SPRICS No:	JNT C01871	**UK Task Manager:**	D Dungate
IAEA Task Officer:	I Tsvetkov		

Background to Task

The IAEA is continuing to develop the State-level concept as part of the evolution of safeguards to a system that is fully information-driven. Acquisition Path Analysis[1] is an essential element of the State-level concept, to determine whether a proposed set of safeguards measures would provide sufficient detection capability with respect to a specific acquisition path or acquisition strategy. To implement the State-level concept, it is necessary to perform an ongoing analysis of all safeguards-relevant information concerning a State and its relevance to the acquisition path for that State. Such analysis must be based on accepted safeguards methodology, and should factor in expert judgements and State-specific factors for the evaluation.

Summary Report on Activities in 2010/2011

The Agency proposed a task to provide a coordinated framework for Member State Support Programmes to work together within a dedicated IAEA work group to produce an accepted methodology, enhanced safeguards knowledge and customised software tools. In March 2011, a workshop was announced to discuss various methodologies to be used for acquisition path analysis, to be held at IAEA Headquarters from 14-17 June 2011. The UK Support Programme accepted the task late-March 2011, in order to enable Tessella, a technology and consultancy company, to provide input to the workshop.

Task Area A8 - 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.

[1] Acquisition path analysis – the analysis of all plausible acquisition paths or acquisition strategies for a State to acquire nuclear material useable for the manufacture of a nuclear explosive device.

Task A8(e) – Regional Information Collection Centre 1

IAEA SP-1 No:	08/ICA-003	**UK Sub-contractor:**	King's College London
IAEA SPRICS No:	UK D01730	**UK Task Manager:**	J Kidd
IAEA Task Officer:	C Eldridge		

Background to Task

In November 2001, the UK Support Programme initiated the development of a Regional Information Collection Centre (RICC) within the International Policy Institute, King's College London (KCL). The RICC subsequently established methodologies for the collection of information to support the production of detailed surveys of States' industrial and nuclear research infrastructures. The KCL RICC, established under Task UK D01569, extended the Agency's ability to identify relevant information, without which the Agency's confidence in safeguards conclusions would be reduced.

Upon completion of Task UK D01569, the Agency prepared a new Task Proposal for the provision of open source information, to include 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. Work commenced under the new task in April 2008.

Summary Report on Activities in 2010/2011

Collections of abstracts of open source information on nuclear-related issues, gathered from both English and regional language sources, were sent monthly to the IAEA during 2010/2011.

Two State Profiles were updated, with the issue of a third postponed to enable developments at the year-end to be incorporated. In addition, an ad-hoc report on the subject of Scientific Conferences was updated and a report on civilian nuclear infrastructure was prepared. Updates on political issues were researched and sent to the Agency on six occasions during the year.

Activity will continue through 2011/2012, including expansion of existing information collection capabilities, the update of a further four State Profiles, the continued provision of abstracts and political updates and an ad-hoc report on a subject to be specified by the Agency.

Task A8(f) – Regional Information Collection Centre 2

IAEA SP-1 No:	08/ICA-002	**UK Sub-contractor:**	King's College London
IAEA SPRICS No:	UK D01728	**UK Task Manager:**	J Kidd
IAEA Task Officer:	C Eldridge		

Background to Task

In July 2003, a second RICC commenced the collection of open source information on a second region. As a successor to this task, the Agency proposed a RICC to focus primarily on emerging nuclear programmes within the region. The new RICC would expand the region, whilst also updating existing reports. In addition, the RICC would continue the regular monitoring of open sources, providing abstracts of new information on a monthly basis. The task of providing this expanded RICC was accepted by the UKSP, and work commenced in April 2008.

Summary Report on Activities in 2010/2011

Collections of abstracts of open source information on nuclear-related issues, gathered from both English and regional language sources, were sent monthly to the IAEA during 2010/2011.

Three State Profiles were updated, together with a new Profile of a fourth State. Reviews on political issues were researched and sent to the Agency on six occasions during the year.

The work will continue through 2011/2012, to include the updating of four State Profiles and preparation of an ad-hoc report, in addition to the regular research and issue of scientific abstracts and political updates.

Task A8(g) – Delivery of Regional Information

IAEA SP-1 No:	08/ICA-004	**UK Sub-contractor:**	King's College London
IAEA SPRICS No:	UK D01731	**UK Task Manager:**	J Kidd
IAEA Task Officer:	C Eldridge		

Background to Task

The value of the open source information provided to the Agency through the UK Support Programme has been substantially enhanced by moving from unstructured text to a semi-structured file format in Extensible Markup Language (XML). In this format, key entities, structures and concepts are tagged using a specially developed taxonomy, enabling the semi-automatic generation of indices, cross-references and tables and supporting the disambiguation of entity names. The result is improved usability and greater user confidence in the quality of the data being retrieved.

Under a previous task, the XML format was successfully implemented on a KCL server accessible by Department of Safeguards staff. However, the system did not fully utilise all of the capabilities inherent in the XML data structure. Further development was required, and

was proposed by the Agency for a task commencing in April 2008. Work was subsequently carried out to establish a new URL site for the overarching RICC URL online information repository, including the debugging of abstracts and profiles already marked-up in XML and the cleaning of authority lists. The new repository was completed during 2009, debugging of all of KCL's XML data was completed and Authority Lists covering People; Institutions; Companies; Locations and Countries were transferred to the Agency. Final transfer to the Agency of all XML data was completed by the end of 2009/2010.

Summary Report on Activities in 2010/2011

The Agency intended to take in-house the marking-up of future open source information collected by the two RICCs, enabling KCL to focus on the collection of information and development of new sources and capabilities. KCL produced the last of its State Profiles to be marked up in XML during April 2010, completing work on this task.

AREA B - SUPPORT FOR IAEA ANALYTICAL SERVICES

Destructive Analysis (DA) techniques are the most accurate way of assaying 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 Safeguards Analytical Laboratory (SAL), or to an accredited member of the IAEA NWAL in a Member State. Since its inception, the UK Support Programme has assisted with all aspects of destructive analysis, from on-site sampling trials through the development of analytical techniques and provision of equipment to the development of processes for the treatment of analysis waste residues. In particular, from 1984 to 2001, the UK Support Programme assisted in the development and supply to the IAEA of standards for application to quality control of the analysis of inspection samples.

Task Area B1 - Analytical Services

As bulk handling plants become larger, and material throughput increases, so 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.

Task B1(t) – Consultant: NWAL for Nuclear Materials Expansion Study

IAEA SP-1 No:	08/TTS-004	**UK Sub-Contractor:**	NNL
IAEA SPRICS No:	UK C01742	**UK Task Manager:**	J Tushingham
IAEA Task Officer:	R Lafolie		

Background to Task

In 2006, the Task Manager chaired a workshop, convened by the Agency's Department of Nuclear Science and Applications, to consider the future requirements for analytical support to the Department of Safeguards and the need for renovation, replacement or substitution of existing facilities at SAL. One of the main recommendations of that workshop was that the Agency should explore the possibility of expanding the existing NWAL for nuclear materials analysis.

Under the current task, the UK Support Programme subsequently explored the possibilities and practicalities of expanding the NWAL, and the degree of expansion required under different scenarios to provide the Department of Safeguards with sufficient analytical support to satisfy the timeliness and performance criteria for safeguards. The Task Manager chaired a Panel of Consultants, convened by the Agency to provide recommendations on the current and future requirements for analytical services, and provided further input to the Agency in

respect of advice on the draft plans for a new Nuclear Material Laboratory (NML) and the constraints on its mission that could be envisaged following the development of appropriate support from the NWAL.

Summary Report on Activities in 2010/2011

The Task Manager completed a report on options for the utilisation of an NWAL for nuclear materials analysis, with emphasis on how to maintain a sustainable resource to supplement the Agency's in-house capabilities and mitigate against a single point of failure. In addition, he chaired a further Experts' Meeting, convened by the Agency in June 2010. This meeting reviewed the conceptual design of the proposed new NML.

The Task Manager returned to Vienna in February 2011, to participate in a workshop on progress and developments in the programme "Enhancing Capabilities of the Safeguards Analytical Services" (ECAS).

Support will continue to be required by the Department of Safeguards, as it determines the future requirements and plans for a new NML, and the UK Support Programme anticipates continuing to provide assistance to the ECAS Programme during 2011/2012.

Task B1(v) – Evaluation of Ultra-High Sensitivity Secondary Ion Mass Spectrometry for Environmental Samples

IAEA SP-1 No:	08/IDS-002	**UK Sub-Contractor:**	QinetiQ
IAEA SPRICS No:	UK A01776	**UK Task Manager:**	A J Pidduck
IAEA Task Officer:	K Vilece		

Background to Task

SIMS is employed by several laboratories within the IAEA NWAL for environmental samples, and the IAEA operates its own instrument at SAL. SIMS offers relatively rapid measurement of samples at moderate mass resolution and sensitivity, but the quality of data for minor isotopes is affected by high molecular ion interferences and low signal strength, leading to high uncertainty in results. The alternative technique of FT-TIMS offers improved performance in the measurement of minor isotopes, which can provide important information in support of safeguards conclusions or detection of undeclared activities. However, FT-TIMS is available to very few laboratories and it is not considered feasible for SAL to develop its own in-house FT-TIMS capability.

The Agency requires an independent capability to measure minor isotopes in environmental samples. In the absence of FT-TIMS, a more sophisticated type of SIMS instrument, Large-Geometry (LG) SIMS, was procured by the Agency, with installation expected to be completed during 2011. This new instrument is expected to offer improvements in ion transmission, mass resolution and simultaneous multiple ion counting, resulting in data of higher quality, optimal for drawing safeguards conclusions. QinetiQ, one of two UK laboratories within the NWAL for environmental samples, had access to an existing LG-SIMS instrument at Edinburgh University, in addition to its own conventional SIMS instrument. During 2008/2009, the UK Support Programme undertook comparative trials of conventional

and LG-SIMS instruments, presenting the initial results at an IAEA Particle Analysis Consultants' Group Meeting in October 2009.

Summary Report on Activities in 2010/2011

Two Agency staff members visited QinetiQ's SIMS laboratory during July 2010, for discussions on the performance of LG-SIMS.

Data from Energy-Dispersive X-ray (EDX) SEM automated particle searching and individual uranium particle analysis of samples used in the earlier comparison of standard geometry and large geometry SIMS instruments were evaluated and reported to the Agency in January 2011. Work subsequently commenced on the preparation of a full report on the UK SIMS comparison trials.

Following the closure of analytical facilities at QinetiQ, it is anticipated that former staff will continue to support the task in 2011/2012. In particular, the Agency has indicated that it would wish to utilise their expertise during the second half of 2011 in relation to the development of an in-house LG-SIMS capability.

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 nuclear facilities, which can only be made available by Member States.

Task Area C1 - Inspectors' Training Courses

The UK Support Programme 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. Training courses held at Sellafield and Springfields for IAEA inspectors are provided with the support of the UK Nuclear Decommissioning Authority.

Task C1(c) - DIV Exercise at Bulk Handling Facilities

IAEA SP-1 No:	06/TTR-003	**UK Sub-Contractor:**	NNL
IAEA SPRICS No:	UK B01618	**UK Task Manager:**	S M Francis
IAEA Task Officer:	P Rodriguez		

Background to Task

Courses on safeguards at bulk-handling facilities have been run for the benefit of IAEA inspectors by the UK Support Programme since 1992. During this period, over 300 inspectors (usually recent recruits) have received general training and familiarisation aimed at providing an enhanced understanding of operations at a variety of bulk handling facilities.

Prior to 2001, the course included a simulated Physical Inventory Verification (PIV) exercise, using Non-Destructive Analysis (NDA) instrumentation at Springfields. In 2001, the course was reviewed and, at the request of the IAEA, the focus changed to performing a Design Information Verification (DIV) exercise. The course was of three weeks duration, the first week being conducted by the IAEA in-house; the second and third weeks being hosted by BNFL, at Springfields and Sellafield in the UK, and including one day at Capenhurst hosted by Urenco (Capenhurst) Ltd. Consolidation over subsequent years led to the visit to the Urenco enrichment plant being removed and the overall duration of the course being reduced to two weeks.

Summary Report on Activities in 2010/2011

The course on safeguards and design verification at bulk handling facilities was successfully delivered to twelve IAEA Inspectors, accompanied by two Agency tutors, from 10 - 20 May 2010. The itinerary included two days of classroom-based training and six days of site visits, taking in facilities at Sellafield and Springfields, with a final day for reporting back and making presentations.

The first week of the course took place at Sellafield. Following two days of lectures on Design Information, the Design Information Questionnaire (DIQ) and processes and essential equipment within reprocessing and LEU conversion and fabrication facilities, each participant completed two DIE/DIV/DIQ exercises within the THORP reprocessing plant. These were followed by an additional exercise, new to the syllabus for 2010, within the hot cell and alpha glove box areas of NNL's Central Laboratory. The new exercise required the participants to draw up a draft DIQ for the facility, placing them in the role of facility operator.

The second week's schedule, at Springfields, was also revised from previous years. One day was dedicated to activities in the Enriched Uranium Residues Recovery Plant (EURRP), involving separate exercises in the pulsed column and harp tank areas. These were followed by an exercise in the fuel canning and assembly area, which introduced the Essential Equipment List and the differences between life cycle phases under investigation. Finally, a partial site examination provided experience in the use of GPS units and practice in identifying the potential scope for undeclared operations.

The revised itinerary proved highly successful and will form the basis for future courses, including a course scheduled for May 2011.

Task C1(f) - Training on the Nuclear Fuel Cycle and Proliferation Pathways

IAEA SP-1 No:	07/CTR-004	**UK Sub-contractor:**	NNL
IAEA SPRICS No:	UK B01698	**UK Task Manager:**	S M Francis
IAEA Task Officer:	K Dinov		

Background to Task

The main objective of strengthened safeguards is to provide assurances of the absence of undeclared nuclear activities in States. 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. Over the next fifteen years, the course was run on 25 occasions by the UK Support Programme.

Summary Report on Activities in 2010/2011

Two Nuclear Fuel Cycle and Proliferation Pathways Courses were run in 2010, in June and November. These concentrated on the safeguards-relevant elements of the nuclear fuel cycle and on the nuclear proliferation pathways associated with its more 'sensitive' activities, such as enrichment, fuel reprocessing, MOX fuel fabrication and power generation from reactors capable of unreported plutonium production.

The 26th Proliferation Pathways Course was delivered to 13 participants, with introductory lectures at IAEA Headquarters on 18 June 2010 followed by a residential course at Puchberg from 21 – 25 June 2010. The introductory lectures covered Integrated Safeguards, Information Review and Nuclear Export Controls Evaluation, with a full day subsequently assigned to each fuel cycle module. The UK Support Programme provided four experts, who gave lectures on subjects including conversion, reprocessing and reactors. For 2010, animations of centrifuge, diffusion and laser enrichment processes were included in the enrichment presentation for the

first time, whilst revisions were also made to the reprocessing presentations in order to optimise the schedule.

The 27th course was delivered from 22 - 26 November 2010, following an introductory session on 19 November 2010. The course followed the same format as the previous one, with the UK Support Programme providing four experts and the Agency providing in-house expertise in reprocessing. There were 12 course participants, mainly inspectors with a small complement of information analysts. Modifications to two modules were introduced, whilst the reactor module was reviewed with changes subsequently made to incorporate research and fast breeder reactors.

Demand from inspectors for the course remains high, and a further two Proliferation Pathways Courses have been requested by the Agency for 2011/2012. These are expected to be held in June and November, and planning for the courses has commenced. Further revision of course modules is expected during the year, to reflect developments in safeguards and non-proliferation.

Task C1(i) – Advanced Training in Nuclear Fuel Cycle Facilities

IAEA SP-1 No:	05/TTR-002	**UK Sub-contractor:**	NNL
IAEA SPRICS No:	UK B01550	**UK Task Manager:**	S M Francis
IAEA Task Officer:	K Dinov		

Background to Task

IAEA inspectors with additional responsibility to evaluate safeguards compliance in particular States as a whole are known within the IAEA as Country Officers. Arising from the Agency's strengthened and integrated safeguards approach, advanced training was required to provide such personnel with 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. Since a proliferator may choose to adopt old technology, the scope of any training course was required to cover both new and old equipment. Physical access to reactors, conversion, enrichment and reprocessing facilities on three scales: laboratory, pilot plant and commercial, were specific requirements.

The course was to be targeted at Country Officers of States with significant nuclear activities, and selected staff members with significant responsibility for Complementary Access and State Evaluation activities. Following a feasibility study in 1999, involving a series of visits to enrichment, reprocessing and conversion sites at Capenhurst, Sellafield and Springfields, respectively, the UK Support Programme designed a pilot course. This pilot course was successfully completed in 2000, and a full course was provided thereafter by the UK Support Programme on an annual basis until 2008/2009, since when the course has been held twice-yearly.

Summary Report on Activities in 2010/2011

Two advanced training courses were requested by the Agency for 2010/2011. The first was held in the UK from 4 – 8 October 2010, with the second course held from 7 – 11 March 2011: each course following two half-day introductory sessions at IAEA Headquarters. Both courses followed a similar itinerary, with twelve Agency participants on the first course and ten on the second.

The courses included two days at Sellafield, with tours of the site; the Fuel Handling plant; and THORP and B205 Magnox Reprocessing facilities. Additional visits to the hot cell area and high integrity glove box suites of the NNL Central Laboratory highlighted the kind of facilities that a clandestine proliferator may choose to construct and operate, whilst a visit to Calder Hall fulfilled a similar purpose with respect to reactors.

At Springfields, the course participants toured the Chemical Plants, Uranium Hexafluoride/Fluorine Plants and the EURRP. This was followed by visits to the Oxide Fuels Complex and R&D facilities, enabling the participants to experience small fluorine cells, kilns, pellet machines and a range of powders, liquids and acids likely to be encountered during the Conversion process.

The final day of each course was spent at Capenhurst, and included a site tour and visits to the E22 and E23 centrifuge plants and the mass spectrometry area.

The Section Head for training within the Department of Safeguards attended the second course, to assess its continuing effectiveness against a goal of safeguards that are fully information-driven. As a result, agreement was reached to replace the existing course with one that is more suitable for both inspectors and safeguards analysts. The new course is expected to focus on Sellafield and Springfields, without a visit to Capenhurst, and it is hoped that the design of the new course will be complete in time for it to be held in October 2011.

Task C1(l) – Specialist Training for IAEA's Imagery Analysts

IAEA SP-1 No:	03/IIS-001	**UK Sub-Contractor:**	NNL
IAEA SPRICS No:	UK B01495	**UK Task Manager:**	S M Francis
IAEA Task Officer:	S Robb		

Background to Task

In order to enhance the expertise of its staff and develop its in-house imagery analysis capability, the IAEA SIAU requires the availability of training across a range of technologies. To assist in the identification of nuclear facilities, imagery analysts employed by the SIAU have visited a number of Member States' nuclear facilities, specifically for familiarisation with the flow patterns of the various processes, the buildings and equipment being used and the necessary support facilities, notably electrical, heating, cooling and air handling and filtration services.

The facilities, processes and systems used in UK facilities differ considerably from those available overseas, and an orientation and familiarisation visit was considered important to

complement and build upon experience gained elsewhere. Consequently, a UK Visual Indicators Course was held for three imagery analysts from the SIAU in 2004, incorporating in-depth visits to reprocessing, reactor and fuel fabrication facilities along with the Urenco Capenhurst enrichment plant. The course proved a success, and further courses were held in 2007 and 2009, the latter held for the benefit of both satellite imagery and open source information analysts.

Summary Report on Activities in 2010/2011

A further Visual Indicators Course was held for the benefit of three imagery analysts and two open source analysts from 26 - 30 April 2010. The course followed an itinerary including two days at Sellafield, two days at Springfields and one day at Capenhurst, with all visits supported through the use of satellite imagery and aerial photographs of each of the sites.

The course commenced with an overview of Sellafield, followed by a site tour and more detailed visits to the THORP reprocessing plant; Fuel Handling Plant/Pond/Ion Exchange Effluent Plant; NNL Central Laboratory hot cells and alpha glove boxes; Calder Hall; and Magnox reprocessing facility.

At Springfields, a site tour was supplemented by visits to the Main Line Chemical Plants; Natural Uranium Hexafluoride Plant; Oxide Fuels Complex; and EURRP.

At Capenhurst, all areas of the old diffusion plant were visited and an extensive tour around the external features of the site was undertaken, enabling comparison of visible features to commercially available satellite imagery.

Throughout the course, the participants were accompanied by a UK expert in satellite imagery analysis of nuclear facilities and by local guides with particular expertise in the plant and processes visited.

No further courses are scheduled under the current task, as the Agency and UK Support Programme seek to revise course content to accommodate the wider requirements for familiarisation visits to UK nuclear facilities by small teams of specialists within the Department of Safeguards.

Task C1(r) - Comprehensive Inspection Exercise at Bulk Handling Facilities

IAEA SP-1 No:	07/CTR-005	**UK Sub-Contractor:**	NNL
IAEA SPRICS No:	UK B01751	**UK Task Manager:**	S M Francis
IAEA Task Officer:	P Rodriguez		

Background to Task

It is essential to provide newly-recruited safeguards inspectors with a range of practical skills to enable them to perform inspections at bulk handling facilities such as LEU Fuel Fabrication Plants (FFPs), Storage Facilities and Locations Outside Facilities (LOFs) handling depleted, natural and low enriched uranium.

A UK-based Comprehensive Inspection Exercise at Bulk Handling Facilities Course was developed at the request of the Agency, to be conducted in two parts. The first of these would take place at the Agency Headquarters, with lectures and practical demonstrations of measurement equipment. The second part, to take place at Springfields, would focus on applying these techniques at a nuclear facility. The inaugural course was successfully held in 2002 and subsequent courses were held annually, in March, from 2003 – 2007 and from 2009 - 2010. From 2004 - 2007, the course was extended to include a visit to Urenco's Capenhurst Enrichment Plant, providing the inspectors with a wider understanding of different fuel cycle facilities.

Summary Report on Activities in 2010/2011

The ninth UK Comprehensive Inspection Exercise had been scheduled for March 2011, and preparation for the course was completed with receipt of equipment from the IAEA earlier in the month.

Unfortunately, the late withdrawal of key resources from within Springfields Fuels Ltd, together with over-running maintenance work, prevented the course from continuing. The possibility of holding a course late in 2011 was explored, although this was considered a remote possibility. The UK Support Programme expects to be able to continue to offer the course, on an annual basis, from 2012.

Task C1(t) – Revision to Nuclear Fuel Cycle Training Manuals

IAEA SP-1 No:	07/CTR-010	**UK Sub-Contractor:**	NNL
IAEA SPRICS No:	UK B01727	**UK Task Manager:**	S M Francis
IAEA Task Officer:	M Hunt/S Pickett		

Background to Task

The Department of Safeguards requires up to date information on all parts of the fuel cycle, to train inspectors and to provide information and training to Member States. In 1985, a series of training manuals was prepared that described the technical aspects of fuel fabrication, research reactors, critical assemblies, nuclear power plants and reprocessing plants. In 2007, the Agency requested support in preparing new manuals, to reflect developments in the fuel cycle, plus expansion of the range to include the front end of the fuel cycle, waste and, most importantly, enrichment.

Technical descriptions were required, to include all current technologies and technologies under evaluation or development. Individual Support Programmes were expected to take responsibility for the preparation of the different manuals, with the UK Support Programme agreeing to provide the revised Fuel Fabrication and Power Reactor volumes. Revised drafts of the two manuals were subsequently prepared and passed to the Agency for review late in 2008/2009. The content of the UK Support Programme's submission on FFPs was accepted by the Agency. However, significant further work was required on the Power Reactors volume, both to combine newly-produced text on new reactor designs with the existing volume, and also to incorporate details on other reactors including Pebble Bed, Advanced

BWR and CANDU. Editing was completed during the year, and the revised volume was passed to the Task Officer for review in February 2010.

Summary Report on Activities in 2010/2011

The Task Manager completed work on the final version of the Fuel Fabrication manual, working on remaining details with the Agency's compiler and editor during November 2010. This manual was subsequently published by the Agency early in 2011. Meanwhile, the earlier draft of the Power Reactor manual provided by the UK Support Programme was reformatted by the Task Officer to match the final format of the Fuel Fabrication manual and will be subject to final review by the Task Manager following an ongoing technical review within the Agency.

The IAEA Task Officer requested that the UK Support Programme commence work on a Reprocessing manual. A layout and content were agreed and work commenced on drafting the early sections of the manual. Sections 1-3 were completed in draft during the remainder of the year.

The first draft of the Reprocessing manual is scheduled to be completed by the UK Support Programme during the first half of 2011/2012.

Task C1(u) – Limited Frequency Unannounced Access (LFUA) Training

IAEA SP-1 No:	08/CTR-004	**UK Sub-Contractor:**	Urenco Capenhurst
IAEA SPRICS No:	UK B01797		
IAEA Task Officer:	P Rodriguez	**UK Task Manager:**	C Taylor

Background to Task

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 to incorporate visual observation and environmental sampling. Representatives from Urenco participated in a two-day workshop on the feasibility and practicalities of Enrichment LFUA training, convened by the Agency in April 2009. Approval was subsequently given by the Quadripartite Committee Safeguards Working Group for IAEA and DGTrEn Inspectors to have access to cascade areas during an LFUA inspection course, subject to certain restrictions. A pilot LFUA course was subsequently held at Capenhurst in December 2009, providing the necessary information and experience to establish and finalise the course content for a regular LFUA course.

Summary Report on Activities in 2010/2011

The first full LFUA course was run under the Netherlands Support Programme, at Urenco (NL) Almelo, from 1 – 3 September 2010. The Task Manager assisted in the running of the course, with the UK Support Programme providing financial support.

A second LFUA training course took place at Capenhurst from 18 – 20 January 2011. Following a series of lectures and an orientation and familiarisation tour of E22 and E23, external to the cascade halls, a group of IAEA and DGEner inspectors completed two days of exercises. These included visual observation and swipe sampling along the agreed LFUA routes within E22 and E23, with demonstrations of how uranium hexafluoride samples are taken from the Unit Product Header sampling stations, as well as a demonstration on mailbox interrogation. The course was completed with an exercise on feed station check at the E23 plant, with documentation of activities and relevant observations during the exercises, debriefing and discussions between participants, instructors and operators.

The third LFUA course will be held at Gronau, under the auspices of the German Support Programme. It is expected that the course will follow the training schedule of the previous events, with the UK Support Programme enabling the continued participation of the Task Manager. A further UK-based course is anticipated for later in the year.

Task C1(v) – Negotiation Skills Training Course

IAEA SP-1 No:	10/CTR-006	**UK Sub-Contractor:**	ADRg Ambassadors
IAEA SPRICS No:	UK B01874		
IAEA Task Officer:	R Barnes	**UK Task Manager:**	P Jenkins

Background to Task

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. Specific skills include direct/positive speaking, careful listening skills, open questions, impartiality, confidentiality, emotions, self-esteem and face-saving strategies, handling values, differing ethnic/cultural value systems and dealing with ‘spoilers’ and ‘bad leaders’.

Late in 2010, the UK Support Programme was requested to provide training to senior inspectors in diplomatic negotiation skills, utilising a team of former diplomats with high-level experience in negotiation and professional mediation.

Summary Report on Activities in 2010/2011

Work during the year was limited to completing arrangements for a series of interviews with experienced inspectors, to be held during May 2011, to facilitate the preparation of course materials and to supply case histories.

Four consecutive half-day training sessions will then be provided from 14 – 17 June 2011. These will cover a number of modules that may include key negotiation theory and techniques; negotiation techniques in practice; and extended role play, the exact content being decided on the basis of the findings from the initial research.

AREA D - SAFEGUARDS PROCEDURES

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.

Task Area D2 - Near Real Time Accountancy

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.

Task D2(g) – Evaluation Software Co-Development for Solution Monitoring at TRP

IAEA SP-1 No:	06/OA2-003	**UK Sub-Contractor:**	University of Glasgow
IAEA SPRICS No:	UK A01653	**UK Task Manager:**	J Howell
IAEA Task Officer:	R Binner		

Background

Solution volume and mass estimation systems are installed in the Plutonium Conversion Demonstration Facility (PCDF) and product storage area of Tokai Reprocessing Plant (TRP), whilst implementation of a comprehensive solution monitoring system is underway at Rokkasho Reprocessing Plant (RRP). The hardware and software systems collect and store solution data such as the level, temperature and density of solution in key vessels. Evaluation of the data collected by such systems should provide additional safeguards assurances of non-diversion of nuclear material. Earlier UK tasks undertaken by Glasgow University specified mathematical algorithms for the evaluation software and provided support to the development of a small solution monitoring evaluation system (SMES), called TAMES, for the PCDF.

Following on from this work, the Agency requested that Glasgow University assist through the co-development of evaluation software for the solution monitoring system installed in the product storage area of the TRP under a previous task of the Japanese Support Programme. Development of a complete package in the Python high-level programming language, including a user interface, was completed by end-2007. Flexibility was built into the software package, which was then subjected to extensive testing at Glasgow University. Following further enhancement, the IAEA Task Officer took the package to TRP, to evaluate data collected off the plant. A number of changes to the software were requested, and revised routines were

produced prior to final review and hand-over of the Solution Monitoring software, TAMES-TRP 1.0.5, during a visit to the IAEA in January 2009.

Summary Report on Activities in 2010/2011

The Task Manager visited the Agency during May 2010 to update TAMES-TRP, in order that it could accommodate data collected from new instrumentation. The file structure of the new data was very different from the original data, and the Department of Safeguards required the capability to combine the two data streams together. This was achieved during the visit and tested on the limited data available.

Following the installation of back-up scani-valves on the new product storage tanks at TRP, further changes to the TAMES-TRP evaluation package were required, to accommodate the different data acquisition system outputs from the new valves. TAMES-TRP was modified to accommodate this new data stream, and tested late-2010.

The Agency requested that the task remain open until at least May 2011, to accommodate a further period of operational experience and the potential requirement for minor modifications to the TAMES-TRP software.

Task D2(h) – Development of a Software Tool to Simulate the Nuclear Material Accountancy System for MOX Facilities

IAEA SP-1 No:	10/OA2-001	**UK Sub-Contractor:**	University of Glasgow
IAEA SPRICS No:	UK D01878	**UK Task Manager:**	J Howell
IAEA Task Officer:	K Zhao		

Background

A software tool to simulate the nuclear material accountancy system for MOX facilities is required by the Agency, to support review of the operator's accountancy system design and the refinement of safeguards approaches for the J-MOX facility. Glasgow University had previously worked on the development of a simulation tool for MOX facilities, and the Agency sought development of a prototype software written in Python, set up with model MOX plant parameters for demonstration purposes. The IAEA Safeguards Division of Information Management (SGIM) would then take ownership of the product to conduct specific simulation case studies by configuring or extending the software with J-MOX design and operational parameters.

Summary Report on Activities in 2010/2011

The UK Support Programme agreed to fund the enhancement of an existing discrete simulation of the movement of material through a MOX facility. Most movements are in cans, so the simulation focuses on their filling, emptying, measurement and storage. The aim is to simulate the data an operator would have available on a day by day basis, together with the true values behind this data. Accountancy results would then derive from this data, combined with hold-up measurements made in the facility.

The existing package would need enhancements to accommodate:

- the flexible provision of balance, NDA and DA measurement points;
- simulation of the addition of binding material and of its partial evaporation;
- addition of measurement error models including tare weight handling;
- simulation of heel carry-over in internally re-used cans;
- addition of scrap recycle; and
- the need for graphics, to show the movement of cans etc.

Glasgow University agreed to produce a report on the structure and use of the package, to enable use in its current form. Longer term, the Task Manager will investigate the possibility of producing a more general package.

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.

Task Area E10 – Instrument Vulnerability Assessments

Technical assessments of vulnerabilities are required during equipment development, to optimise design, prior to implementation, and periodically during the lifetime of the equipment, to account for advances in technology. It is important that the IAEA gains assurance through verification by organisations neither connected with the manufacturer nor operating facilities where the equipment may be employed by the IAEA. However, during development, it is more appropriate to employ a vulnerability assessor from the same State as the equipment manufacturer, and to foster collaboration between developer and assessor in order to optimise resistance to tamper. The assessment techniques applied may be defined by the IAEA, who will highlight specific features or applications for analysis. Equally, the assessor may be left to utilise a broad range of technologies in an attempt to exploit potential vulnerabilities. The results from assessments are provided in confidence to the IAEA.

Task E10(j) - Laser Surface Authentication Prototype Test and Evaluation

IAEA SP-1 No:	08/TSR-003	**UK Sub-contractor:**	Ingenia Technology
IAEA SPRICS No:	UK E01762	**UK Task Manager:**	J Tushingham, NNL
IAEA Task Officer:	B Wishard		

Background to Task

Laser Surface Authentication (LSA) is a new technique, developed in the UK, to identify materials using an intrinsic fingerprint extracted by a laser scanning device. Such a method, if successfully proven, could lead to automation of seals identification within the Agency's Seals Laboratory, and could also enable authentication of seals on site or in-situ, in addition to increasing confidence in the integrity of the metal seal.

The Department of Safeguards requested that the UK Support Programme provide financial assistance towards the procurement of two prototype LSA instruments plus one field scanner. These were to be utilised in a vulnerability assessment and parallel development work within the IAEA's seals laboratory. In March 2009, the UK Support Programme completed a voluntary financial contribution towards the procurement of LSA equipment from Ingenia Technology. Ingenia Technology worked directly with the Agency during the following year, supplying two laboratory LSA instruments and a portable scanner for evaluation at the Seals

Laboratory. The performance of the instruments was generally satisfactory, although difficulties were encountered in reading the serial numbers engraved on the seals when using the in-built character recognition software, particularly in the case of mechanically deformed or corroded seals.

Summary Report on Activities in 2010/2011

Ingenia Technology continued to work directly with the Agency, so that this task was effectively on standby from a UK Support Programme perspective. The use of a 2D barcode on the seals was proposed as a solution to the difficulties encountered in reading serial numbers, and the Agency awaited implementation at the year-end. Meanwhile, work commenced at the General Physics Institute of Moscow on a vulnerability assessment of the equipment.

Task Area E11 - Technical Documentation

The UKSP provides assistance to the Department of Safeguards through the preparation of technical manuals and procedures for NDA instrumentation used by safeguards inspectors. This work has been undertaken by staff from Canberra-UK Ltd since 1996.

Task E11 - Technical Manuals and Procedures for Safeguards Instrumentation

IAEA SP-1 No:	08/TAU-001	**UK Sub-contractor:**	Canberra UK Ltd
IAEA SPRICS No:	UK A01729	**UK Task Manager:**	C Wilkins
IAEA Task Officer:	H Klein		

Background to Task

The Agency requires documentation to a standard format for safeguards instrumentation, including a Reference Manual for Instrumentation and a Checklist Procedure. Task UK A01729 involves re-writing the documentation for existing equipment in the required format and producing documentation for new equipment or existing equipment that has updated software.

In response to an earlier Agency Task Proposal, the contractor prepared documentation for the Candu Spent Fuel Bundle Verification Basket (CBVB); the Inventory Sample Counter (INVS); the Passive Neutron Coincidence Collar Detector (PNCL); the Fork Detector Irradiated Fuel Measurement System (FDET); and the Fresh MOX Attribute Tester (FMAT). This work was completed during 2007, and a new Task Proposal, for the preparation of further Reference Manuals and Checklist Procedures, was accepted by the UK Support Programme in March 2008. Work subsequently proceeded with documentation for the Active Well Coincidence Counter (AWCC) and High-Level Coincidence Counter (HLCC) instruments.

Summary Report on Activities in 2010/2011

Work commenced in 2010 on the preparation of documents for the new Triangular Load Cell (500kg), developed for the Agency by Mettler-Toledo. Drafts of the three documents requested by the Agency – a Reference Manual, Checklist Procedure for uranium hexafluoride cylinder weighing, and Maintenance Procedure for on-site calibration – were completed and passed to the Agency for review in August 2010. Comments on the draft documents were received back from the Agency, and used in the preparation of final versions that were submitted to the Task Officer in October 2010.

Two additional instruments were identified by the Agency that required documentation updates:

- ATOMTEX Backpack Radiation Monitor; and
- ICx Raider.

Canberra's technical author visited the Agency in February 2011, to obtain further information and agree detailed requirements. A Raider instrument was received on loan from the manufacturer in February 2011 and draft documentation was prepared and delivered to the Agency the following month. A Backpack Radiation Monitor was received on loan from the Agency, and work began on the documentation for this instrument late in the year.

Draft documentation for the Backpack Radiation monitor will be submitted to the Agency for review early in 2011/2012. The UK Support Programme anticipates contributing to the preparation of further documents, in response to requests from the IAEA, during the year.

Task Area E12 – Development of Remote Monitoring Techniques and Equipment

The UK Support Programme provides support to equipment development tasks in areas where its particular expertise or experience in facility application is essential.

Task E12(c) – Upgrade of the Continuous Enrichment Monitoring System (CEMO)

IAEA SP-1 No:	08/TAU-002	**UK Sub-contractor:**	Canberra-UK Ltd
IAEA SPRICS No:	UK A01763	**UK Task Manager:**	M Wormald
IAEA Task Officer:	A Lebrun		

Background to Task

A continuous enrichment monitoring system had previously been developed under the UK Support Programme, based on low energy resolution gamma spectrometry, to deliver qualitative information on gas centrifuge enrichment plant operational status to the Agency via telephone line. Two systems were installed at a gas centrifuge enrichment plant, and these yielded satisfactory results. However, component and architecture obsolescence, and

association with maintenance-intensive ^{109}Cd sources required for pressure correction purposes, made it desirable to develop an improved CEMO system.

The Agency sought assistance, to enhance its capability to monitor continuously uranium enrichment at the cascade output. This was to be achieved through development of an improved CEMO, within an architecture supporting modular implementation at sites of different size and configuration. The UK Support Programme offered contributions both to the preparation and design of equipment, through feedback on the suitability of different options, and the field testing of a demonstration system. The latter would be subject to approval from the ETC Quadripartite Committee.

No other Member State Support Programme offered support to the task and, as a consequence, work within the UK was limited to the preparation of a report describing options for a new CEMO, particularly in the context of reduced maintenance and increased reliability. The draft report, completed in February 2010, concluded that a modified CEMO, designed to use pressure information provided by gauges under the control of the operator, was feasible.

Summary Report on Activities in 2010/2011

The draft report was reviewed during the year, and feedback was consolidated into a revised report by the Task Manager. Additional consideration was given to the cost of developing and manufacturing a modified CEMO. Assumptions were made regarding the specification, including several new features:

- An independently provided total gas pressure, in place of the existing gamma-transmission measurement;
- Greater accuracy in the enrichment data; and
- Data encryption of the measurement head output.

The proposed solution would see most of the hardware and software functions transferred into the measurement head. The cost of detectors and sources was provided March 2011, whilst further information was sought on installation and maintenance costs and the user interface.

Task E12(d) – On-Line Enrichment Monitor (OLEM)

IAEA SP-1 No:	10/TAU-004	**UK Sub-contractor:**	-
IAEA SPRICS No:	UK A01868	**UK Task Manager:**	J Tushingham, NNL
IAEA Task Officer:	L Smith		

Background to Task

The concept of an On-Line Enrichment Monitor (OLEM), enabling a relative enrichment measurement on a header pipe, is seen by the Agency as a powerful and direct way to support the goal of ^{235}U material balance in large-scale enrichment plants. The intention would be to install OLEM at Gas Centrifuge Enrichment Plants to monitor permanently and accurately the uranium enrichment of uranium hexafluoride in unit header pipes through application of passive gamma spectrometric measurements.

Task Proposal 10/TAU-004 was issued by the Agency in March 2010, with the scope to develop the measurement technology and system architecture required to measure and record accurate enrichment of the uranium hexafluoride circulated in the three high pressure unit header pipes (Feed, Product and Tails) of each enrichment unit. A phased approach was foreseen, commencing with system design and cost evaluation against IAEA user requirements. This was to be followed, subject to positive evaluation, by manufacture and subsequent demonstration on an appropriate test bed facility.

Summary Report on Activities in 2010/2011

Urenco, the US Department of Energy (USDoE), Los Alamos National Laboratory and the IAEA have been in discussion for over two years on the development of an OLEM. Subject to suitable arrangements being in place, Urenco agreed to allow a field test of an OLEM of US origin at its Capenhurst enrichment plant. Contractual arrangements were subsequently agreed late in 2010, and USDoE and Agency parties met at Urenco Capenhurst in January 2011, to enable the US side to gather preliminary analysis data at a product header pipe location and to discuss the preliminary results with meeting participants.

The UK Support Programme's contribution to this task will involve support to IAEA activities associated with the project.

Task E12(e) – Support for the Safeguards Systems at the JNFL MOX Fuel Fabrication Plant (J-MOX)

IAEA SP-1 No:	08/OA2-001	**UK Sub-contractor:**	Hybrid Instruments
IAEA SPRICS No:	UK A01887	**UK Task Manager:**	M Joyce
IAEA Task Officer:	A Lavietes		

Background to Task

Neutron detectors play an essential role in NDA systems for plutonium measurement, such as those that will be required to be installed at J-MOX. ^{3}He is widely used in neutron detectors due to its outstanding γ-ray rejection properties. Recently, a world-shortage of ^{3}He has led to renewed interest in systems based upon ^{10}B and even ^{6}Li. However, what all these systems lack is an ability to detect fast neutrons: the neutrons emitted by plutonium must be slowed down to energies in thermal equilibrium with their surroundings.

The Mixed Field Analyser (MFA) produced by Hybrid Instruments, a UK company, is a small, portable instrument that performs real-time neutron/gamma discrimination of scintillator pulses for direct input into a data acquisition and analysis system. The instrument was evaluated by the IAEA, at its Headquarters in Vienna and then at Rokkasho in Japan, and found to offer superior performance to other developments in neutron detection. Whilst the system was an early production version, the system architecture and discrimination algorithm were successfully demonstrated and the system is now ready for a final hardware design and subsequent qualification and deployment for J-MOX.

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Summary Report on Activities in 2010/2011

The UK Support Programme was requested to enable further development of the MFA, and accepted the task in January 2011. During the remainder of the year, Hybrid Instruments largely completed Phase 1 of the task, including:

- providing parallel data processing channels for neutrons and gamma rays;
- achieving performance specifications, including exceeding the required minimum performance specification of 250,000cps (with the unit successfully tested to 3,000,000cps);
- achieving electrical and mechanical specifications; and
- achieving the user interface specification.

Phase 2 was in progress at the end of the year, involving improvements in signal processing and channel to channel timing jitter, operation over an industrial temperature range and the provision of three parallel data processing channels. The Phase 2 units will be physically larger than those of Phase 1, enabling the inclusion of improved heat sinks and user interface circuitry.

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.

Task Area F1 - 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.

Task F1(c) - Consultant - Assistance in ISIS Re-engineering Project

IAEA SP-1 No:	02/IIS-005	**UK Sub-Contractor:**	HTSPE
IAEA SPRICS No:	UK D01412	**UK Task Manager:**	C Lockett
IAEA Task Officer:	R Kirkgoeze		

Background to Task

The requirements of strengthened and integrated safeguards have resulted in many new functions being added to the IAEA Safeguards Information System (ISIS) but, due to resource limitations, there has never been an opportunity to invest in a comprehensive reorganisation or upgrade of the information systems. Consequently, two studies were carried out under the US Support Programme, to develop an overall plan for an ISIS Re-engineering Project (IRP). The IRP plan estimated that the project would cost €27.2 million for equipment and contracts over a 3.5 year period, and require Agency resources to the equivalent of 30 full-time staff for the duration of the project. For these resources, only partial coverage could be provided through the regular budget.

In addition to the provision of significant extrabudgetary contributions, since 2002, the UK Support Programme made available a consultant, responsible for technical advice directly to the IRP project team, reviewing the progress of the project and preparing special reports on the project for the Director-SGIM and DDG-Safeguards.

Summary Report on Activities in 2010/2011

No request for support was received, and consequently no work was undertaken on this task during the year.

The UK's consultant remains available to give ad hoc support to the IRP Project Management Team, provide informal progress reports and highlight any issues to the Director, SGIM.

Task F1(d) – Training on Satellite Imagery Analysis for Safeguards Applications

IAEA SP-1 No:	05/IIS-005	**UK Sub-contractor:**	J E C Cartwright
IAEA SPRICS No:	UK B01655	**UK Task Manager:**	J E C Cartwright
IAEA Task Officer:	K Steinmaus		

Background to Task

Since 2002, the IAEA Department of Safeguards has made use of satellite imagery as an operational tool for safeguards inspections and State Evaluation purposes, and the demand for detailed analytical reports derived from imagery has increased dramatically. The Department wished to develop, in-house, the analytical skills of the present staff of the SIAU and those to be recruited.

Mr Cartwright had fulfilled the role of an imagery analyst, initially as an external consultant and then as a full-time CFE in imagery analysis. During the latter period, he developed a specialised handbook for the imagery analyst, based on the nuclear fuel cycle and all associated facilities and activities. In addition, briefings and presentations to IAEA inspectors and operations staff were undertaken on satellite imagery capabilities and applications to safeguards. For the specific training of imagery analysts, training tutorials, exercises and assessed examination material were compiled. Following the completion of this period of full-time consultancy, and the recruitment of additional imagery analysts by the Agency, there was a continuing requirement for periodic support to develop fully the potential capabilities of newly recruited imagery analysts and operations staff. From April 2006, Mr Cartwright supported the work of the Agency in the periodic training of both imagery analysts and safeguards inspectors.

Summary Report of Activities in 2010/2011

In November 2010, the UK Support Programme's satellite imagery training consultant contributed to the training of IAEA inspectors during two Satellite Imagery Awareness courses, co-sponsored by the Canadian and Swedish Support Programmes. He gave presentations on geographical location systems and specific applications of satellite imagery of relevance to safeguards, in addition to providing support to course exercises, discussions and evaluations.

Two weeks of specialised nuclear fuel cycle imagery analysis training were provided in March 2011. Training in the first week delivered a condensed but comprehensive nuclear fuel cycle awareness course for Geographical Information Systems (GIS) staff that had recently

joined the SIAU. The personnel who received this training had no previous knowledge of nuclear fuel cycle facilities, installations or processes, so the course was specially designed for the GIS staff with this in mind.

Training in the second week was devoted principally to refresher training on specifically requested nuclear fuel cycle subjects, exclusively for SIAU imagery analysts. Tentatively, similar training was requested for November 2011.

Task F1(e) – Expert: Satellite Imagery/Geospatial Analyst

IAEA SP-1 No:	08/ICA-010	**UK Sub-contractor:**	M Flory
IAEA SPRICS No:	UK D01794	**UK Task Manager:**	J Tushingham, NNL
IAEA Task Officer:	K Steinmaus		

Background to Task

In order to respond effectively to increasing demands for imagery-driven products and services, the SIAU needs to maintain and grow its current analytical capabilities. CFEs are required in the areas of satellite imagery and geospatial analysis, to supplement in-house expertise, to analyse commercial satellite imagery and related geospatial information, and to contribute to the enhancement and automation of analytical processes within the Unit.

During 2008, the Agency approached a number of Member State Support Programmes, seeking the nomination of imagery experts for two-year posts within the SIAU. The Agency accepted the UK Support Programme's nomination of a candidate for the position of satellite imagery cost-free expert in January 2009, and an extrabudgetary voluntary contribution, equivalent to the costs associated with the first year of employment of the expert by the Agency, was made the following month. The nominated CFE commenced work with the Agency in September 2009.

Summary Report of Activities in 2010/2011

The UKSP-sponsored imagery analyst completed his first year with the Agency, and commenced a second year working within the SIAU. During this period, he continued to gain familiarity with the workflow within the SIAU, and the production of imagery analysis reports in support of safeguards monitoring and verification activities. He authored several reports, suggesting process improvements based on his experience as an imagery analyst, whilst working closely with Agency staff in operations and evaluation divisions. He participated in training and site awareness visits, to maintain and develop relevant skills and expertise, and developed additional training materials in support of SIAU and other staff. These included:

- organising and annotating training materials for Nuclear Fuel Cycle Training Programme Parts I & II;
- initiating and working on a project to update and formalise standard operating procedures for the production of SIAU reports and illustrations; and
- authoring and presenting a satellite imagery briefing to prepare inspectors for Complementary Access training.

The imagery analyst's duties will extend into a third year, and an extrabudgetary contribution to support the third year's activity was made to the Agency at the end of the 2010/2011 financial year.

Task F1(f) – Nuclear Fuel Cycle Specialist Assistance

IAEA SP-1 No:	09/ICA-004	**UK Sub-contractor:**	Various
IAEA SPRICS No:	UK D01819	**UK Task Manager:**	J Tushingham, NNL
IAEA Task Officer:	S Robb		

Background to Task

The SIAU, within SGIM, requires technical support from specialists in the nuclear fuel cycle, to assist on priority imagery analysis tasks to complement or supplement in-house expertise. This task was accepted in order that the UK might provide such support on an ad-hoc basis, in response to specific requests.

Following acceptance of the task, it became apparent that there was a wider requirement, within the Department of Safeguards as a whole, for technical support to the review and assessment of information from a variety of sources including, but not limited to, satellite imagery. The scope of the task was subsequently expanded in order to accommodate this requirement.

Summary Report of Activities in 2010/2011

During the year, the UK Support Programme provided expert assistance in three areas. This work was ongoing at the end of the year.

SRDP REPORTS PUBLISHED OR IN PREPARATION DURING 2010/2011

SRDP Reports Published or In Preparation during 2010/2011

A5(h) **SRDP-R305** "Review of Air Particulate Sampling for Potential Application in Safeguards", K W Nicholson. (Draft)

B1(t) **SRDP-R306** "Use of the IAEA Nuclear Material Network of Analytical Laboratories", J W A Tushingham. (Issued November 2010)

B1(v) **SRDP-R308** "A Comparison of Standard SIMS, Large-Geometry SIMS and SEM-EDX Analysis of Selected Environmental Swipe Samples", A J Pidduck, M R Houlton, G M Williams and P O Jackson. (In preparation)

E12(c) **SRDP-R304** "A Study of options for Continuous Enrichment Monitors for use in Nuclear Safeguards of Gas Centrifuge Enrichment Plants", M Wormald. (Draft)

SRDP-PR30 "Report on the Activities and Progress during the Period 1 April 2009 to 31 March 2010", J W A Tushingham. (Issued September 2010)

ABBREVIATIONS

Abbreviation	Term
AGR	Advanced Gas-cooled Reactor
AWE	Atomic Weapons Establishment
BNFL	British Nuclear Fuels Limited
BWR	Boiling Water Reactor
CANDU	Canadian Deuterium Uranium Reactor
CEMO	Continuous Enrichment Monitor
CFE	Cost Free Expert
DA	Destructive Analysis
DDG	Deputy Director General
DECC	Department of Energy and Climate Change
DGEner	Directorate General for Energy of the European Commission
DGTrEn	Directorate General for Transport and Energy of the European Commission
DIE/V	Design Information Evaluation/Verification
DIQ	Design Information Questionnaire
DIV	Design Information Verification
EC	European Commission
ECAS	Enhancing Capabilities of the Safeguards Analytical Services
ETC	Enrichment Technology Company
EURRP	Enriched Uranium Residues Recovery Plant
FFP	Fuel Fabrication Plant
FISPIN	A Fuel Inventory Code
FT-TIMS	Fission Track-Thermal Ionisation Mass Spectrometry
GIS	Geographical Information System
GPS	Global Positioning System
GUI	Graphic User Interface
HEU	High-Enriched Uranium
HIFAR	High Flux Australian Reactor
HWR	Heavy Water Reactor
IAEA	International Atomic Energy Agency
IM	Ion Microprobe
INFCIRC	IAEA Information Circular
I/O	Input/Output
IRP	ISIS Re-engineering Project
ISIS	IAEA Safeguards Information System
J-MOX	Japanese Mixed Oxide facility
KCL	King's College, London
LEU	Low-Enriched Uranium
LFUA	Limited Frequency Unannounced Access
LG-SIMS	Large Geometry-Secondary Ion Mass Spectrometer
LIBS	Laser-Induced Breakdown Spectroscopy
LOF	Location Outside Facility
LSA	Laser Surface Authentication
MFA	Mixed Field Analyser
MOX	Mixed Oxide
MTR	Materials Test Reactor

NDA	Non-Destructive Analysis
NMCA	Nuclear Material Control and Accountancy
NML	Nuclear Material Laboratory
NNL	National Nuclear Laboratory
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
NRTA	Near Real Time Accountancy
NWAL	Network of Analytical Laboratories
OLEM	On-Line Enrichment Monitor
PCDF	Plutonium Conversion Demonstration Facility, Tokai
PIV	Physical Inventory Verification
PWR	Pressurised Water Reactor
R&D	Research and Development
RAE	Resistive Anode Encoder
RICC	Regional Information Collection Centre
RRP	Rokkasho Reprocessing Plant
SAL	IAEA Safeguards Analytical Laboratory
SEM	Scanning Electron Microscopy
SGIM	IAEA Safeguards Division of Information Management
SIAU	IAEA Satellite Imagery Analysis Unit
SIMS	Secondary Ion Mass Spectrometry
SMES	Solution Monitoring Evaluation System
TAMES	Tank Monitoring Evaluation System
THORP	Thermal Oxide Reprocessing Plant
TIMS	Thermal Ionisation Mass Spectrometry
TRP	Tokai Reprocessing Plant
UK	United Kingdom
UKSP	United Kingdom Support Programme
URL	Uniform Resource Locator
US	United States of America
USDoE	US Department of Energy
WAES	Wide Area Environmental Sampling
WIMS	Winfrith Improved Multigroup Scheme, a neutronics code
XML	Extensible Markup Language

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