STR-371

# Development and Implementation Support Programme for Nuclear Verification 2012–2013

IAEA
International Atomic Energy Agency

# Foreword

To be better prepared for future challenges and opportunities, in August 2010 the Department of Safeguards completed its *Long-Term Strategic Plan (2012-2023)*. One of our immediate priorities is to evolve safeguards implementation to be more focused on areas of concern, adaptable to the changing environment and objectives based – in other words, we want to implement smarter safeguards.

Our approach, based on an evolution of the State-level concept, will make use of all of the information available to us, be results oriented, supported by transparent and consistently applied processes and judged against our overall aim – to deter the proliferation of nuclear weapons.

We want the key elements of these changes to be in place by the end of 2012, with full implementation in 2014. For this to happen we will need the support of all our stakeholders. Nuclear non-proliferation is a collective global effort and to succeed the international community needs to works together. In that context, we will continue to rely on the invaluable expertise of Member States and on their assistance in keeping us abreast of the latest verification technologies and techniques.

To meet its near-term development objectives and to support the implementation of its verification activities, the IAEA needs a properly-structured, comprehensive and well-funded development and implementation support programme. To this end, the Department has produced this document describing the *Development and Implementation Support Programme for Nuclear Verification 2012–2013*. It aims to provide a clear vision of our requirements to Member States, and to facilitate the mobilisation of resources within Member State Support Programmes.

We are determined to vigorously pursue the change process we have embarked upon in order to deliver more efficient and effective safeguards. I call on all concerned to join us in our efforts and support this important objective.

Herman M. G. Nackaerts
Deputy Director General
Head of the Department of Safeguards

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# Introduction to the Development and Implementation Support Programme for Nuclear Verification, 2012–2013

The purpose of the Biennial Development and Implementation Support (D&IS) Programme for Nuclear Verification is to assist the IAEA's Department of Safeguards meet its short term development objectives and to support the implementation of its verification activities in a manner which is effective, efficient and encourages innovation and excellence.

In preparing the D&IS Programme, the Department has worked to identify, review and coordinate the management of all of its short term D&IS activities. The resources required to implement the D&IS Programme come from the Department of Safeguards itself, Member State Support Programmes (MSSPs) and from other extra-budgetary contributions. The implementation of the programme would not be possible without the transfer of technology, funds and expertise that are provided through the MSSP mechanism. The biennial programme illustrates the scope and diversity of the Department's activities and provides a better understanding of where assistance is needed.

## D&IS PROGRAMME OBJECTIVES

The D&IS Programme aims to improve and sustain the practice and methods utilized in the Department of Safeguards, rather than pursue advances in the basic scientific foundation for a specific project. This application-based programme is driven by Departmental strategic needs and builds upon the basic scientific information, advances in technology and research results made available to the Department by Member States, as well as the experience and requirements associated with specific safeguards implementation needs or operating conditions. Therefore it is positioned at the meeting point of a top-down needs analysis and a bottom-up identification and selection of verification and detection technologies and approaches needed in support of future safeguards implementation. As a combination of this internal needs-driven specification process and external developments, with input from Member States and all of its stakeholders, the IAEA's Department of Safeguards has prepared its D&IS Programme for the biennial period 2012–2013 to refine its strategic focus areas, define key objectives and prioritize activities in the context of its total work portfolio. During this planning exercise, the Department paid special attention to the coordination and cross-referencing of D&IS activities between projects. Special emphasis was put on the full integration of the D&IS Programme into the strategic planning framework to ensure consistency between the long, medium and short term activities. Also important was the prioritization of activities within the D&IS Programme in order to provide enhanced visibility for the respective technical areas, to facilitate the mobilization of MSSP and internal resources, and to augment the effectiveness and efficiency of the implementation of the D&IS Programme.

The objective of the D&IS Programme is to define and describe development and implementation support activities planned for the 2012–2013 biennium, in order to achieve the long-term directions for R&D supporting the implementation of the Departmental strategies identified in the Long-Term Strategic Plan, 2012–2023. The D&IS Programme has been prepared in accordance with the Departmental Long-Term Strategic Plan, the IAEA Medium-Term Strategy, 2012–2017[1], and the Departmental Long-Term R&D Plan, 2012–2023[2]. In particular, the structural elements of each individual D&IS project plan developed within this D&IS Programme are derived from the Long-Term R&D Plan, 2012–2023. Each project manager identified the Departmental strategies supported by his/her D&IS project; developed or confirmed his/her strategic vision for the project and formulated it under the project's long-term direction(s), consistent with the long-term directions for R&D defined by the Long-Term R&D Plan, 2012–2023; and identified key objectives – and activities to achieve them – for the 2012-13 biennium.

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

## DEPARTMENTAL STRATEGIC PLANNING FRAMEWORK

In 2008 the IAEA's Department of Safeguards initiated a process for long-range strategic planning, which resulted in a global framework enabling the Department to perform strategic planning over the short (2 years), medium (6 years) and long term (12 years). That process resulted, among other things, in a number of documents:

- The Long-Term Strategic Plan, 2012–2023, completed in August 2010, identifies the following three Departmental Strategic Objectives:

  1. *Deter the proliferation of nuclear weapons, by detecting early the misuse of nuclear material or technology, and by providing credible assurances that States are honouring their safeguards obligations.*
  2. *Contribute to nuclear arms control and disarmament, by responding to requests for verification and other technical assistance associated with related agreements and arrangements.*
  3. *Continually improve and optimize departmental operations and capabilities to effectively carry out the IAEA's verification mission.*

  The document also provides the strategic context and issues facing the Department; it describes the Departmental overall strategy, which is further detailed in 9 strategies. Each strategy is characterized by long-term directions to be pursued over the 12-year duration of the plan and related expected outcomes.
- The Implementation Guide of the Long-Term Strategic Plan proposes to managers actions to be implemented over the first 6 years of the plan under each of the 9 strategies.
- The verification chapter of the IAEA Medium Term Strategy (MTS) was developed based on input taken directly from the Long-Term Strategic Plan.
- The Long-Term R&D Plan, 2012–2023 supports the implementation of relevant strategies of the Long-Term Strategic Plan; it provides long-term directions for R&D that should be pursued over 12 years, and activities to be implemented through 'Projects' within the first 6 years of the plan.
- The D&IS Programme for Nuclear Verification, 2012–2013 was developed consistent with the strategic planning documents mentioned above.

While the D&IS Programme for Nuclear Verification is to be reviewed and updated every 2 years, the Departmental methodology for strategic planning requires a review and update of the Long-Term Strategic Plan, its Implementation Guide, and the Long-Term R&D Plan after 6 years. This is intended to ensure that possible external environment changes that may affect the Department are appropriately taken into account when preparing input for the next IAEA MTS, which is also reviewed on a 6-year cycle.

## D&IS PROGRAMME SCOPE

The D&IS Programme addresses safeguards development and implementation activities funded by MSSPs and by the IAEA's regular budget. The programme's development and implementation activities aim at:

- Continual improvement – those efforts addressing improvements to the efficiency and effectiveness of the Department's processes, equipment/systems, tools, concepts and approaches, and information acquisition, analysis and evaluation capabilities. The Quality Management System of the Department is included as it serves as a formal mechanism to drive improvement.
- Sustainability and technology enhancement – efforts are focused to sustain core capabilities and technologies. They include the development of new equipment and modification or replacement of obsolete equipment and systems. Training programme implementation is included to sustain and advance knowledge, skills and abilities of the Department's staff.
- New capabilities – the programme seeks to champion studies and demonstrations to address emerging needs. Efforts include the evaluation of Member State technology proposals that address safeguards applications and explore the practical applications of new and novel technologies and analytical capabilities. The programme's goal here is to strive to advance the state-of-the-art in nuclear safeguards technologies.

## D&IS PROGRAMME DEVELOPMENT AND APPROVAL

The coordination of D&IS activities, including the administration of the MSSPs, is carried out by the Division of Concepts and Planning. For 2012–2013 the Department of Safeguards has identified 24 D&IS projects. The projects and their managers are listed on page vii–viii, in the List of D&IS Projects and Project Managers.

The current edition of the D&IS Programme includes a new feature: a selection of expected key achievements, which are specific, measurable, achievable, reasonable and time-bound (SMART), and which reflect the high-priority needs of the Department of Safeguards.

The table on pages ix to xix provides an overview of all D&IS projects long-term directions, key objectives and expected key achievements.

## PROGRAMME AND PROJECT MANAGEMENT

The execution of the programme is performed through activities planned in the 24 D&IS project plans that are described in the main body of this document. For activities involving MSSPs the work is performed through a number of Support Programme tasks managed by IAEA task officers with assistance from the respective MSSP technical points of contact.

Of the 24 projects, three are managed by the Division of Concepts and Planning (SGCP), three by the Office of Analytical Services (SGAS), nine by the Division of Technical and Scientific Services (SGTS), five by the Division of Information Management (SGIM), two by the Office of Information and Communication Services (SGIS), one by the Division of Operations A (SGOA), and one by the Division of Operations C (SGOC).

## SIGNIFICANT CHANGES FOR 2012–2013

The Research and Development Programme for Nuclear Verification was renamed as the Development and Implementation Support Programme for Nuclear Verification as it was recognized that this biennial programme addresses, to a large extent, "development and implementation" instead of actual research. In addition the 24 D&IS projects reflect the organizational changes implemented in the Department of Safeguards in 2010 and 2011.

Activities related to analytical services are now structured under three projects: *SGAS-01 Destructive Analysis of Nuclear Materials*, *SGAS-02 Environmental Sample Analysis Techniques*, and *SGAS-03 Sampling Logistics, Analysis Support and NWAL Coordination*. The SGAS-01 project hosts activities which were managed under project *SGTS-06 Destructive Analysis of Nuclear Materials for Safeguards* until 2010. It focuses on the development and implementation of new and/or strengthened processes supporting laboratory practices related to the destructive analysis of nuclear material samples. This pertains particularly to the Nuclear Material Laboratory (NML), including the On-Site Laboratory in Rokkasho, Japan. SGAS-02 focuses on the development of new and enhanced forensic methods of analysis for environmental samples in order to detect undeclared nuclear materials and activities. These activities were previously managed under the *SGIM-07* project which has been renamed as *Evaluation of Data from Environmental Sampling and Destructive Analysis* in order to reflect its current focus on the evaluation of data produced by the Network of Analytical Laboratories (NWAL), including the IAEA's Safeguards Analytical Laboratory at Seibersdorf. SGAS-03 includes activities related to the development and implementation of new or strengthened processes for sampling logistics, analysis support and coordination of the NWAL, including quality monitoring and control of analytical services across the entire network. These activities were previously managed under projects SGTS-06 and SGIM-07.

In the field of equipment development, the former project *SGTS-07 Improved Techniques and Instruments for Spent Fuel Verification and Monitoring* was merged with the continuing project *SGTS-01 NDA Techniques* in order to combine within a single project plan all the activities devoted to the development, evaluation, implementation,

and enhancement of attended portable and facility-resident non-destructive assay (NDA) instrumentation for the assessment and verification of nuclear material, spent fuel and processed irradiated nuclear material.

In addition, one new D&IS project, *SGTS-15 Technologies for New IAEA Mandates*, was established in order to develop the technical tools needed for current and future verification regimes that the IAEA will possibly implement under new mandates. The project focuses upon technical implementation, and is closely tied to the approaches being considered under the project *SGCP-03 Safeguards Approaches*. Initially, the project will focus on development and implementation needs relevant to the verification measures to be performed in relation to the U.S.-Russia Plutonium Management and Disposition Agreement.

As a consequence of the creation of the new Office of Information and Communication Services (SGIS), the former project SGIM-10 was renamed as *SGIS-02 Information Security*. The project goal is to shift the focus from information technology (IT) security to information security at large. This project provides the IT security policies, guidelines, and infrastructure to other projects, in particular *SGIS-01 Integrated Analysis*. The SGIS-01 project takes over from the former *SGIM-01 Integrated Safeguards Environment (ISE)* and *SGIM-06 Integrated Analysis*; having all the tasks under one project is expected to make the management of the resulting project more coordinated and more efficient.

## PROJECT PLAN STRUCTURE

Each project is described in terms of:

- Introduction describing the scope of the project, with reference to relevant Departmental strategies from the Long-Term Strategic Plan, 2012–2023;
- Overview (executive summary) presenting:
  - Long-term direction(s)
  - high-level vision of the project that is consistent with the long term directions defined in the Long-Term R&D Plan, 2012–2023;
- Key objectives focused on the project scope and the 2012–2013 biennium;
- Activities: detailed description of specific project activities, linked to the key objectives, including recent achievements and next steps, as well as references to active MSSP tasks, outstanding and future task proposals and development activities funded by the regular budget. This description includes cross-references to related projects;
- Key achievement targets – a new feature, showing the most important achievement targets that reflect the Department's high priority needs;
- Active MSSP tasks;
- Proposed and newly planned MSSP task proposals; and
- If applicable, currently active and planned development activities supported through the regular budget.

The project plan structure aims to give the reader a clear view of all the work to be performed within the project and the reasons for any new tasks planned. The tables of tasks within the project show the tasks active at the time of finalizing the project plans. Up to date information can be found in the Support Programmes Information and Communication System (SPRICS).

## REPORTING AND REVIEW

An internal mid-term review is traditionally performed at the end of the first year of the biennium in order to analyse progress made, report on the expected key achievements, highlight positive outcomes or issues

encountered in the course of the activities and propose any project plan adjustment if needed, making the D&IS Programme adaptable and responsive to changes.

A report on the completed biennium is produced and provided to MSSPs. A report on the R&D Programme for Nuclear Verification 2010–2011 will be provided during 2012.

Task officers share task status reports with the MSSPs on a regular basis.

When a task is completed, application reports are submitted to the respective Support Programme to summarize the task objectives, if and how they were met, and highlight the achievements and impact the activity had on IAEA safeguards.

## THE FUTURE

The IAEA's Department of Safeguards will continue to rely mainly on MSSP resources to provide the necessary technology, funds and expertise to meet its research, development and implementation support needs.

With respect to the management of the D&IS Programme, the Department intends to pursue its policy of continual improvement. During future preparation of the D&IS Programme for Nuclear Verification, the Department will continue to streamline the top-down planning and implementation process of the D&IS activities, and demonstrate the full integration of the D&IS Programme under the Departmental long-range strategic planning framework. The D&IS project plans will continue to be defined based on Departmental needs for the long-term expressed in the Long-Term Strategic Plan and the Long-Term R&D Plan while taking into account specific safeguards implementation needs, scientific and technological state-of-the-art, and challenges facing each individual project. The D&IS Programme will also continue to include a prioritization process.

The Department has already taken steps towards further improvement of the day-to-day management of MSSP activities. Development of an updated version of SPRICS is underway. It is planned to be capable of holding all Support Programme data, handling the whole MSSP task workflow from request initiation to completion and evaluation, and providing transparency and new opportunities for collaboration between all parties involved in executing the Department's D&IS Programme.

## ADMINISTRATION OF MEMBER STATE SUPPORT PROGRAMME TASKS

Existing MSSP tasks and new task proposals are included within the activities of each project. These tasks are administered by the Department's Support Programmes Coordination Team (SPCT) in the Section for Strategic Planning and External Coordination, Division of Concepts and Planning, together with MSSP coordinators. The appointed MSSP coordinator is the IAEA's main point of contact with the Member State concerning D&IS projects. Annual and semi-annual meetings with individual Member States are held to review the status of their Support Programmes and progress on specific tasks. A biennial meeting is also held with all MSSP coordinators to discuss the overall programme and other issues of general interest to the MSSPs.

# List of Member State Support Programmes

Argentina (ARG SP)
Australia (AUL SP)
Belgium (BEL SP)
Brazil (BRZ SP)
Canada (CAN SP)
China, People's Republic of (CPR SP)
Czech Republic (CZ SP)
European Commission (EC SP)
Finland (FIN SP)
France (FRA SP)
Germany (GER SP)
Hungary (HUN SP)
Japan (JPN SP)
Netherlands (NET SP)
Republic of Korea (ROK SP)
Republic of South Africa (RSA SP)
Russian Federation (RUS SP)
Spain (ESP SP)
Sweden (SWE SP)
United Kingdom (UK SP)
United States of America (USA SP)

# List of D&IS Project Plans and Project Managers 2012–2013 and Related Projects under the Agency's Programme and Budget 2012–2013

| Project ID | Project Title | Project Manager | Responsible Division | Approving Committee | Programme and Budget 2012–2013 |
|---|---|---|---|---|---|
| SGCP-03 | Safeguards Approaches | Masato Hori | SGCP/CCA | SSP | 4.3.1.1, 4.3.1.5 & 4.1.1.1 |
| SGCP-101 | Quality Management | Haroldo Barroso | SGCP/CPD | SSP | 4.0.0.2 & 4.1.1.2 |
| SGCP-102 | Training | Jean-Maurice Crété | SGCP/CTR | SSP | 4.1.1.3 |
| SGAS-01 | Destructive Analysis of Nuclear Materials | Steven Balsley | SGAS/NML | SSP | 4.1.7.1 |
| SGAS-02 | Environmental Sample Analysis Techniques | David Donohue | SGAS/ESL | SSP | 4.1.7.1 |
| SGAS-03 | Sampling Logistics, Analysis Support and NWAL Coordination | Christian Schmitzer | SGAS/CSS | SSP | 4.1.7.2 |
| SGTS-01 | NDA Techniques | Stefan Jung | SGTS/TND | SSP | 4.3.2.1 & 4.1.6.1 |
| SGTS-02 | Techniques and Instruments for Sealing and Containment Verification | Bernard Wishard | SGTS/TSI | SSP | 4.3.2.2 & 4.1.6.2 |
| SGTS-03 | Surveillance Techniques | Martin Moeslinger | SGTS/TUS | SSP | 4.3.2.2. & 4.1.6.2 |
| SGTS-08 | Novel Technologies in Support of Safeguards Implementation | Julian Whichello | SGTS/TND | SSP | 4.3.2.3 |
| SGTS-11 | Unattended Measurement Techniques | Thierry Pochet | SGTS/TUS | SSP | 4.3.2.2 & 4.1.6.1 |
| SGTS-12 | Verification Techniques for Large Scale Enrichment Plants | Alain Lebrun | SGTS/TND | SSP | 4.3.2.1 & 4.1.6.1 |
| SGTS-13 | Universal NDA Data Acquisition Platform (UNAP) | Mark Pickrell | SGTS/TND | SSP | 4.3.2.1 & 4.1.6.1 |
| SGTS-14 | Remote Monitoring and Data Processing Systems | Jim Regula | SGTS/TSI | SSP | 4.3.2.2 & 4.1.6.2 |
| SGTS-15 | Technologies for New IAEA Verification Mandates | Kenneth Baird | SGTS/TSI | SSP | 4.3.3.4 & 4.2 |
| SGIM-02 | Commercial Satellite Imagery | Karen Steinmaus | SGIM/SIA | SSP | 4.1.5.3 |
| SGIM-03 | Information from Open Sources | Matthew Ferguson | SGIM/SFA | SSP | 4.1.5.3 |
| SGIM-07 | Evaluation of Data from Environmental Sampling and Destructive Analysis | Maxim Penkin | SGIM/NFCA | SSP | 4.1.7.1 |
| SGIM-08 | Statistical Analysis | Claude Norman | SGIM/NFCA | SSP | 4.1.5.4 |
| SGIM-09 | Early Detection of Proliferation Activities through Trade Indicators | Matthew Ferguson | SGIM/SFA | SSP | 4.1.5.3 |
| SGIS-01 | Integrated Analysis | Jean-Michel Becar | SGIS/SSD | SSP | 4.3.1.2, 4.3.1.3 & 4.1.5.1 |
| SGIS-02 | Information Security | Peter Chow | SGIS/SAC | SSP | 4.3.1.4 & 4.1.5.2 |

| Project ID | Project Title | Project Manager | Responsible Division | Approving Committee | Programme and Budget 2012–2013 |
|---|---|---|---|---|---|
| SGOA-02 | Safeguards System for JNFL MOX Fuel Fabrication Plant (J-MOX) | Christophe Creusot | SGOA/OA2 | SSP & JMOX-Project Board | 4.3.3.1 |
| SGOC-01 | Chernobyl | Rastislav Hajdusek | SGOC/OC2 | SSP | 4.3.3.2 |

SSP: Safeguards Strategy and Policy Sub-Committee

# Overview of the long-term directions, key objectives and key achievement targets

| Project | Long-term direction(s) | | |
|---|---|---|---|
| | **Key Objectives** | **Key achievement targets expected during the 2012-2013 biennium** | |
| SGAS-01 Destructive Analysis of Nuclear Materials | **Enhance the NML and OSL Team effectiveness by continuing to explore and develop techniques and capabilities that meet the Department's current and projected analytical needs for the analysis of nuclear material samples.** | | |
| | 1. Advance laboratory capabilities through expert contributions and provision of instrumentation.<br>2. Improve analytical competency through training.<br>3. Improve laboratory proficiency through interlaboratory sample exchanges. | Introduce new U-Pu spike for spent fuel samples in Japan in order to reduce the consumption of rare Pu-certified reference materials. (Key Objective 1) | December 2013 |
| | | Develop and implement analytical training for new laboratory staff members for assignment at the Rokkasho On-Site Laboratory, Japan. (Key Objective 2) | December 2013 |
| | | The Institute of Reference Materials and Measurements (IRMM) to verify and validate current U-Pu spikes used by inspectors in the field. (Key Objective 3) | June 2012 |
| SGAS-02 Environmental Sample Analysis Techniques | **Make improvements in the sensitivity, accuracy and reliability of analytical techniques that provide information of safeguards relevance in the search for undeclared nuclear materials and activities. The project thereby contributes to the identification and use of Science & Technology developments that could support a Safeguards system that is more objectives-based and information-driven, while continuing to explore and develop analytical service capabilities, including forensics-oriented techniques.** | | |
| | 1. Develop and implement methods and techniques to detect signatures of undeclared nuclear materials and activities on environmental samples.<br>2. Develop laboratory tools that support the environmental sampling implementation and enhance the capabilities of the ESL.<br>3. Develop and produce quality control materials to improve the reliability of analytical data reported by SAL and the NWAL. | Implement improved sample preparation method for Large-Geometry Secondary Ion Mass Spectrometer (LG-SIMS). (Key Objective 1) | December 2012 |
| | | Validate and apply the Multi Collector-Inductively-Coupled Plasma Mass Spectrometry (MC-ICP-MS) technique to environmental sample analysis. (Key Objectives 1 and 2) | December 2012 |
| | | Validate and apply the laser-ablation sampling technique to the MC-ICP-MS instrument. Key Objective 2) | December 2013 |
| | | Produce and distribute quality control swipes containing Pu and U/Pu particles. (Key Objective 3) | December 2012 |
| SGAS-03 Sampling Logistics, Analysis Support and NWAL Coordination | **Enhance effectiveness and efficiency of sampling logistics and analytical support by exploring new safeguards sampling capabilities and techniques as well as software tools;**<br>**Continue to expand and coordinate the NWAL (qualification of new laboratories, methods and tools to monitor quality and performance) based on departmental needs to further develop analytical services.** | | |
| | 1. Improve quality monitoring and control of analytical services across the entire NWAL.<br>2. Improve and/or develop new sampling methods.<br>3. Qualify new laboratories to expand the NWAL.<br>4. Develop new software to support the Laboratory Information Management System of the Safeguards laboratories at Seibersdorf. | Enhance quality control throughout the Network of Analytical Laboratories (NWAL). (Key Objective 1): | |
| | | — Evaluate and communicate results of the currently ongoing round-robin laboratory proficiency testing (impurity analysis) – Technical Meeting to take place in May/June 2012 | July 2012 |
| | | — Negotiate a comprehensive proficiency testing programme with NWAL and agree on timelines and sample materials | October 2013 |
| | | Validate and apply improved UF6 sampling methods. (Key Objective 2) | December 2012 |
| | | Harmonize NWAL expansion with the Safeguards long-term strategy. (Key Objective 3): | |
| | | — Define NWAL strategy compliant with Safeguards strategic objectives and long-term directions | November 2012 |
| | | — Renegotiate NWAL contracts in line with NWAL strategy | December 2013 |
| | | Deploy next version of Laboratory Information Management System (LIMS 2.0). (Key Objective 4) | December 2013 |

| Project | Long-term direction(s) | | |
|---|---|---|---|
| | **Key Objectives** | **Key achievement targets expected during the 2012-2013 biennium** | |
| SGCP-03 Safeguards Approaches | **Develop and implement innovative and effective concepts and approaches to continue to meet safeguards challenges.** | | |
| | 1. Further develop the State-level concept to enhance effectiveness and efficiency of the safeguards system.<br>2. Develop new concepts and approaches for verification activities, especially with regard to an enhanced ability to detect undeclared nuclear material and activities.<br>3. Monitor and address any observed deficiencies or vulnerabilities in safeguards approaches.<br>4. Continue to improve safeguards working methods.<br>5. Strengthen cooperation between the IAEA and SSACs.<br>6. Provide advice and assistance for the effective verification of nuclear arms control and reduction agreements, including nuclear disarmament on request. | Issue guidelines and models for State evaluation groups to use in the development and preparation of State-level objectives-based safeguards approaches. (Key Objective 1) | March 2012 |
| | | Update processes maps and finalize procedures needed to implement State-level objectives-based safeguards in 2013. (Key Objective 1) | December 2012 |
| | | Revise other Key existing policies, procedures and guidance documentation to support the implementation of the State-level concept. (Key Objective 1) | December 2013 |
| | | Finalize the draft high level safeguards by design (SBD) principle document and distribute it to Member State Support Programmes for comment. (Key Objective 1) | December 2012 |
| | | Issue updated study of "Long Term Strategic Planning – External Environment". (Key Objective 4) | December 2013 |
| | | Publish guidance to States to improve their performance in the implementation of safeguards (Key Objective 5): | |
| | | — Publish "Guide for States Implementing Comprehensive Safeguards Agreements and Additional Protocols" in both hard copy and in a web-based format: | December 2012 |
| | | — Publish the entire "Safeguards Implementation Series": | December 2013 |
| | | Implement methods and arrangements to enhance cooperation and make full use of the EURATOM system, including data generated by the EC. (Key Objective 5) | December 2012 |
| SGCP-101 Quality Management | **Continue to implement a department-wide quality management system and monitor, analyse, and report on its effectiveness.** | | |
| | 1. Support implementation of the management system.<br>2. Develop, and implement fully, the process-based approach within the management system and continually improve its processes.<br>3. Orient the departmental working culture to support the achievement of the Department's Strategic Objective to continually improve and optimize departmental operations and capabilities to effectively carry out the IAEA's verification mission.<br>4. Improve the management of knowledge, and encourage knowledge sharing.<br>5. Enhance financial transparency and accountability by refining the methodology and process for evaluating the costs of safeguards implementation (e.g. State level approaches, annual implementation plans) and possible new verification missions, including refining the methodology to account for finances used. | Support the Department's transition to a safeguards system that is more objectives-based and information-driven: | |
| | | — Map or re-map the processes related to the implementation of the State-level concept, in line with the Departmental project for "Evolving the State-level Concept", so that the ability to calculate costs of the main safeguards products will be maintained. (Key Objective 2) | June 2013 |
| | | — Revise Key process documentation, such as policies, procedures and guides, to reflect the changes made to the processes during the implementation of the Departmental project for "Evolving the State-level Concept". (Key Objective 2) | December 2013 |
| | | Develop, implement, and routinely monitor on a trial basis performance indicators for 4-6 safeguards processes. (Key Objective 2) | December 2013 |
| | | Consolidate and improve process documentation (i.e. procedures, guides, forms, etc.) for 4-6 main safeguards processes. (Key Objective 2) | December 2013 |
| | | Analyse and improve a second safeguards process (to be selected before the end of 2011) using the knowledge-oriented methodology. (Key Objective 4) | September 2012 |

| Project | Long-term direction(s) | | |
|---|---|---|---|
| | **Key Objectives** | **Key achievement targets expected during the 2012-2013 biennium** | |
| SGCP-102 Training | **Achieve the technical and behavioural competencies of IAEA safeguards staff needed to successfully carry out their assigned safeguards duties and to strengthen SSACs competencies in the fulfilment of their safeguards obligations.** | | |
| | 1. Ensure adequate competence of safeguards staff, and ensure that safeguards-related activities are carried out in an efficient and effective manner, through the provision of appropriate, up-to-date training.<br>2. Maintain and update the relevant and necessary nuclear expertise within the Department.<br>3. Help States to establish and maintain their SSACs and other relevant infrastructure as required by safeguards agreements. | Provide appropriate, up-to-date training (Key Objective 1): | |
| | | — Integrate the State-level concept in all courses: | December 2013 |
| | | — Integrate software Freeze Frame in the training environment: | June 2012 |
| | | — Develop and deliver a virtual reality based training tool: | December 2012 |
| | | — Develop and deliver a soft skills training for State evaluation and activities in the field: | December 2013 |
| | | Help States to establish and maintain their SSACs (Key Objective 3): | |
| | | — Develop and implement a harmonization coordination mechanism between all stakeholders providing training to Member States developing nuclear programmes or for additional protocol implementation: | December 2013 |
| SGIM-02 Commercial Satellite Imagery | **Continuously improve the IAEA's ability to acquire, analyse and exploit satellite imagery and geospatial information to support verification activities.** | | |
| | 1. Continuously improve capability in satellite image processing and analysis of NFC related sites/facilities.<br>2. Enhance geospatial data storage, management, dissemination. | Integrate more tools and methods for better exploitation of SAR data to support day/night and all weather monitoring. (Key Objective 1) | December 2013 |
| | | Implement automated (semi-automated) change detection tools and methods within the satellite imagery exploitation system. (Key Objective 1) | December 2013 |
| | | Deploy the Geospatial Exploitation System in the Division of Information Management, including integrated linkages with other Division resources (i.e. AP data, Open Source data/information, etc.). This effort will begin in January 2012 and continue through 2012. (Key Objective 2) | December 2012 |
| | | Deploy the Geospatial Exploitation System to the Department of Safeguards. This is planned as an iterative effort, and is expected to be complete by December 2013. (Key Objective 2) | December 2013 |
| SGIM-03 Open Sources Analysis | **Enhance the IAEA's ability to collect and analyse information in support of the IAEA's verification mission, in particular with respect to the State evaluation process and support of in-field verification activities.** | | |
| | 1. Optimize information utilization.<br>2. Expand and Diversify Sources.<br>3. Enhance Information Evaluation and Analysis. | Test technologies (in collaboration with SGIS) to increase the efficiency of the collection and management of information. (Key Objective 1) | August 2013 |
| | | Implement technologies that will increase SGIM's ability to collect and manage information from disparate information sources. (Key Objective 1) | December 2013 |
| | | Test, and possibly implement, the Rapid News Service to monitor news and streamline information management processes. (Key Objective 1) | March 2012 |
| | | Implement a scientific and technical literature monitoring system grounded in professional bibliometry and semantic searching. (Key Objective 1) | July 2013 |

| Project | Long-term direction(s) | | |
|---|---|---|---|
| | **Key Objectives** | **Key achievement targets expected during the 2012-2013 biennium** | |
| **SGIM-07 Evaluation of Data from Environmental Sampling and Destructive Analysis** | **Enhance analysis and evaluation capabilities for data obtained by the environmental sampling and destructive analysis of nuclear materials through the further development of existing and acquisition of new tools for more systematic information handling and comprehensive evaluation; and through the constant improvement of the analytical processes aimed at the optimization of the use of available information and expertise.**<br>**Further investigate signatures of nuclear fuel cycle activities and expand their use through ES and DA. Continue to develop processes and tools to maintain the knowledge required for the Department to produce credible conclusions.** | | |
| | 1. Improve the confidence level of conclusions regarding the absence of undeclared nuclear material and activities.<br>2. Improve the confidence level of conclusions regarding the non-diversion of the declared nuclear material, in particular at the bulk-handling facilities.<br>3. Develop capabilities to fingerprint nuclear materials and verify their declared origin. | Deliver the upgraded *MSTAR* uranium isotope enrichment code. (Key Objective 1) | June 2012 |
| | | Deliver the *WIMSD* irradiation code calculations for MOX and thorium fuel. (Key Objective 1) | October 2012 |
| | | Implement the upgrade of the Environmental Sampling Database software. (Key Objective 1) | April 2013 |
| | | Analyse results of the CAN SP study of trace elements behaviour during U conversion. (Key Objective 3) | April 2012 |
| **SGIM-08 Statistical Analysis** | **Review, enhance and develop statistical verification and evaluation methodologies and tools to optimize verification implementation plans and information analysis in support of the State evaluation process.**<br>**Investigate the application of state-of-the-art data analysis methods and computerized tools to the evaluation of a large amount of all-source information in order to support the State evaluation process and draw credible safeguards conclusions.** | | |
| | 1. Develop Near Real Time Accountancy (NRTA) systems for Pu Bulk Handling Facilities.<br>2. Develop a generic software system capable of simulating the material flows and inventories for Pu reprocessing plants, MOX plants and LEU fabrication plants.<br>3. Update and consolidate sampling-plan references and develop an upgraded sampling plan code.<br>4. Investigate the use of advanced mathematical methodologies and computerized tools for safeguards applications. | Implement and validate a Near Real Time Accountancy (NRTA) system for the Pu Bulk Handling Facility at RRP. (Key Objective 1) | 3 months after restart of RRP |
| | | Develop and validate a generic software system capable of simulating the material flows and inventories for Pu reprocessing plants and MOX and LEU fabrication plants. (Key Objective 2) | June 2012 |
| | | Update Safeguards Technical Reports (STR) related to sampling plan design and in-the-field implementation. (Key Objective 3) | December 2012 |

| Project | Long-term direction(s) | | |
|---|---|---|---|
| | **Key Objectives** | **Key achievement targets expected during the 2012-2013 biennium** | |
| **SGIM-09 Early Detection of Proliferation Activities through Trade Indicators** | **Improve analysis of international (covert) trade in nuclear related goods and technology and proliferation networks. Both the activities of State actors and of non-State actors are addressed. This will result in an enhanced capability within the Department of Safeguards to detect early indications for declarable (national) and other (transnational) proliferation activities.** | | |
| | 1. Enable a more efficient use of data.<br>2. Enhance analysis.<br>3. Further diversify information sources.<br>4. Enhance trust/communication with Member States. | Implement a new software system replacing the current Procurement Tracking System (PTS). (Key Objective 1) | December 2013 |
| | | Report on the ability to judge to what extent non-technical indicators analysis can be implemented as part of the State Factors analysis. (Key Objective 2) | June 2013 |
| | | Report on the ability to use risk-based approaches as part of the State Factors analysis. (Key Objective 2) | December 2012 |
| | | Formulate a strategy to successfully pursue outreach to trading hubs. (Key Objective 3) | June 2013 |
| | | Define and utilize new instruments to enhance building partnerships with additional Member States that are willing to provide voluntary information, using the expertise and knowledge of the IAEA. (Key Objective 4) | December 2012 |
| **SGIS-01 Integrated Analysis** | **Enhance information and system integration.**<br>**Support information analysis.** | | |
| | 1. Deliver an integrated, service oriented, analysis-friendly information architecture, as an effective base to collect, evaluate, analyse, structure, secure and disseminate safeguards-relevant information.<br>2. Continue to design and define enhanced information analysis architecture.<br>3. Support a collaborative analytic platform that enhances the Department's ability to draw sound safeguards conclusions.<br>4. Ensure information is appropriately classified and secure (in conjunction with project SGIS-02). | Test and implement new technologies to increase the efficiency of the collection and management of information (Key Objective 1): | |
| | | — Deliver Comprehensive Tracking, Scheduling and Tasking (CTST) v1.0 | February 2012 |
| | | — Test SPRICS 2.0 with the MSSP | March 2012 |
| | | — Test Reference Data Management (RDM) | April 2012 |
| | | — Test State Supplied Data Handling (SSDH) | September 2012 |
| | | Enhance access to diverse information sources (Key Objective 1): | |
| | | — Deliver re-engineering of the Additional Protocol System (APS) | December 2012 |
| | | Enhance collaboration and visualization of all information for each country (Key Objective 2): | December 2013 |
| | | — Deploy Geographical Exploitation System | December 2012 |
| | | — Deliver State File to support the IAEA State Evaluation Groups | February 2012 |
| | | — Integrate Freeze Frame into the Virtual State File | September 2012 |
| | | Implement an analytical laboratory supported by IT tools. (Key Objective 3) | December 2013 |
| | | Test, develop and implement a state-of-the-art enterprise search engine making all safeguards data easily accessible and secure for authorized users on a role-based access for evaluation purposes. (Key Objective 4) | December 2012 |

| Project | Long-term direction(s) | | |
|---|---|---|---|
| | **Key Objectives** | **Key achievement targets expected during the 2012-2013 biennium** | |
| **SGIS-02 Information Security** | **Ensure that security measures in the Department of Safeguards are developed in accordance with 'best practice' in the field of security and incorporate, wherever possible, the latest technology and procedures to combat the developing threats to information and mission. (IT focus)**<br>**Leverage information security to support a Safeguards system that is more objectives-based and information-driven, providing an appropriate balance between the need-to-know and the need-to-share. (Business focus)**<br>**Establish the Department as a centre of excellence within the IAEA for security expertise, and to disseminate its ideas and procedures across the wider house, in accordance with the 'one house approach'. (Process focus)**<br>**Update the information security policies, procedures, and awareness training to ensure staff members in the Department are able to conduct their work securely. (People focus)** | | |
| | 1. Enhance security capabilities to facilitate Safeguards business. (Business focus)<br>2. Refine the Safeguards Information Security Management System. (Process focus)<br>3. Improve prevention, detection, and availability capabilities. (IT-Infrastructure focus)<br>4. Embed security into all phases of software development. (IT-Software focus)<br>5. Heighten security awareness for staff members. (People focus) | Assess the security and practicality of utilizing mobile devices with existing Safeguards processes and applications. (Key Objective 1) | September 2012 |
| | | Implement a secure printing solution to protect the confidentiality and integrity of hard copy data. (Key Objective 1) | December 2012 |
| | | Deploy Network Access Protection to automatically update systems before permitting access to secured resources. (Key Objective 3) | December 2012 |
| | | Develop and demonstrate business continuity to enable the Department to continue normal operations in the event of a major disaster in the data centre at the VIC. (Key Objective 3) | December 2013 |
| | | Build a tier-3 compliant Safeguards Data Centre to meet the growth, security, and availability requirements of the Department. (Key Objective 3) | December 2013 |
| **SGOA-02 Safeguards System for JNFL MOX Fuel Fabrication Plant (J-MOX)** | **Develop and implement effective and efficient safeguards systems by the beginning of the J-MOX plant commercial operation.** | | |
| | 1. Develop an integrated safeguards approach for J-MOX based on the basic elements agreed with Japan and start of the preparation of procedures for implementation.<br>2. Design, test and install safeguards equipment (NDA, Containment / Surveillance) that provide high quality, independent and reliable results.<br>3. Design, test and implement an integrated data collection and evaluation software for J-MOX, using synergies with RRP Information System.<br>4. Establish and implement Design Information Examination/Design Information Verification (DIE/DIV) procedures that assure that the facility is constructed and will operate as declared and that the safeguards approach remains adequate and robust. Carry out DIE/DIV activities from construction to MOX commissioning phases. | Develop and deliver Near Real Time Accountancy (NRTA) concept and tool for J-MOX. (Key Objective 1) | December 2013 |
| | | Development of NDA systems with adequate detectors for gamma and neutron measurement. (Key Objective 2) | December 2013 |
| | | — Finalize testing of the Advanced Material Accountancy Glove Box system (AMGB) prototype | March 2012 |
| | | — Deploy AMGB | December 2013 |
| | | — Finalize Detailed Design of Rods Verification Systems | December 2012 |
| | | Finalize requirements specification and IT architecture of the integrated data collection and evaluation system for J-MOX (JADE) system. (Key Objective 3) | July 2013 |
| | | Finalize first draft of detailed Design Information Verification (DIV) procedures for the construction phase. (Key Objective 4) | July 2013 |

| Project | Long-term direction(s) | | |
|---|---|---|---|
| | **Key Objectives** | **Key achievement targets expected during the 2012-2013 biennium** | |
| SGOC-01 Chernobyl | **Develop and implement effective and efficient safeguards systems at Chernobyl site.** | | |
| | 1. Develop and finalize the safeguards approaches for Chernobyl site.<br>2. Implement equipment and technologies supporting the verification and monitoring of nuclear material at the Chernobyl site.<br>3. Integrate safeguards systems for collection of data and remote monitoring at the Chernobyl site. | Finalize safeguards implementation at "Shelter". (Key Objective 2) | December 2012 |
| | | Implement safeguards at Conditioning facility. (Key Objective 2) | July 2013 |
| | | Develop safeguards approach at New Safe Confinement. (Key Objective 1) | December 2013 |
| SGTS-01 NDA Techniques | **Develop and improve performance and detection capabilities of equipment/methods to verify, detect, check and monitor nuclear material (including irradiated material) and nuclear activities.** | | |
| | 1. Improve detection capability and efficiency of NDA equipment and techniques for safeguards.<br>2. Enhance the capability of detecting undeclared materials and activities by NDA techniques.<br>3. Develop and implement technologies capable of performing partial defect tests on spent fuel assemblies.<br>4. Investigate technologies supporting direct reverification of spent fuel storage casks.<br>5. Develop instruments and methods supporting verification of material resulting from processing of irradiated material.<br>6. Contribute to the development of additional tools for disarmament verification.<br>7. Provide implementation support to Divisions of Operations. | Deliver hand-held radionuclide identification devices to operations. (Key Objective 1) | June 2012 |
| | | Implement the Combined Procedure for Uranium Concentration and Enrichment Assay (COMPUCEA) in Member States outside the European Union. (Key Objective 2) | December 2012 |
| | | Demonstrate extended fuel-type range capability for Digital Cerenkov Viewing Device (DCVD) quantitative Partial Defect Test of spent fuel assemblies. (Key Objective 3) | December 2013 |
| | | Demonstrate Passive Gamma Emission Tomograph (PGET) for Partial Defect Test on spent fuel assemblies. (Key Objective 3) | June 2013 |
| | | Demonstrate Passive Gamma Top Imager for direct re-verification of dry spent fuel storage casks. (Key Objective 4) | October 2013 |

| Project | Long-term direction(s) | | |
|---|---|---|---|
| | **Key Objectives** | **Key achievement targets expected during the 2012-2013 biennium** | |
| **SGTS-02 Techniques and Instruments for Sealing and Containment Verification** | **Develop and provide implementation support for sealing systems and containment verification instruments, identify areas where improved techniques and capabilities are required, systematically plan for the next generation of seals, and investigate the applicability of new and evolving technologies** | | |
| | 1. Modernize and sustain sealing systems used in safeguards and increase their tamper resistance.<br>2. Develop and maintain sealing systems for facility specific application.<br>3. Improve and expand techniques, tools and procedures for containment verification.<br>4. Enhance system integration of sealing technologies with surveillance and non-destructive assay (NDA) systems and software.<br>5. Research, develop, and implement new and novel technologies that can be applied for secure sealing and containment verification systems.<br>6. Expand and improve capabilities to identify and mitigate the vulnerabilities of safeguards equipment and data derived from equipment.<br>7. Act as focal point to increase data security of SG equipment. | Built and assess 1000 glass seal prototypes designed to replace the CAPS metal seal. (Key Objective 1) | June 2013 |
| | | Develop and deliver the upgrade of the new iCobra reader so that it will verify the Electronic Optical Sealing System (EOSS), making this an all-in-one reader. (Key Objective 1) | September 2013 |
| | | Complete Remote Monitoring Sealing Array (RMSA) Vulnerability Assessment and finalize RMSA commercialization. (Key Objective 1) | November 2013 |
| | | Finalize Vulnerability Assessment and assess usefulness of Laser Surface Mapping for Containment Verification (LMCV) with dry storage canisters. (Key Objective 3) | December 2012 |
| **SGTS-03 Surveillance Techniques** | **Provide advanced surveillance equipment and technologies to improve and optimize departmental operations and capabilities to effectively carry out the IAEA's safeguards mission.** | | |
| | 1. Develop, test, authorize and implement advanced surveillance equipment.<br>2. Enhance surveillance data processing and review tools to reduce the burden on SG inspectors and analysis.<br>3. Develop and implement 3D imaging that would allow improved inspector vision and enhanced pattern recognition.<br>4. Enhance surveillance capabilities by further developing non-video based systems (laser, radar, etc.) for both imaging and design/containment verification application.<br>5. Expand current capabilities by extending surveillance beyond the visible light spectrum. | Develop and deliver an analog (CCTV) interface for the Next Generation Surveillance System (NGSS) camera in order to use special radiation hardened and/or operator owned cameras. (Key Objective 1) | December 2012 |
| | | Develop and deliver an underwater housing for the NGSS camera. (Key Objective 1) | September 2012 |
| | | Develop and deliver an NGSS camera based electronic sealing system to replace the obsolete VMOS. VMOS was designed to allow the application or removal of IAEA electronic seals by a facility operator without the physical presence of SG inspectors. (Key Objective 1) | March 2013 |
| | | Develop and deliver a 3D Camera to augment standard 2D surveillance with spatial information in order to better protect against image falsification. (Key Objective 3) | October 2012 |
| | | Evaluate CALADIOM® Camera Technology to confirm its potential for a significant reduction of the amount of surveillance data presented to SG inspectors for review. The goal is a reduction in the time spent for data analysis and review and the review quality improvement. (Key Objective 2) | March 2013 |
| | | Develop and evaluate a modular surveillance review software tool in order to allow a more efficient integration with other SG sensors, to sustain the surveillance data review platform and to ensure compliance with emerging information security requirements. (Key Objective 2) | June 2013 |

| Project | Long-term direction(s) | | |
|---|---|---|---|
| | **Key Objectives** | **Key achievement targets expected during the 2012-2013 biennium** | |
| SGTS-08 Novel Technologies in Support of Safeguards Implementation | **Continue to build a systematic mechanism to identify emerging and future Safeguards needs, particularly those in regard to early detection of undeclared activities, materials and facilities; identify and analyse gaps in the inspectorate's technical capabilities; identify effective and efficient technology solutions to those needs; and, where required, establish tasks to develop and to evaluate proposed solutions against Safeguards implementation requirements.** | | |
| | 1. Finalize outstanding conceptual prototype development and evaluation tasks.<br>2. Analyse and evaluate novel technologies that have been proposed to meet specific safeguards needs.<br>3. Survey novel technologies and conduct market research and reviews of science and technology publications in novel technological areas. | Complete the following carry-over of tasks from the previous biennium: | |
| | | — Contingent upon the provision of the optically stimulated luminescence equipment from Canada, devise a suitable test plan, undertake required training and carry out laboratory and field evaluation of the instrument. A report shall be made on the outcome (Key Objective 1) | April 2012 |
| | | — With end-user support, and direction, propose and undertake follow up task(s) to GER A 1643 regarding noble gas sampling and monitoring (Key Objective 1) | June 2012 |
| | | Identify, evaluate and report on novel technologies meeting IAEA needs in support of safeguards implementation at geological repositories. (Key Objective 1) | December 2012 |
| | | Identify new hand-held instruments, in order to support Complementary Access inspections. Search through existing manufacturers' listings for hand-held instruments that are predominately commercially available and that can detect the ancillary signs of undeclared nuclear activity. (Key Objective 2) | December 2012 |
| | | Test and qualify at least one new, commercial instrument per year that can directly support the Complementary Access inspection by detecting or identifying a particular indicator for undeclared activities (Key Objective 2) | December 2012 / December 2013 |
| SGTS-11 Unattended Measurements Techniques | **Provide optimized unattended measurement techniques that enhance present safeguards equipment capabilities and techniques for the detection and monitoring of declared and undeclared nuclear material and activities.** | | |
| | 1. Improve reliability, standardization and maintainability.<br>2. Adapt NDA and analytical methods to unattended, remotely monitored operation.<br>3. Expand and enhance data reduction and interpretation software.<br>4. Monitor and evaluate new sensors and methods. | Authorize upgrades in electronics (improved Mobile Unit for Neutron Detection) and data acquisition modules (Next Generation of the Stand-Alone Autonomous Data Acquisition Module (NGAM) and Universal Data Acquisition Platform (UNAP)). (Key Objective 1) | June 2013 |
| | | Deploy standardized front-end electronics for Unattended Monitoring Systems after completing performance and environmental testing. (Key Objective 1) | December 2013 |
| | | Complete field evaluation of On-Line Enrichment Monitor and Unattended Cylinder Verification System for enrichment plant safeguards. (Key Objective 2) | December 2013 |
| | | Authorize enhanced, integrated Irradiated Fuel Monitor Analysis software including the completion of Core Discharge Monitor (CDM) algorithms revision and the integration of CDM and Bundle Counter reporting at the facility level in order to facilitate data analysis. (Key Objective 3) | June 2013 |
| | | Complete evaluation of advanced sensors and methods and authorize the upgrade of the multi-Silo Entrance Gate Monitor. (Key Objective 4) | June 2013 |

| Project | Long-term direction(s) | | |
|---|---|---|---|
| | **Key Objectives** | **Key achievement targets expected during the 2012-2013 biennium** | |
| **SGTS-12 Verification Techniques for Large Scale Enrichment Plants** | **Conceptualize and demonstrate feasibility of a new approach in the use of instrumentation at enrichment plants. In essence, the main long term proposal reverses the continuous operator data capture versus inspection paradigm to maintain safeguards conclusion credibility while securing cost effectiveness. The proposed direction is to capture data from operator systems and continuously secure it in IAEA systems on a systematic basis thus ensuring 100% coverage of the verification. Both announced and unannounced inspections appropriately defined taking into account relevant state factors would be used to obtain a satisfactory level of confidence that the shared data are genuine and authentic.** | | |
| | 1. Demonstrate the feasibility of cost-effective and secured sharing data from operators weighing systems.<br>2. Develop monitors for continuous accurate assay of the enrichment in high pressure take off piping.<br>3. Develop the techniques for attended NDA on UF6 material allowing on-site bias defect analysis.<br>4. Establish the feasibility of unattended measurement stations where all cylinders in and out of the facility would be identified and quantitatively assayed.<br>5. Select and develop the NDA components of such measurement station or alternative solution to quantitatively assay the nature and quantity of uranium in cylinders stored at the facility, or being connected to the process.<br>6. Select and develop the techniques to uniquely identify the cylinders supporting their tracking at facilities including those attached to the process. | Evaluate Data Collected From Operator Systems at Enrichment Plants. (Key Objective 1): First results of the evaluation of the concept of data authentication by analysis of data coherence across the plant and of the development of data evaluation packages able to verify continuously the mass balance at all times will be implemented in support of inspections in 2012. | December 2012 |
| | | Update assessment of the technical feasibility of on-site bias defect analysis on UF6 samples by laser absorption spectrometry or transportable mass spectrometry. (Key Objective 3) | June 2013 |
| **SGTS-13 Universal NDA Data Acquisition Platform (UNAP)** | **Provide a standardized, secure and highly reliable universal NDA data acquisition platform (UNAP) for future NDA systems (except of hand held systems) supporting the verification and monitoring of nuclear material.** | | |
| | 1. Develop the full set of specification for the UNAP system in consultation with NDA instrumentation experts from all principal developers and vendors. (Initial Key Objective, already completed in 2009)<br>2. Design and build a prototype of the UNAP system with operating software.<br>3. Test UNAP prototype to demonstrate specified functionalities and to select the final version for production. | Deliver 12 pre-production UNAP prototypes for evaluation and testing. (Key Objective 2) | March 2012 |
| | | Complete UNAP full field testing and authorize UNAP for safeguards use. (Key Objective 3) | March 2013 |
| | | Project completed. | March 2013 |

| Project | Long-term direction(s) | | |
|---|---|---|---|
| | **Key Objectives** | **Key achievement targets expected during the 2012-2013 biennium** | |
| SGTS-14 Remote Monitoring and Data Processing Systems | **Expand and upgrade Remote Monitoring (RM) software and hardware infrastructure to include new equipment, near real-time data processing, and advanced inspector communications world-wide.** | | |
| | 1. Develop and implement improved technologies for network monitoring of the RM infrastructure.<br>2. Develop advanced communications for future inspector needs.<br>3. Ensure data security and integrity through entire RM process.<br>4. Obtain specific Member State trust in RM security and promote the use of RM.<br>5. Develop enhanced software tools, especially for data acquisition, storage and post-transfer analysis. | Upgrade the current network monitoring system for RM to include the capability to detect critical outages due to provider failures and to quantify these outages for service level agreements. (Key Objective 1) | December 2013 |
| | | Develop advanced communications for future inspector needs, which includes VPN clients for mobile handheld devices and wireless access to SGTS equipment during inspections. (Key Objective 2) | December 2013 |
| | | Perform Vulnerability Assessment of the RM infrastructure and implement recommendations to ensure long-term network security. (Key Objective 3) | December 2012 |
| SGTS-15 Technologies for New IAEA Verification Mandates | **Make ready for implementation instruments and measurement techniques needed to support new IAEA verification mandates.** | | |
| | 1. Identify and develop technologies capable of maintaining Continuity of Knowledge (CoK) of "Designated plutonium" (i.e. Plutonium designated for disposal) as it passes through the lifecycle.<br>2. Develop and validate NDA tools supporting the verification of "Designated plutonium" and "Designated fuel" in particular with regards to requirements of the Plutonium Management and Disposition Agreement (PMDA) on accounting of minor plutonium isotopes.<br>3. Develop and validate power monitoring techniques applicable to fast neutron and light water reactors.<br>4. Develop and implement a methodology to validate core calculations relevant to the burn up verification.<br>5. Explore "substitution pathways" that are relevant to the PMDA.<br>6. Establish appropriate reporting tools to manage state declarations and inspection results that would meet requirements of verifications associated with disarmament initiatives in general and PMDA in particular. | Validate the feasibility of the Pu minor isotopes measurement methods. (Key Objective 2) | December 2012 |
| | | Validate the burn-up calculation method supporting the PMDA burn up criteria verification. (Key Objective 4) | March 2013 |
| | | Identify and characterise possible substitution pathways to the PMDA. (Key Objective 5) | December 2012 |

# Projects

# SGAS-01

## Destructive Analysis of Nuclear Materials

**Project Manager: Steven D. Balsley** **Division: SGAS**

### 1. Introduction

This document describes the plans for developing and implementing new or strengthened processes supporting laboratory practices in SGAS related to the destructive analysis of nuclear material samples for the period 2012–2013. This pertains particularly to the Nuclear Material Laboratory (NML), including the On-Site Laboratory Team (OSL Team) in Rokkasho, Japan. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–20171, and the Long-Term R&D Plan, 2012–20232.

This project supports in particular *Strategy 1 – Building Support for the Non-proliferation Regime, Strategy 2 – Coping with the Workload*, and *Strategy 6 – Managing the Workforce*, of the Long-Term R&D Plan, 2012–2023.

### 2. Overview

The NML including the OSL Team in Rokkasho, Japan has the main responsibility for the processing, analysis and result reporting of nuclear material samples for the Department of Safeguards. It is the mandate of SGAS management to continuously improve analysis quality, to reduce radioactive waste and to operate its laboratories in accordance with established safety and security guidelines. The special nature of nuclear laboratory operations requires that the SGAS-01 project manager stays informed about technological advancements, training opportunities and other research and development prospectives.

The SGAS-01 project plan fits into Strategies 1 and 2 of the Department's Long-Term R&D Plan, 2012-2023, in that the development of the Agency's resources in the area of destructive analysis is consistent with the long-term goals to be prepared for future challenges by continuing to explore and develop analytical service capabilities, including forensics oriented techniques, as well as strengthening laboratory workforce skills. Destructive analysis of nuclear material samples is the backbone of the Agency's efforts to verify the declared nuclear material inventories in bulk handling facilities. Therefore the SGAS-01 project defined its long-term direction as follows: to enhance the NML and OSL Team effectiveness by continuing to explore and develop analytical techniques and capabilities that meet the Department's current and projected needs for the analysis of nuclear material samples. In particular technological improvements will be sought that allow the NML and the OSL Team to process, measure and report results from increasing numbers of nuclear material samples in a timely manner. The quantification of trace metal impurities in uranium materials, the measurement of the minor isotopes of uranium with high precision, and the determination of uranium and plutonium age in certain types of inspection samples are recent examples of techniques and methods that enable the Department to more thoroughly verify declared materials and activities. These activities frame the scope of the SGAS-01 project in the foreseeable future. Within the current scope of the project, nearly all of the requested support has been or is being addressed. The most important unfulfilled request is to assist with disposition of about 60 g of legacy plutonium, which is becoming a critical concern for SGAS management in light of the difficult and increasingly expensive disposal paths for the Agency.

During the last two years, significant achievements were obtained in the development of instruments supporting the independent determination of plutonium for certification of internal laboratory standards in NML, for the quantification of measurement uncertainty following the Guide to the Expression of Uncertainty in Measurement (GUM) of the Bureau International des Poids et Mesures (BIPM), which is the standard being

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

adopted across many analytical laboratories, and for the improvement of the hybrid k-edge densitometry (HKED) measurement system used in Rokkasho Japan by the OSL Team.

As chemical and analytical instrumentation advancements are realized, SGAS-01 shall seek to explore the feasibility of these improvements for implementation in the NML and the OSL, Rokkasho. Clear movement towards more emphasis on chemical and physical attribution factors in nuclear material may dictate new task proposals from within SGAS-01, as will advancements toward the reduction of radioactive waste.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term directions for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023.

As a first step, the long-term direction of the current D&IS project was defined:

***Enhance the NML and OSL Team effectiveness by continuing to explore and develop techniques and capabilities that meet the Department's current and projected analytical needs for the analysis of nuclear material samples.***

In order to support this long-term direction, activities have to be initiated, continued or finalized during the biennium and can be structured under 3 key objectives:

1. *Advance laboratory capabilities through expert contributions and provision of instrumentation.*

   The NML applies sophisticated chemical treatment schemes and makes use of state-of-the-art analytical instrumentation to deliver analytical results to the Department of Safeguards that are fit for intended use. The NML is challenged to meet an increasingly complex set of analytical requirements, both with regard to the standard sample types as well as non-traditional safeguards samples. In this regard, SGAS-01 strives for improvement through expert collaboration and acquisition of specialized instrumentation. Focus areas in the biennium will include uranium and plutonium assay and isotopic determination in nuclear material samples, the determination of impurities in uranium samples, and age determination of uranium samples.

2. *Improve analytical competency through training.*

   Continuous improvement of analytical services in the NML is strongly dependent on the competency of the analytical staff. Training is an important aspect of maintaining a high level of skill and proficiency in NML. In the biennium, SGAS-01 will target specific training for newly recruited staff of the On Site Laboratory in Rokkasho, as well as for the Seibersdorf-based staff of the NML.

3. *Improve laboratory proficiency through interlaboratory sample exchanges.*

   Beyond formal participation in laboratory intercomparison programmes (see SGAS-03), the NML seeks to strengthen the quality of its services through the exchange of well characterized samples with other laboratories. SGAS-01 seeks to fortify its existing laboratory relationships and develop new associations with laboratories outside of the NWAL to strengthen the quality of NML measurement results.

## 4. Activities

Funding for most of the described D&IS activities is foreseen to be provided by Member State Support Programmes (MSSPs) which continue to play a major role in achieving the stated project objectives. The activities to be pursued under each Key Objective are shown below.

*Key Objective 1. Advance laboratory capabilities through expert contributions and provision of instrumentation.*

- The task EC A 1606, "Study on Optimization of a New LSD Spike" will be re-activated in order to explore the boundary conditions for newly developed U-Pu solid spikes, as well as for the testing of a new spike composition and concept proposed by IRMM. The objective of the task is to reduce the amount of precious plutonium certified reference material consumed by JNFL when the Rokkasho Reprocessing Plant becomes commercially active.
- Under task EC A 1832 and FRA A 1858, "Analysis of HALW-Samples Containing Particles" a kick-off meeting with experts is to be planned in Rokkasho in 2011 or 2012. The objective of this work is to quantify the amount of plutonium adsorbed onto undissolved particles in high active liquid waste samples from the Rokkasho Reprocessing Plant. The OSL is unable to fully dissolve such samples because of ruthenium release and subsequent radiological alarms. Although not yet accepted formally (09/OAT-002), the United States Support Programme has expressed interest and will participate in the kick-off meeting.
- Under Task EC F 1642, "Resource requirements for an On-Site Analytical Laboratory", the OSL Team will receive advice from experts on best practices derived from the Institute of Transuranium Elements, Karlsruhe and their experience with the operation of two on-site laboratories within the European Union.
- Under Task USA A 1049, "Controlled Potential Coulometry of 3-5 mg Pu with SRL Coulometer", the NML recently received a completely new electronics package that replaced the existing system, which was more than 10 years old. The new system will provide improved electronics stability and should be easier to maintain.
- Under task USA A 1369, "Enhanced Alternative Nuclear Materials (ANM) Capacity for HKED Software at SAL", refinements to the original software from LANL have been initially tested. The transition of the software from a VAX to a Windows based platform was accomplished by Canberra, and testing is continuing. Fixes and enhancements to the new software will require close cooperation with LANL, users in the European Commission and the United States, as well as with the software vendor. The new software will eventually allow for determination of Np/Pu and Np/U. A related pending task proposal (09/OAT-001) to the United States Support Programme is seeking approval for cooperation with Oak Ridge National Laboratory in parallel with their successful efforts to establish an HKED capability.
- Under task proposal 10/NML-001, the NML is seeking a Member State facility to accept approximately 60 grams of plutonium process solution for final disposition. This effort is consistent with the goal of reducing unnecessary Pu inventory in the NML before operations are transferred to the new NML in 2014.
- As part of the Regular Budget activities, SGTS in cooperation with SGAS and SGIM is in the process of establishing and evaluating COMPUCEA for in-field usage (*Activity #1*). The comprehensive master-plan for establishing COMPUCEA at the IAEA deals with the provision of reference materials (procurement, validation, storage, shipping), creation of instrument hardware and software as well as integration testing and authorizing as field-use equipment, training and transfer of expertise to in-field teams, and finally field testing with associated vulnerability and cost/benefit-analysis. Specific areas of MSSP assistance will be characterized and ultimately formulated as new task proposal(s) in the relevant projects SGTS-01 NDA Techniques, SGAS-01 Destructive Analysis of Nuclear Materials and SGAS-03 Sampling Logistics, Analysis Support and NWAL Coordination (New Task Proposal #1).

- Under objective 1, SGAS-01 foresees support needs in the areas of age determination of uranium materials. This will involve the development of new methods, the development and acquisition of new reference materials and the innovation of new or modified chemical methods and analytical instrumentation.
- Microcalorimetry may represent a technical alternative to traditional destructive analytical techniques for the determination of plutonium content in very small samples. As the technology matures, SGAS-01 may request support investigations of applications to NML.
- Nuclear forensics capabilities for safeguards are expected to become more important to the Department for strengthening facility declarations or verifying the origin of material. In this regard, SGAS-01 will be the vehicle by which the NML acquires new technology, training or other related resources for establishing a nuclear forensics capability consistent with the Department's needs. Specific areas of MSSP assistance will be characterized and ultimately formulated as new task proposal(s).

*Key Objective 2. Improve analytical competency through training.*

- Under Task JPN A 1345 (in coordination with project SGCP-102 Training), "Technical Support for the Joint IAEA/Japan On-Site Analytical Laboratory at the Rokkasho Reprocessing Plant", training of inspector analysts is facilitated in various Japanese nuclear laboratories. This is most important for new inspector analysts.
- Under Task EC A 1391 (in coordination with project SGCP-102 Training), "Support for the Rokkasho On-Site Laboratory", important training for new OSL staff is provided at ITU Karlsruhe regarding the HKED system, and an important opportunity for the OSL Team is made to interact with ITU staff experienced at working in the EC on-site laboratories.
- Under task FRA B 1562 in SGOA-02 (in coordination with project SGCP-102 Training), "Familiarization Visit to La Hague for RRP Inspectors", new inspector analysts for the On-Site Laboratory will undergo site specific training at the French reprocessing plant.
- Under objective 2, new training needs will be identified in the areas of sample preparation and treatment for ICP-MS, in coordination with project SGCP-102 Training.

*Key Objective 3. Improve laboratory proficiency through interlaboratory sample exchanges.*

- Under Task EC A 1806, "Verification of Mixed U-Pu Spikes", the NML and the JRC Institute of Reference Materials and Measurements (IRMM) exchange dried spikes for mutual verification of make-up values. This task recognizes a process that started between the labs some years ago, and has now matured to a formal level. The benefit to both labs has been recognized in terms of improved quality control and assurance measures.
- Under Task JPN A 1795, "Characterization of Japanese LSD Spikes", the IAEA facilitated the distribution of samples and provided analysis results to JAEA in support of their program to produce a U-Pu spike using a domestic plutonium source. The task was successful and helped identify a weakness in the NML reporting process that was subsequently corrected.
- Future exchanges of well characterized nuclear material, internally certified material, or material produced and certified exclusively for NML will be the focus of a system of strengthened relationships between NML and other laboratories within and outside the NWAL. Member States may be asked to support their national laboratories in these endeavours.

### Key achievement targets

- Introduce new U-Pu spike for spent fuel samples in Japan in order to reduce the consumption of rare Pu-certified reference materials (Key Objective 1): December 2013.

- Develop and implement analytical training for new laboratory staff members for assignment at the Rokkasho On-Site Laboratory, Japan (Key Objective 2): December 2013.
- The Institute of Reference Materials and Measurements (IRMM) to verify and validate current U-Pu spikes used by inspectors in the field (Key Objective 3): June 2012.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### *5.1. Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| EC | A 1391 | Support for the Rokkasho On-Site Analytical Laboratory | Ongoing task |
| EC | A 1606 | Study on Optimization of a New LSD Spike | Desired completion: end 2012 |
| EC | A 1806 | Verification of Mixed U-Pu Spikes | Ongoing task |
| EC | A 1832 | Analysis of HALW-Samples Containing Particles | Desired completion: end 2012 |
| FRA | A 1858 | | Desired completion: end 2012 |
| EC | F 1642 | Resource Requirements for an On-Site Analytical Laboratory | Desired completion: end 2011 |
| JPN | A 1345 | Technical Support for the Joint IAEA/Japan On-site Analytical Laboratory at the Rokkasho Reprocessing Plant (JU-01) | Desired completion: end 2012 |
| JPN | A 1795 | Characterization of Japanese LSD Spikes | Desired completion: end 2011 |
| USA | A 1049 | Controlled Potential Coulometry of 3-5 mg Pu with SRL Coulometer (A218) | Ongoing task |
| USA | A 1369 | Enhanced ANM Capability for HKED Software at SAL (A.250.02) | Desired completion: end 2011 |

### *5.2. Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 09/OAT-001 | Support for HKED Hardware and Software Testing and Training | Outstanding with US (2009) |
| 09/OAT-002 | Analysis of HALW-Samples Containing Particles | Outstanding with JPN and US (2009) |
| 10/NML-001 | Disposal of Legacy Pu Waste from the Nuclear Material Laboratory (former Safeguards Analytical Laboratory) | Outstanding with RUS and UK (2010) |

### *5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | Evaluation of the COMPUCEA technique for IAEA usage |

Figure 1: Controlled potential coulometer in NML is used to independently verify the plutonium content of in-house standards.

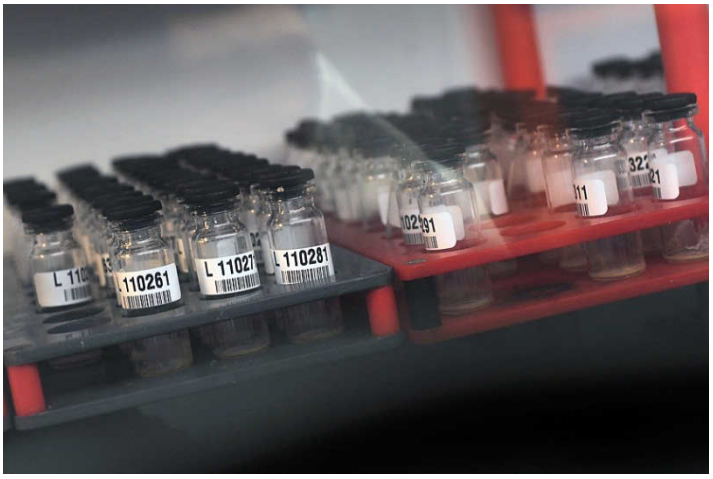


Figure 2: Large size dried spikes produced in NML for making U and Pu determinations from spent fuel samples.

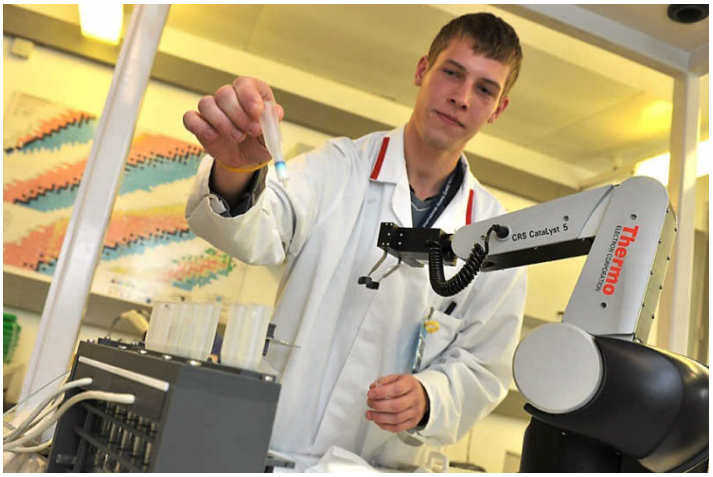


Figure 3: Robot arm system used in NML for automated processing of highly radioactive spent fuel samples.

# SGAS-02

## Environmental Sample Analysis Techniques

**Project Manager: David Donohue** **Division: SGAS**

### 1. Introduction

This document describes the plans for developing and implementing advanced analytical methods and quality control materials for the analysis of environmental samples within the Department of Safeguards for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building Support to the Non-Proliferation Regime*, *Strategy 2 – Coping with the Workload*, *Strategy 4 – Taking on New Mandates* and *Strategy 6 – Managing the Workforce* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

The project aims to develop new and enhanced forensic analytical methods of analysis for environmental samples in order to detect undeclared nuclear material and activities. All aspects of environmental sample processing are affected: development of improved sampling equipment and procedures, development of more sensitive screening methods and more accurate bulk and particle analysis methods, development of better data evaluation methods and uncertainty estimation and development of quality control materials to check the performance of analytical laboratories. The ultimate goal is to provide improved information to SG Operations for drawing conclusions about the absence of undeclared nuclear material and activities.

This project supports the IAEA Medium Term Strategy 2012–2017, in particular by strengthening the IAEA's capability of early detection of possible misuse of nuclear material and/or technology and by supporting the goal of strengthening the Agency's analytical capabilities of the Safeguards Analytical Laboratories. The project is consistent with Strategy 1 of the Safeguards Department Long-Term Strategic Plan 2012-2023 for building support for the non-proliferation regime through further enhancement of analytical capabilities. The project plan is in line with the Department of Safeguards Long-Term R&D Plan 2012-2023.

The improvement of analytical methods and techniques for the analysis of environmental samples will provide the Department of Safeguards with high-quality information to aid the drawing of safeguards conclusions, especially about the presence or absence of undeclared nuclear material and activities. Detection of uranium or plutonium, either in the whole sample (so-called bulk analysis) or in the form of micrometre-sized particles, allows early detection of materials such as highly-enriched uranium (HEU) or activities such as separation of plutonium which might be indicators of a non-peaceful nuclear activity. The probability of detecting an undeclared activity or the presence of an undeclared material is based on the release scenario and amount and on the probability of an inspector collecting this signature on an environmental sample some distance away either in space or time. Lower detection limits for elements of interest such as U, Pu or fission and activation products will translate into earlier and more reliable detection of undeclared material and activities.

Challenges to be addressed in the near future include: to lower detection limits for Pu in swipe samples to below one femtogram, to more reliably find and measure U or Pu particles in the presence of an excess of background material by scanning electron microscopy (SEM) or secondary ion mass spectrometry (SIMS), to improve the sensitivity of screening methods such as gamma spectrometry or X-ray fluorescence spectrometry for the detection and localization of traces of nuclear material on swipe samples, and to develop and produce

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

quality control materials to assess the performance of analytical laboratories that measure environmental samples, thus improving the reliability of their data and the robustness of safeguards conclusions drawn therefrom. In addition, new analytical techniques are being developed all the time and the Agency must keep abreast of such developments. One such method is laser-ablation combined with inductively-coupled plasma mass spectrometry (LA-ICP-MS) for the measurement of large numbers of particles and the isotopic analysis of U or Pu-containing particles identified by other methods such as SEM.

The structuring of this project is based on identifying needs by discussion with safeguards data evaluators, inspectors and outside experts. From such discussions, priorities for new developments in forensic analysis methods or improvements in existing techniques are derived, along with the associated measures of performance that must be met. This information is then turned into task proposals for the Member State Support Programmes or assigned to IAEA staff as part of their duties funded under the Regular Budget (RB). New instrumentation is procured from Regular Budget or Extra-Budgetary sources and laboratory facilities to house them are provided. Training of IAEA staff is also carried out under the MSSPs or other means in order to continuously improve the quality of measurements at the Safeguards Analytical Laboratory (SAL). All developments carried out at SAL through the MSSPs or RB are communicated and transferred to the Network of Analytical Laboratories (NWAL) for the benefit of the entire environmental sampling implementation.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term direction for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are in line with the Long-Tem R&D Plan, 2012–2023.

As a first step, the long-term direction of the current D&IS project was defined:

***Make improvements in the sensitivity, accuracy and reliability of analytical techniques that provide information of safeguards relevance in the search for undeclared nuclear material and activities. The project thereby contributes to the identification and use of Science & Technology developments that could support a Safeguards system that is more objectives-based and information-driven, while continuing to explore and develop analytical service capabilities, including forensics-oriented techniques.***

This project concentrates on chemical and isotopic analysis of environmental samples, the instrumentation, procedures and methods used to obtain information and the means by which the quality of such information is assessed. Improving the Agency's own analytical capabilities, as distinct from the NWAL, is a key long-term aim. Of particular importance is the enhancement of the Environmental Sample Laboratory (ESL) of the IAEA through the Project for Enhancing Capabilities of the Safeguards Analytical Services (ECAS) with the construction and commissioning of the Clean Laboratory Extension building and the installation and commissioning of the Large-Geometry Secondary Ion Mass Spectrometer (LG-SIMS) instrument. Analytical capabilities to be enhanced are the age-determination of Pu, elemental impurity measurements to reveal the origin of source materials and nuclear materials, particle morphology and age determination of HEU. In essence, and as stated above, the long-term direction of this project is to continue to make improvements in the sensitivity, accuracy and reliability of techniques that provide information of safeguards relevance in the search for undeclared nuclear material and activities.

In order to support the long-term direction, activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Develop and implement methods and techniques to detect signatures of undeclared nuclear material and activities on environmental samples.*

   The ESL has implemented a number of highly sophisticated methods for the analysis of environmental samples. A scanning electron microscope with X-ray spectrometry (SEM/XRS) has been acquired and optimized for automated searching and detection of particles containing U or Pu. An inductively-coupled plasma mass spectrometer (ICP-MS) has been installed for the bulk analysis of environmental swipe samples and the detection limit for Pu has been reduced to the 5-10 femtogram range. A large-geometry secondary ion mass spectrometer has been acquired and installed in a new clean laboratory extension building for the detection and isotopic analysis of U-containing particles from environmental samples. Sensitive methods of radiometric screening of samples using gamma and X-ray fluorescence spectrometry have been implemented, thus giving rapid and sensitive information in a non-destructive way before samples are submitted for detailed analysis at SAL or the NWAL. The key objective of this project is to improve on all the above methods: to reduce the detection limit for Pu by bulk analysis to less than 1 femtogram per sample, to improve the sensitivity and accuracy of particle analysis data provided by SEM/XRS and LG-SIMS, to develop age-dating methods for Pu and U particles and to improve the sensitivity and timeliness of screening methods.

2. *Develop laboratory tools that support the environmental sampling implementation and enhance the capabilities of the ESL.*

   The analysis of bulk samples at the sub-femtogram, level will be facilitated by the addition of a multi-collector ICP-MS to the CLE in 2012. This instrument will have the basic sensitivity needed, but development will be needed in the chemical separation of the sample and in the maintenance of cleanliness in the laboratory areas, reagents and labware. The production of certified swipe sampling kits will be installed in a new room of the CLE, providing redundancy and higher cleanliness for this essential activity in the future. Laser ablation ICP-MS will be tested for its sensitivity and ability to provide unique information about particles in a sample, including both nuclear (U, Pu) and non-nuclear particles. Improved screening of environmental samples will be accomplished with a re-designed X-ray fluorescence screening instrument or by using laser induced breakdown spectroscopy (LIBS).

3. *Develop and produce quality control materials to improve the reliability of analytical data reported by SAL and the NWAL.*

   The ESL already has a number of particle standards which have been used in the production of quality control swipes in the past. New materials that have been recently produced (Pu and U/Pu mixed particles) will be characterized and used to produce QC swipes that will test a laboratory's ability to detect Pu-containing particles and to measure the U/Pu and Am/Pu ratios as well as the U and Pu isotopic composition.

## 4. Activities

Funding for most of the described D&IS activities is foreseen to be provided by Member States Support Programmes (MSSPs) which continue to play a major role in achieving the stated project objectives.

*Key Objective 1. Develop and implement methods and techniques to detect signatures of undeclared nuclear material and activities on environmental samples.*

- The Task EC B 1752, "Mass Spectrometry Training" is expected to continue for the foreseeable future in collaboration with the institute for Reference Materials and Measurements (IRMM) in Geel, Belgium, that has expertise in highly accurate and precise thermal ionization mass spectrometry (TIMS) and

the Institute for Transuranium Elements (ITU) in Karlsruhe, Germany, that has expertise in TIMS, ICP-MS and SIMS. Training efforts will intensify as LG-SIMS is implemented in the IAEA and at ITU. The Task will be extended as needed but the current completion date foreseen is December 2013.

- Under task FRA A 1565, "Technical Support for ICP MS Measurements", IAEA staff will be trained at a French Laboratory of the Comissariat à l'Energie Atomique (CEA) in the highly sensitive measurement of U and Pu by ICP-MS. The expected completion date is December 2012.
- Task USA A 1081 "Support to SAL (A.223)" will continue to be used in 2012–2013 to train new IAEA staff from the ESL in techniques appropriate to clean-room laboratories and for the selective and efficient separation of U, Pu and Am from environmental samples. The expected completion date is December 2013.
- Task JPN A 1845 "Sample Preparation for Particle Analysis" involves the development of improved methods of sample preparation for LG-SIMS analysis. Various methods will be tested to improve the efficiency and cleanliness of planchet preparation and the results will be transferred to IAEA staff for implementation. The expected completion date is December 2012.
- The original Task Proposal 10/ESL-001 "Sample Preparation for Particle Analysis" has also been sent to a number of Member States to stimulate research and development in this area. New methods are sought that efficiently remove particles of interest from environmental swipes and deposit them cleanly on SIMS planchets. These methods may also be applicable to SEM or other particle analysis techniques in use at the IAEA. The USSP accepted this task proposal in July 2011. This task USA A 1909 will provide improved methods of sample planchet preparation for particle analysis by SIMS or SEM. The expected completion date is December 2012.
- Task JPN A 1679 "Age Determination of Uranium and Plutonium Particles (JPN JC-21)" is for the development of methods to measure radioactive decay products as a means of determining the age of a material since its last chemical purification. Such methods exist for larger samples (milligrams) but it is challenging to apply such methods to individual particles (picogram to nanogram amounts). The age-dating of Pu particles using Am-241 in-growth has been demonstrated but the age-dating of U particles using Th-230 or Pa-231 in-growth requires extreme sensitivity and is not yet possible. Further work is needed to improve the accuracy of Pu age dating and to develop a viable scheme for U particle measurements. Expected completion date is December 2013.
- Task RUS A 01652 "Age Determination of Uranium and Plutonium Particles" involves the measurement of Th-230 coming from the decay of U-234. Initial results indicate that inductively-coupled plasma mass spectrometry can be used to measure this ingrowth if the particle size is in the mm size range (i.e. with micrograms to milligrams of material). Chemical separation methods and ICP-MS measurement protocols have been developed for this amount of material but the application of these methods to micrometre-sized particles will be very challenging. Work is continuing to reduce the size of particles that can be measured and this work is expected to be completed by December 2012.
- A new task proposal will focus on the measurement of Pu and mixed U/Pu particles by SIMS. This will allow rapid measurement of Pu-containing samples to understand how the materials were produced or irradiated (*Task Proposal #2*).
- A new task proposal will be submitted for the improvement of chemical separation methods for environmental samples. Methods that are more robust and with higher chemical yields will be needed to achieve a lower detection limit for Pu and Am and to reduce the interference effect from U in the ICP-MS measurements. MSSP support will be needed to develop such methods and transfer them to the Agency staff (*Task Proposal #3*).

*Key Objective 2. Develop laboratory tools that support the environmental sampling implementation and enhance the capabilities of the ESL.*

- Task UK A 1776 "Evaluation of Ultra-High Sensitivity Secondary Ion Mass Spectrometry for Environmental Samples" will continue during the initial implementation of the LG-SIMS. The collaboration with the UK LG-SIMS facility and UK SIMS experts will aim at improving measurement protocols, data reduction and reporting of LG-SIMS data for safeguards purposes. The expected completion date is June 2012.
- Task GER A 1835 "Feasibility Study of a Pre-screening System Based on Laser Induced Breakdown Spectroscopy (LIBS) for Environmental Samples at IAEA-SAL (C.41)" involves collaboration with a German laboratory to develop and deliver to ESL a prototype screening device for the detection of isotopically altered U in swipe samples. This would enhance the IAEA's ability to design detailed analysis schemes for samples and would streamline the handling at the selected laboratory (ESL or NWAL). The initial work will be focused on proof of principle and would be followed by assembly of a working device and transfer to the ESL, along with training of IAEA staff in its use. The expected completion date is June 2013.
- The LG-SIMS at the ESL will go into routine operation in late 2011 and will enhance the quality of analytical data and the throughput of samples in the ESL. RB resources and IAEA staff will be used for installation, testing and implementation of data reduction software (*Activity #1*).
- The procurement of a Multi-Collector ICP-MS instrument for environmental sample analysis will be funded through an extra-budgetary contribution from Germany in 2011, with the instrument to be delivered to ESL in early 2012. IAEA staff will be responsible for the installation, testing and routine operation of this instrument (*Activity #2*). MSSP support may also be required in the interfacing of this instrument to a laser-ablation sample introduction system in 2013 (*Task Proposal #1*).

*Key Objective 3. Develop and produce quality control materials to improve the reliability of analytical data reported by SAL and the NWAL.*

- Task FIN A 1543 "Production of Particles for Quality Control of Environmental Analysis" involved the setting up and testing of a system for producing U and/or Pu-containing particles from certified starting solutions. Once the system was in operation, several batches of U, Pu and U+Pu particles were prepared and transferred to the IAEA for further characterization and use in preparing QC swipes. This Task succeeded in producing the first fully useful Pu-containing particles but only a limited set of U/Pu mixed particles. Further work under this or a follow-up Task will be the testing of a Vibrating Orifice Aerosol generator for more precise control of the particle size and composition. If successful, this technology would be transferred to ESL where another batch of particle materials would be produced. Expected completion date is December 2012.
- Quality control materials are constantly under production and distribution to the analytical laboratories. The Agency will continue to specify such materials as the need arises and collaborate with Member State laboratories in their production (*Activity #3*).

### Key achievement targets

- Implement improved sample preparation method for Large Geometry-Secondary Ion Mass Spectrometer (LG-SIMS) (Key Objective 1): December 2012.
- Validate and apply the Multi Collector-Inductively-Coupled Plasma Mass Spectrometry (MC-ICP-MS) technique to environmental sample analysis (Key Objective 1 and 2): December 2012.
- Validate and apply the laser-ablation sampling technique to the MC-ICP-MS instrument (Key Objective 2): December 2013.
- Produce and distribute quality control swipes containing Pu and U/Pu particles (Key Objective 3): December 2012.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### 5.1. *Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| EC | B 1752 | Mass Spectrometry Training | Collaboration with IRMM and ITU, tentative completion date December 2013. |
| FIN | A 1543 | Production of Particles for Quality Control of Environmental Analysis | May require follow-up Task for Testing of particle production systems and transfer to ESL by December 2012. |
| FRA | A 1565 | Technical Support for ICP MS Measurements | Training of additional ESL staff with completion in December 2012. |
| GER | A 1835 | Feasibility Study of a Pre-screening System Based on Laser Induced Breakdown Spectroscopy (LIBS) for Environmental Samples at IAEA - SAL (C.41) | Testing for proof-of-principle in 2011 and production of prototype instrument to ESL by June 2013. |
| JPN | A 1679 | Age Determination of Uranium and Plutonium Particles (JPN JC-21) | Successful age-dating of Pu particles but U particles will need more development. Completion expected in December 2013. |
| RUS | A 1652 | | Initial work has been performed and more detailed investigations will be carried out in 2012. Completion expected in December 2012. |
| JPN | A 1845 | Sample Preparation for Particle Analysis | Improved methods of particle recovery and deposition on planchets to be completed in December 2012. |
| USA | A 1909 | | Improved methods for preparing planchets for particle analysis by SIMS to be completed in December 2012. |
| UK | A 1776 | Evaluation of Ultra-High Sensitivity Secondary Ion Mass Spectrometry for Environmental Samples (B1(v)) | Further studies to document advantages of LG-SIMS and collaboration on development of measurement and data reduction protocols. Completion expected in June 2012. |
| USA | A 1081 | Support to SAL (A.223) | Additional ESL staff to receive training in clean-room operations, chemical separations and measurements of environmental samples. Expected completion in December 2013. |

### 5.2. *Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 10/ESL-001 | Sample Preparation for Particle Analysis | Outstanding with FRA, GER, UK and US (2010) |
| New Task Proposal #1 (Key Objective 2) | Method Development for Laser-Ablation MC-ICP-MS | Submitted: June 2012<br>MSSP(s): FRA, USA, GER, EC |
| New Task Proposal #2 (Key Objective 1) | Development of Methods for the Measurement of Pu and Mixed U/Pu particles by SIMS | Submitted: June 2012<br>MSSP(s): FRA, USA, GER, EC, RF |
| New Task Proposal #3 Key Objective 1) | Development of improved chemical separation methods for U, Pu and Am in environmental samples | Submitted June 2012<br>SSP(s) FRA, USA, EC, RF, JAP |

*5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | (Key Objective 2) | Improvement of LG-SIMS measurements and data reduction software |
| Activity #2 | (Key Objective 2) | Installation and optimization of MC-ICP-MS for environmental samples |
| Activity #3 | (Key Objective 3) | Production of quality control materials for environmental sample analysis |

## Attachments

Figure 1: The IAEA's Large-Geometry – Secondary Ion Mass Spectrometer (LG-SIMS).


Figure 2: The Clean Laboratory Extension building to house the LG-SIMS, MC-ICP-MS and other ESL activities.

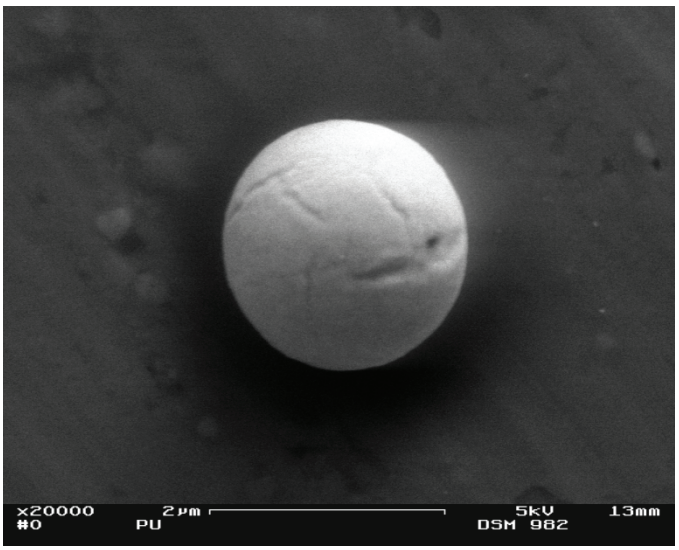


Figure 3: Plutonium oxide particle produced under Task FIN A 1543 for use in making quality control samples.

# SGAS-03

## Sampling Logistics, Analysis Support and NWAL Coordination

**Project Manager: Christian Schmitzer** **Division: SGAS**

### 1. Introduction

This document describes the plans for developing and implementing new or strengthened processes for sampling logistics, analysis support and coordination of the Network of Analytical Laboratories (NWAL) within the Department of Safeguards for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building Support for the Non-Proliferation Regime* and *Strategy 2 – Coping with the Workload* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

The project *SGAS-03 Sampling Logistics, Analysis Support and NWAL Coordination* is linked to the Coordination and Support Section of the Office of Analytical Services. The key functions of this section are reflected in the project title, they provide the framework for the analyses of samples done at specific laboratories, within the Agency or the NWAL. The desirable goal is smooth performance of routine operations, within agreed timeliness and quality targets – the desired outcome of all development and implementation support tasks addressed under this project ideally supports this mission. However, due to the nature of MSSP closely working with members of the NWAL, some tasks actually constitute ongoing efforts more in the line of implementation than development, such as continuous proficiency testing of NWAL performance or provision of highly specialized reference materials.

This project plan addresses Strategies 1 and 2 of the Departmental Long-Term Strategic Plan, 2012–2023. Under *Strategy 1 – Building Support for the Non-Proliferation Regime*, the long-term directions for R&D suggest to *enhance safeguards equipment capabilities and techniques* as well as *continue to explore and develop analytical services capabilities including forensic oriented techniques*. *Strategy 2 – Coping with the Workload* augments and supports the same key drivers in terms of enhancing efficiency and effectiveness. Sampling Logistics, Analysis Support and NWAL Coordination provide the necessary framework for the analysis of inspection samples, thus directly lending support to the verification mission of safeguards. The long-term directions of this project are therefore two-fold in nature: new capabilities and tools are to be explored – e.g. forensics capabilities – while at the same time routine NWAL performance needs to be controlled and expanded.

In its current state, NWAL performance has reached its maximum capacity. New capacities and capabilities need to be added, while at the same time continuing and enhancing efforts to monitor and control analytical performance in terms of timeliness and quality. Therefore, a key objective over the longer term (very much beyond 2013) will be continued coordination and expansion of the NWAL, in cooperation with MSSPs.

More in the sense of development efforts, a number of tasks address enhancement of capabilities in terms of sampling and in-situ analysis as well as software developments in support of the Agency's safeguards laboratories. These activities, though specifically dedicated to certain areas, constitute the present picture of necessary improvements as borne out from inspection experience in the field or software usage in the laboratories. In all likelihood, new needs will be identified in the overall area of sampling logistics and analysis support, driven by demand of the inspectorate or providers of analyses of samples. Currently, fingerprinting

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

and forensic analysis constitute such new emerging demand. These groups, together with the evaluation sections within the Department of Safeguards, are the end-users of the "products" and associated development and implementation support (D&IS) efforts of the SGAS Coordination and Support Section.

Presently unresolved challenges – partly to be addressed through tasks of this project – result from the high sample load distributed throughout the NWAL. With continued support from MSSPs it is to be expected that these shortfalls will be addressed, if not in the short term, at least over the medium term.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term direction for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Term R&D Plan, 2012–2023.

As a first step, the long-term directions of the current D&IS project were defined:

***Enhance effectiveness and efficiency of sampling logistics and analytical support by exploring new safeguards sampling capabilities and techniques as well as software tools; Continue to expand and coordinate the NWAL (qualification of new laboratories, methods and tools to monitor quality and performance) based on departmental needs to further develop analytical services.***

In order to support the long-term directions, activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Improve quality monitoring and control of analytical services across the entire NWAL.*

   Assuring quality of analytical results through external means, i.e. quality checks beyond internal means prescribed by the specific laboratory's quality management system, is an important tool in demonstrating adequate performance of analytical services across the entire NWAL. Some laboratory proficiency testing and intercomparison programmes are well established, though the specific nature of nuclear material and environmental samples as well as samples used for fingerprinting/forensics necessitate some new developments in this area. This also involves provision of special reference materials.

2. *Improve and/or develop new sampling methods.*

   Sampling needs to receive just as much attention in trying to improve overall analytical performance. Dedicated efforts are directed at sampling $UF_6$ and in-field sampling and analysis of the concentration and enrichment of U fuel pellets.

3. *Qualify new laboratories to expand the NWAL.*

   The Network of Analytical Laboratories suffers capacity shortfalls in certain areas, resulting in substantial delays for sample analysis. However, the NWAL does not only serve sample analysis. A

backup function for the Agency's nuclear material laboratory needs to be implemented as well as other functions in the area of provision of reference materials and quality assurance need to be enhanced.

4. *Develop new software to support the Laboratory Information Management System of the Safeguards laboratories at Seibersdorf.*

A major development effort is required to align existing software with opportunities arising from joining the Department of Safeguards and its IT domain. At the same time, the Laboratory Information Management System needs further development as well as harmonization efforts across the entire division.

## 4. Activities

Funding for most of the described D&IS activities is foreseen to be provided by Member States Support Programmes (MSSPs) which continue to play a major role in achieving the stated project objectives. In many cases, development efforts are foreseen as part of the D&IS programme, whereas provision is made to cover routine operation of implemented new techniques, software or methods from regular budget funds.

*Key Objective 1. Improve quality monitoring and control of analytical services across the entire NWAL.*

- Tasks CZ A 1516, NET A 1467, and RUS A 1514 "External Quality Control of Analytical Services" will continue to check measurements of quality assurance samples provided under separate task FRA A 1100. NRI Rez, NRG Petten and Khlopin Institute participate in the CETAMA EQRAIN programme under this task. The tasks will be extended until the end of 2013.
- Tasks EC A 0267 and FRA A 1100, "Analytical Quality Control Services" focus on proficiency testing of laboratory performance through the distribution of well characterized materials from IRMM and CETAMA, respectively. Whereas IRMM administers the programmes NUSIMEP and REIMEP, CETAMA has various materials (plutonium, uranium, impurities) under the EQRAIN programme. The tasks will be extended until end of 2013.
- Task USA A 1497 "Analytical Quality Control – Participation of SAL in NBL SME Programme (A.264)" provides for the Agency's nuclear material laboratory to participate in the SME intercomparison programme administered by the New Brunswick Laboratory (NBL). The task will be extended until end of 2013.

The following tasks serve to provide special reference materials for quality assurance of analytical performance as well as special source materials for production of secondary reference materials (mostly Large Size Dried Spikes) to the Agency's nuclear material laboratory (special emphasis is placed on reference materials suitable for particle and/or forensics-type analysis):

- Tasks EC A 0318, FRA A 1101, RUS A 0491, "Special Reference and Source Materials for DA" provide such materials from IRMM, CETAMA and Khlopin Institute, respectively. The task will be extended until end of 2013.
- Task USA A 0909 "Separation of Plutonium Isotopes for the Production of High Purity Spike Reference Materials (A.202)" aims at providing Plutonium isotopes for subsequent separation of Pu-244 as a secondary reference material as high purity spike. The task will be extended until end of 2013.
- Task USA A 1496 "Traceability of DA Measurements – Provision of NBL Certified Reference Materials (A.263)" provides well characterized reference materials from NBL. The task will be extended until end of 2013.

*Key Objective 2. Improve and/or develop new sampling methods.*

- Tasks ARG A 1769, and BRZ A 1764 "$UF_6$ Sampling Method using Alumnia" aims at developing and field-testing a new method for sampling $UF_6$, allowing significant savings in material and effort. Special emphasis will be placed on a sampling campaign with parallel efforts according to classical and new sampling methods. The tasks will be extended until end of 2012.
- Task JNT A 1877 BRZ "Standard Pellets for In-Field DA Calibration" aims to provide calibration standard materials for in-field methods such as COMPUCEA, to perform in-situ analysis of concentration and enrichment of U fuel pellets. The task will be extended until end of 2012 see also section 5.2. and 5.3.
- As part of the Regular Budget activities, SGTS in cooperation with SGAS and SGIM is in the process of establishing and evaluating COMPUCEA for in-the-field usage (*Activity #1*). The comprehensive master-plan for establishing COMPUCEA at the IAEA deals with the provision of reference materials (procurement, validation, storage, shipping), creation of instrument hardware and software as well as integration testing and authorizing as field use equipment, training and transfer of expertise to in-field teams, and finally field testing with associated vulnerability and cost/benefit-analysis. Specific areas of MSSP assistance will be characterized and ultimately formulated as new task proposal(s) in the relevant projects *SGTS-01 NDA Techniques, SGAS-01 Destructive Analysis of Nuclear Materials* and SGAS-03 (*New Task Proposal #1*).
- Task AUL A 0859 "Analytical Services for Environmental Sampling" deals with specialized aspects of employing Accelerator Mass Spectroscopy (AMS) for environmental swipe samples. The task will be extended until end of 2012.
- Tasks RUS X 1515 and UK X 1045 "Analysis of Environmental Samples Supplied by IAEA" aim to support the requested analysis of environmental swipes at institutions in Russia (KRI, LMA) and the UK (QINETIQ, AWE). The tasks will be extended until end of 2013.

*Key Objective 3. Qualify new laboratories to expand the NWAL.*

- Tasks ARG A 1154, BRZ A 1602, CPR A 1725 and ROK A 1765 "Qualification of Environmental Network Laboratories" aim at qualifying new candidate laboratories under the respective MSSP. Task ARG A 1154 is on stand-by, resulting from the decision to initiate qualification of a laboratory for analysis of heavy water samples (see task ARG A 1906 below). IRD (Brazil) has successfully passed qualification, 2 laboratories in China are at the beginning of the qualification procedure, and South Korea is measuring test samples as part of their qualification process. The tasks will be extended until end of 2013.
- Task ARG A 1906 "NWAL Qualification for Heavy Water Laboratory" is currently active, aiming at qualifying a second laboratory to perform Heavy Water analysis as part of the NWAL. The task will be extended until end of 2012.
- Task AUL A 1857 "Qualification of the IAEA's Network of Analytical Laboratories (NWAL) for Particle Analysis of Environmental Samples" is the subject task to qualify the SIMS laboratory at the University of Western Australia at Perth for particle analysis. The task will be extended until end of 2012.
- Tasks BEL A 1758 (BEL) and FRA A 1479 "Qualification of the IAEA's Network of Analytical Laboratories (NWAL) for Analysis of Nuclear Materials" is the subject task to qualify the nuclear laboratory SCK in Belgium and the CEA laboratory at Saclay, respectively, for nuclear material analysis. A second set of test samples will be analysed in the next step. The tasks will be extended until end of 2012.
- Task CZ A 1631 "Qualification of Environmental Network Laboratories for Bulk Analysis" is the subject task to qualify the laboratory at NRI Rez for bulk analysis. The task will be extended until end of 2013.

- Task HUN A 1834 "Qualification of the IAEA's Network of Analytical Laboratories (NWAL) for Analysis of Environmental Samples and Nuclear Materials" is the subject task to qualify the KFKI laboratory at Budapest for analysis of environmental as well as nuclear material samples. The task will be extended until end of 2013.
- Task UK C 1742 "Consultant: NWAL for Nuclear Material Expansion Study" aims at providing expertise regarding policy and strategy to extend the NWAL for nuclear material analysis.

A number of new task proposals – partially accepted by Member States Support Programmes – have been launched to further expand the NWAL:

- A new task proposal 10/CSS-006 "Qualification of Savannah River National Laboratory (SRNL) for the IAEA's Network of Analytical Laboratories (NWAL) for Bulk Analysis of Environmental Samples" has been submitted and is currently outstanding with USSP (2011).
- Another task proposal 08/TTS-007 "Qualification of the IAEA's Network of Analytical Laboratories (NWAL) for Analysis of Environmental Samples and Nuclear Materials" has been submitted and is currently outstanding with South Africa (2009).
- Another task proposal 10/CSS-002 "NWAL qualification for Heavy Water Laboratory" has been launched and accepted by Argentina, and is currently outstanding with Canada (2010).

*Key Objective 4. Develop new software to support the Laboratory Information Management System of the Safeguards laboratories at Seibersdorf.*

- The task USA D 1523 "Software Development Support: LIMS for the SAL (D.156)" successfully implemented version 1.0 of the software – on time and within budget. Minor bug fixes are administered currently as part of the suppliers warranty procedures. This task has been completed.
- A new task proposal 11/CSS-005 "AIMS 2.0 Development Project" aims at providing the next release of software constituting the Laboratory Information Management System for the Agency's Safeguards laboratories at Seibersdorf. This task will enable the system to accommodate reference material integration, advanced report management and versioning, integration of measurement uncertainties, bar code integration and automated result incorporation; furthermore a consolidation of system and database architecture will be accomplished. The task is expected to be completed before the end of 2013.

### Key achievement targets

The long-term direction of this D&IS project SGAS-03 indicates two major items, enhancing effectiveness and efficiency through development efforts, and expanding and coordinating the NWAL. Consequently, activities and key achievements may be identified along these directions. Key Objectives 1 and 3 focus on NWAL, routine quality control and enhancements, whereas Key Objectives 2 and 4 focus on new developments of sampling methods and software tools, respectively.

- Enhance quality control throughout the Network of Analytical Laboratories (NWAL) (Key Objective 1):
  - Evaluate and communicate results of the currently ongoing round-robin laboratory proficiency testing (impurity analysis) – Technical Meeting to take place in May/June 2012: July 2012.
  - Negotiate a comprehensive proficiency testing programme with NWAL and agree on timelines and sample materials: October 2013.
- Validate and apply improved $UF_6$ sampling methods (Key Objective 2): December 2012.
- Harmonize NWAL expansion with the Safeguards long-term strategy (Key Objective 3):
  - Define NWAL strategy compliant with Safeguards strategic objectives and long-term directions: November 2012.

– Renegotiate NWAL contracts in line with NWAL strategy: December 2013.

- Deploy next version of Laboratory Information Management System (LIMS 2.0) (Key Objective 4): December 2013.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### *5.1. Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| ARG | A 1154 | Qualification of Environmental Network Laboratories | Desired completion: end 2013 |
| BRZ | A 1602 | | Desired completion: end 2013 |
| CPR | A 1725 | | Desired completion: end 2013 |
| ROK | A 1765 | | Desired completion: end 2013 |
| ARG | A 1769 | UF6 Sampling Method using Alumina | Desired completion: end 2012 |
| BRZ | A 1764 | | Desired completion: end 2012 |
| ARG | A 1906 | NWAL Qualification for Heavy Water Laboratory | Desired completion: end 2012 |
| AUL | A 0859 | Analytical Services for Environmental Sampling | Desired completion: end 2012 |
| AUL | A 1857 | Qualification of the IAEA's Network of Analytical Laboratories (NWAL) for Particle Analysis of Environmental Samples | Desired completion: end 2012 |
| BEL | A 1758 | Qualification of the IAEA's Network of Analytical Laboratories (NWAL) for Analysis of Nuclear Materials | Desired completion: end 2012 |
| FRA | A 1479 | | Desired completion: end 2012 |
| BRZ | JNT A 1877 | Standard Pellets for In-the-Field DA Calibration | Desired completion: end 2012 |
| CZ | A 1631 | Qualification of Environmental Network Laboratories for Bulk Analysis | Desired completion: end 2013 |
| CZ | A 1516 | External Quality Control of Analytical Services | Ongoing task |
| NET | A 1467 | | Ongoing task |
| RUS | A 1514 | | Ongoing task |
| EC | A 0267 | Analytical Quality Control Services | Ongoing task |
| FRA | A 1100 | | Ongoing task |
| EC | A 0318 | Special Reference and Source Materials for DA (EC MT10a; RUS A25) | Ongoing task |
| FRA | A 1101 | | Ongoing task |
| RUS | A 0491 | | Ongoing task |
| HUN | A 1834 | Qualification of the IAEA's Network of Analytical Laboratories (NWAL) for Analysis of Environmental Samples and Nuclear Materials | Desired completion: end 2013 |
| RUS | X 1515 | Analysis of Environmental Samples Supplied by IAEA (UK A5(b)) | Desired completion: end 2013 |
| UK | X 1045 | | Desired completion: end 2013 |
| UK | C 1742 | Consultant: NWAL for Nuclear Materials Expansion Study (B1(t)) | Ongoing task<br>First part completed end 2010 |
| USA | A 0909 | Separation of Plutonium Isotopes for the Production of High Purity Spike Reference Materials (A202) | Desired completion: end 2013 |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| USA | A 1496 | Traceability of DA measurements – provision of NBL certified reference materials (A.263) | Ongoing task |
| USA | A 1497 | Analytical Quality Control – Participation of SAL in NBL SME Programme (A.264) | Ongoing task |
| USA | D 1523 | Software Development Support : LIMS for the SAL (D.156) | Desired completion: end 2013 |

*5.2. Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 08/TTS-007 | Qualification of the IAEA's Network of Analytical Laboratories (NWAL) for Analysis of Environmental Samples and Nuclear Materials | Outstanding with RSA (2009) |
| 10/CSS-002 | NWAL Qualification for Heavy Water Laboratory | Outstanding with CAN (2010) |
| 10/CSS-006 | Qualification of Savannah River National Laboratory (SRNL) for the IAEA's Network of Analytical Laboratories (NWAL) for Bulk Analysis of Environmental Samples | Outstanding with US (2011) |
| 11/CSS-005 | AIMS 2.0 Development Project | Outstanding with US (2011) |
| New task proposal #1 | Assistance for in-the-field evaluation of the COMPUCEA technique for IAEA usage | To be submitted to the EC SP in 2012 |

*5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | Evaluation of the *COMPUCEA* technique for IAEA usage |

# Appendix

## List of Acronyms

| | |
|---|---|
| AIMS | Advanced Information Management System |
| AWE | Atomic Weapons Establishment, Aldermaston, UK |
| BNFL | British Nuclear Fuels Limited (UK) |
| CEA | Commissariat à l'Energie Atomique (France) |
| CETAMA | Commission d'Etablissement des Methodes d'Analyse (France) |
| CGM | Consultants Group Meeting |
| COMPUCEA | Combined Procedure for Uranium Concentration and Enrichment Assay |
| CRM | certified reference materials |
| DA | destructive analysis |
| DOE | Department of Energy (USA) |
| EQRAIN | Evaluation de la Qualite des Resultats d'Analyse dans les Installations Nucleaires |
| GUM | Guide to the Expression of Uncertainty in Measurement |
| IAEA | International Atomic Energy Agency |
| IRD | Institute of Radioprotection and Dosimetry, Rio de Janeiro |
| IRMM | Institute for Reference Materials and Measurements (European JRC in Belgium) |
| ITU | Institute for Transuranium Elements (European JRC in Germany) |

| | |
|---|---|
| ITV | International Target Values |
| JNC | Japan Nuclear Fuel Cycle Development Institute |
| JRC | Joint Research Centre |
| KFKI Budapest | Hungarian Former Central Research Institute for Physics, Budapest |
| KRI | Khlopin Radium Institute,St. Petersburg |
| LIMS | Laboratory Information Management System |
| LMA | Laboratory for Microparticle Analysis, Moscow |
| LSD | large-size dried [isotopic spike] |
| MSSP | Member States Support Programme |
| NBL | New Brunswick Laboratory (USA) |
| NM | nuclear material |
| NRI Rez | Nuclear Research Institute Rez |
| NUSIMEP | Nuclear Signatures Interlaboratory Measurement Evaluation Programme |
| NML | nuclear material laboratory |
| NWAL | Network of Analytical Laboratories |
| REIMEP | Regular European Interlaboratory MEP |
| QC | quality control |
| QINETIQ | UK defence technology company |
| REIMEP | Regular European Interlaboratory Measurement Evaluation Programme |
| SAL | Safeguards Analytical Laboratory |
| SCK | Studiecentrum voor Kernenergie (Belgium) |
| SGAS | Office of Safeguards Analytical Services |
| SIMS | Secondary Ion Mass Spectrometry |
| SME | safeguards measurement evaluation |
| SRS | Savannah River Site (USA) |

## Attachments


Figure 1: Shipment of nuclear material being made ready for transport.


Figure 2: An anonymised sample of nuclear material, provided to the laboratory for analysis.

Figure 3: R. Hochmann (health physicist, left) and S. Balsley (laboratory head, right) inspecting reference materials in the plutonium storage.

# SGCP-03

## Safeguards Approaches

**Project Manager: Masato Hori** **Division: SGCP**

### 1. Introduction

This section of the document describes the Department's plans to further elaborate and develop safeguards concepts and approaches for the period 2012–2013. This includes further development and implementation of the State-level concept for a safeguards system that is more objectives-based, information-driven, adaptable and focused. This section has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2]. In particular, this project (SGCP-03) supports *Strategy 1 – Building Support for the Non-proliferation Regime, Strategy 2 – Coping with the Workload, Strategy 3 – Safeguarding Advanced and Innovative Nuclear Fuel Cycles, Strategy 4 – Taking on new mandates and Strategy 5 – Changing the way the Department works* as outlined in the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

In the past two years, progress was made in the development of methodologies supporting new safeguards approaches for specific facility types and general improvements were made regarding the overall effectiveness and efficiency of safeguards implementation. In addition, the Safeguards Symposium held in November 2010 provided an opportunity for the IAEA, Member States, the nuclear industry and the non-proliferation community at large to exchange ideas and to explore possible solutions to the various challenges facing international safeguards.

As part of this project, there has been an on-going effort by SGCP to evolve the IAEA safeguards system to one that is more objectives-based, information-driven, adaptable and focused. A Work Plan to achieve this was developed and approved.

This project will serve to help fully implement the State-level concept. It will also help introduce and cultivate the necessary knowledge and skills to effectively and efficiently implement IAEA safeguards to meet the challenges and demands of the future.

Toward this end, valuable contributions related to the development and testing of safeguards concepts, guidelines and approaches have already been provided by Member States through the Member State Support Programmes. These contributions continue to be of paramount importance to the project's ability to meet Department expectations.

### 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term directions for R&D in supporting the implementation of the nine Departmental overarching strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023.

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

As a first step, the long-term direction of the current D&IS project was defined:

> ***Develop and implement innovative and effective concepts and approaches to continue to meet safeguards challenges.***

In order to support this long-term direction, activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Further develop the State-level concept to enhance effectiveness and efficiency of the safeguards system;*
2. *Develop new concepts and approaches for verification activities, especially with regard to an enhanced ability to detect undeclared nuclear material and activities;*
3. *Monitor for and address any observed deficiencies or vulnerabilities in safeguards approaches;*
4. *Continue to improve safeguards working methods;*
5. *Strengthen cooperation between the IAEA and SSACs; and*
6. *Provide advice and assistance for the effective verification of nuclear arms control and reduction agreements, including nuclear disarmament, on request.*

### 4. Activities

In order to achieve the key objectives, the following activities have been identified. Many of these activities will be performed by Safeguards Department personnel. However, some assistance will be required from Member State Support Programmes.

*Key Objective 1. Further develop the State-level concept to enhance the effectiveness and efficiency of the safeguards system.*

- Develop an effective, efficient, and non-discriminatory approach to safeguards implementation taking into account State-specific factors.

  The Deputy Director General, Department of Safeguards (DDG-SG) has established a short-term Departmental Project for guiding the continued evolution of the State-level concept towards an objectives-based and information-driven approach to safeguards planning, implementation and evaluation with the following near term objectives:

  – To integrate inspection-related and State evaluation activities by the end of 2011; and

  – To have a more adaptable, objectives-based system in place by the end of 2012.

  In support of these objectives, the IAEA is pursuing a phased implementation strategy and has established a State File Working Group (SFWG) and a State Level Concept Working Group (SLCWG). The results of these working groups are expected to lead to consistent practices, procedures and associated guidance to address areas such as acquisition path analysis and State specific technical objectives as well as to identify the necessary verification measures and inspection activities. Several activities under SGCP-03 and other D&IS Projects will support the objectives of the Departmental Project for evolving the State-level concept.

  The activities under this D&IS project will be coordinated with projects *SGCP-102 Training*, *SGIM-03 Open Source Analysis*, *SGIS-01 Integrated Analysis*, and *SGTS-08 Novel Technologies in Support of*

*Safeguards Implementation*. This will also include efforts to improve communication and transparency so it is clear to Member States how the IAEA draws its safeguards conclusions.

During the 2012–2013 period, the IAEA plans to accomplish the following tasks (*Activity #1)*:

- Further develop the State-level concept including, improving the process for designing State-level approaches on the basis of a comprehensive knowledge and understanding of the State as a whole.
- Further develop safeguards implementation guidelines based on technical objectives and other relevant factors consistent with proliferation risks and priorities (Task FRA C 1904)
- To more closely link and align the results of the State evaluation process with the development of State-level safeguards approaches (SLAs) along with the selection of verification activities outlined in annual implementation plans (AIPs).

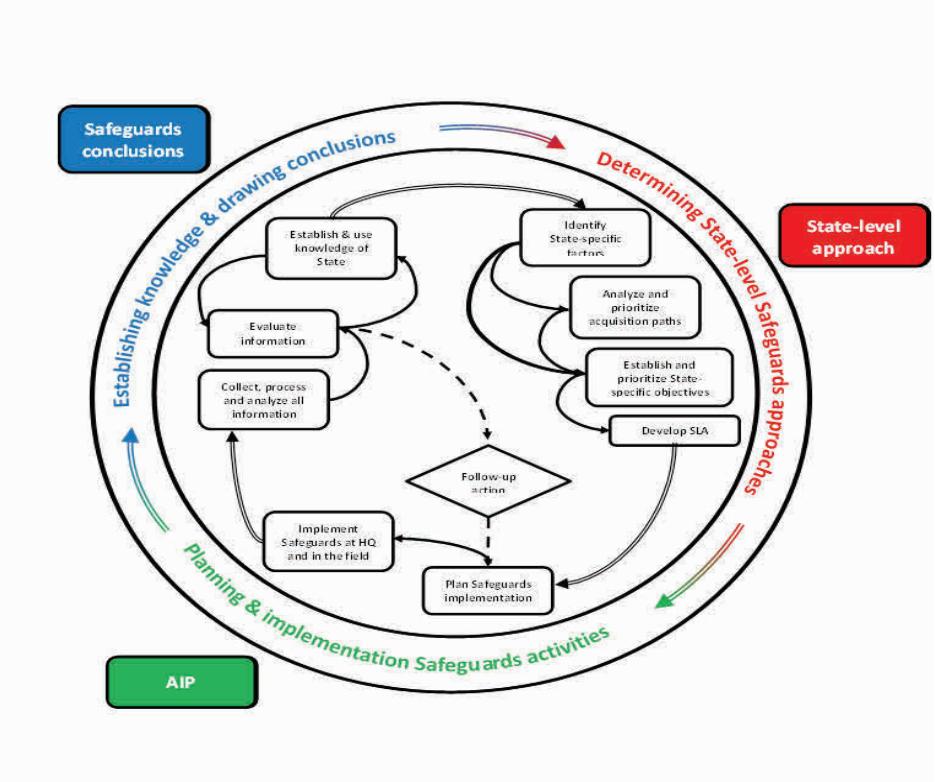


Figure 1: Concept of State Level Process

- Further develop the Physical Model to support the identification of signatures and indicators of nuclear fuel cycle activities (including weaponization) and acquisition path analysis, along with the necessary training.

  The Physical Model text serves as an encyclopaedic technical resource for IAEA personnel involved in safeguards activities such as State evaluation, acquisition path analysis, the development of safeguards approaches, and training. It should be periodically updated in order to take account of developments in nuclear fuel cycle-related technologies as well as experience gained in safeguards implementation and evaluation activities. Vols. 2 and 4, Conversion (Tasks UK C 1660 and USA C 1683); Vol. 3, Enrichment; and Vol. 7, Heavy Water, have been recently updated with assistance from the Canada, UK, and Japan Support Programmes (JNT C 1389). Support for revising Vol. 12 (Weaponization) was proposed in 2007 (Task Proposal 07/CCA-004) to France, UK, and USA, but no Member State has accepted the task. In support of the Model's use in Trade Analysis, an interface between the Physical Model and the Big Table (that includes parsing the text into small easy to use pieces) is being created under *SGIM-09 Early Detection of Proliferation Activities through Trade Indicators*. The IAEA will evaluate the flexibility of this approach as it considers how to improve the efficiency of the Model's maintenance and updating.

The Physical Model also provides information on signatures and indicators that support the identification of equipment needs for detecting undeclared activities (USA E 1663). A prototype software tool was developed that will compare signatures and indicators with instrument measurement categories, designed to identify gaps in existing IAEA instrumentation and to help identify innovative technology needs. The tool is being populated with signatures, indicators, and measurement information in preparation for testing and assessment.

- Develop software tools to support State-specific evaluations.

  Mathematical methods and software tools provide the capability to assist in the analysis, representation, and prioritization of acquisition paths, the evaluation of potential nuclear material diversion and facility misuse scenarios and the assessment of overall safeguards effectiveness. These methods are based on modern mathematical tools (e.g. game theory, possibility theory, probabilistic risk assessment, fault tree analysis, root cause analysis, fuzzy logic, etc.). A Member State Support Programme task to support these efforts began in 2010 with the aim of determining which methods can be most effectively applied to acquisition path analysis and safeguards approach assessment (JNT C 1871 GER, HUN, UK, Task Proposal 10/CCA-004).

- Develop approaches for monitoring and evaluating the effectiveness of safeguards implementation.

  Although the generic State-level safeguards objectives are the same for all States, technical objectives and performance goals based on State-specific acquisition paths will need to be defined for each State. These goals combined with the signatures and indicators of the potential diversion and acquisition pathways will determine the safeguards activities to be conducted in a State. The IAEA's evaluation of the effectiveness of safeguards implementation should consider not only the effectiveness of the implementation of the safeguards verification measures, but also the effectiveness of the information collection, analysis and evaluation.

  During the 2012–2013 period, the IAEA plans to accomplish the following tasks (*Activity #2)*:

  - Review existing safeguards approaches and associated techniques, including transfers of fresh MOX, to ensure they are updated and based on a conceptual framework which is more objectives-based and information-driven (e.g. The ISAs for LWRs in Japan both with and without MOX were combined into a single/streamlined approach in August 2011.),
  - Explore new inspection planning tools, and
  - Develop verification competencies, approach strategies and the necessary instrumentation for re-establishing safeguards in response to catastrophic events at nuclear facilities such as Fukushima.
  - Increase coordination between the Safeguards Department and other parts of the IAEA like Nuclear Energy and Nuclear Safety, with the goal of creating synergies to more fully incorporate safeguards measures into the design of new facilities.

  Safeguarding nuclear material and facilities can be made more efficient and cost effective by improving the proliferation resistance of the system. Under the IAEA's International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO), the Department of Safeguards provides the expertise and guidance for developing and testing a "Proliferation Resistance Assessment Methodology for Innovative Nuclear Fuel Cycles." The Department of Safeguards also participates in the Proliferation Resistance and Physical Protection Working Group established by the Generation IV International Forum (GIF). A common requirement for both INPRO and GIF methodologies is that any diversion of nuclear material should be reasonably difficult and detectable. This requirement led to the use of the term "safeguardability" which is defines as the degree of ease with which a system can be effectively and efficiently put under safeguards.

- Establish the IAEA as having a leading role in development of safeguards by design.

  The concept of safeguards-by-design (SBD) is an approach where international safeguards considerations are fully integrated into the design process of a new nuclear facility.

In 2008, the IAEA enlisted the cooperation of Member States in promoting SBD through the Support Programme structure (Tasks ARG C 1770, BEL C 1746, BRZ C 1767, CAN C 1739. CPR C 1748, EC C 1726, FIN C 1829, FRA C 1792, GER C 1780, JPN C 1738, ROK C 1724, UK C 1755, and USA C 1734). With the help of these Support Programmes, as well as the programmes in other IAEA Departments that inform newcomer States about nuclear power, consideration of safeguards is gaining a presence in the designer/operator community as those stakeholders become aware of the legal requirements for safeguards as well as the equipment installation aspects and the potential to reduce overall nuclear construction project risk. These stakeholders have expressed interest in user-friendly capability to assess proliferation risk and safeguardability. In addition, Finland requested and received assistance with developing and presenting a first-ever SBD workshop targeting operators and designers.

However, the need to respond to such requests for assistance must be balanced against the IAEA need to become more effective and efficient. All MSSPs will be asked to help enhance and improve the training materials developed for the Finnish Support Program. Additionally, these MSSPs will be asked to review and enhance the draft high level SBD Principles document and to help promote the principles therein globally, including improved communication among all stakeholders. Support will continue to be provided in safeguardability, the preparation of briefing materials for newcomer States, and the assessment of proliferation risk. Feedback from the operator and designer stakeholders regarding these SBD initiatives will be included to assess what the next steps should be, with an emphasis on efficiency.

With the recent increase in interest in modular reactors, there is now a new opportunity to reach out to the design community through the associated MSSP programmes and exchange information on safeguards considerations, concepts of operation, and design concepts for modular reactors. In addition, coordination with INPRO and the Department of Nuclear Energy offer the chance to exchange information on safeguards considerations with other stakeholder groups regarding small and medium sized reactors.

*Key Objective 2. Develop new concepts and approaches for verification activities, especially with regard to an enhanced ability to detect undeclared nuclear material and activities.*

- Revise and update the Safeguards Policy Series and other guidance documents, as appropriate.

  The evolution of IAEA safeguards from facility-level to State-level safeguards requires changes to the policy and guidance documents supporting the development of safeguards approaches. Currently there are 20 policy papers covering a variety of implementation issues. During 2010 and 2011, a review of the Policy Series and guidance documents was performed to assess consistency with the State-level concept and to identify opportunities to introduce new efficiencies offered by information driven safeguards. Based on the results of the review, a work plan will be prepared identifying the priorities and schedule for drafting new policy papers and updating existing ones. Tentative areas for the development of new policy or guidance documents include: (1) developing more effective and efficient technical verification approaches and measures for sensitive materials and facilities; (2) determining further applications of random, unannounced and remote data-triggered inspections to increase effectiveness and efficiency; and (3) determining equipment requirements for safeguards approaches using unattended and remote monitoring. The majority of the work is expected to be performed by IAEA staff (*Activity #3)*. As the work plan for the tasks are further developed, areas for MSSP support may be identified.

- Support the Operations divisions in the development of State-level safeguards approaches.

  As the number of State-level safeguards approaches developed and approved has increased and integrated safeguards are implemented in States with advanced nuclear programmes, experience has been gained in developing and implementing integrated safeguards approaches. This accumulated experience should be assessed and the results used to further refine and enhance State level approaches. Japan has been providing technical support (as a cost free expert) to the IAEA on this activity (e.g. development of a site specific integrated safeguards approach on a trial basis for the JNC-1 site at Tokai). In an information based safeguards environment, the analysis of safeguards relevant

State information has increased considerably. This information analysis (e.g. satellite imagery, open source, imports/exports in nuclear trade, etc.) is performed primarily by IAEA staff (*Activity #4)*. In cases where new safeguards approaches are being developed, assistance from Member States in methods to efficiently assimilate and assess the increased volume of information may be sought.

- Develop and test enhanced safeguards approach models for certain facility types.

  Model integrated safeguards approaches have been approved and are in use for the most common types of facilities, such as conversion plants, low-enriched uranium fuel fabrication plants, light-water reactors, on-load reactors, research reactors, and spent fuel storage facilities. Model integrated safeguards approaches are not being developed for sensitive facilities, such as enrichment plants, reprocessing plants, and mixed-oxide fuel fabrication plants. For example the following list of facility types pose safeguards challenges for the future. Assistance to help implement and test the effectiveness and efficiency of the safeguards approaches for these new facility types will be necessary.

  – *Facilities with un-irradiated direct use material*

  The conceptual framework for integrated safeguards did not change timeliness and quantity goals for un-irradiated plutonium or HEU, and stated that enhanced efficiencies in safeguards approaches at reprocessing, MOX and HEU facilities should be achieved through the use of unattended equipment and randomization of inspections. For example, measures to reduce the annual number of predictable interim inspections by the use of randomly scheduled inspections in conjunction with remote monitoring methods and operator mailbox declarations has been tested and are in use in several facilities. Additional combinations of equipment and measures will be evaluated to determine if effectiveness and efficiency gains may be possible for applications such as remote data-triggered inspections.

  – *Pyro-processing facilities*

  Task ROK C 1761 started in 2008 to develop a safeguards approach for a model pyro-processing facility. The task activities have been adjusted to the announced schedule for implementation of pyro-processing technology in the ROK (desired completion of the engineering scale facility as well as an initial mock facility). This work is being performed in close co-operation among the ROK, SGCP, SGIM, SGTS and SGOA. The final reports of the MSSP task will be published by the end of December 2011, the IAEA has been discussing with ROK to identify additional tasks where assistance of Member State Support Programmes is required.

  During the next two years, the IAEA will use the information provided by the ROK Support Programme to identify acquisition paths and diversion scenarios and to develop a generic safeguards approach for a pyro-processing facility with assistance of Member State Support Programmes (Task Proposal 10/CCA-005, ROK C 1885).

  – *Geological Repository*

  The Experts Group for Application of Safeguards to Geological Repositories (ASTOR) was established as a joint Member State Support Programme task (JNT C 1611 BEL, CAN, CZ, EC, FIN, FRA, GER, HUN, NET, ROK, SWE, USA) to provide recommendations to the IAEA regarding the application of safeguards to geological repositories.

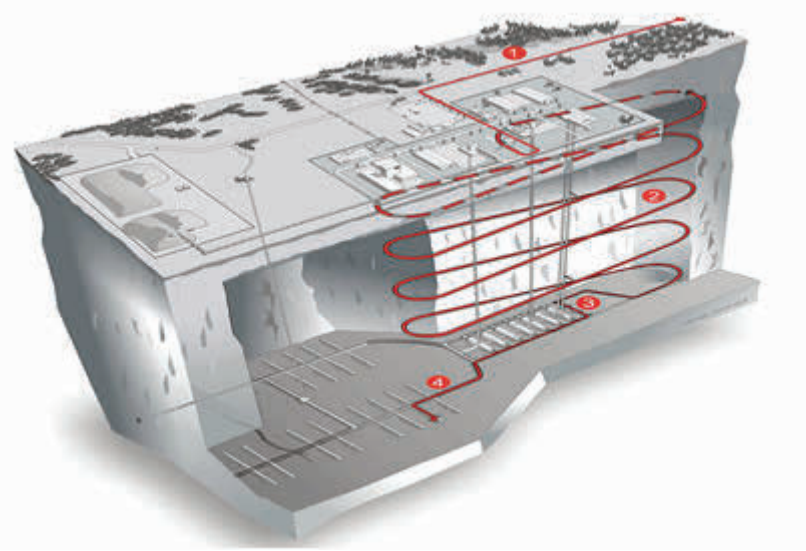

Figure 2: 3D Image of Geological Repository.

The first five-year work plan resulted in the development of model integrated safeguards approaches and design information questionnaires for spent fuel conditioning plants and geological repositories. The ASTOR task plan for the next phase of the ASTOR project is being developed. The plan will identify subtasks to finalize the model safeguards approach for geological repositories and further develop relevant equipment and techniques, including for DIVs, canisters identification and monitoring, as well as long term geophysical monitoring. The ASTOR task is coordinated with projects SGIM-02, SGTS-01, SGTS-08, and SGTS-11.

– Enrichment facilities

In July 2009, Global Laser Enrichment (USA) announced the start-up of a "Test Loop" to evaluate the next-generation Separation of Isotopes by Laser EXcitation (SILEX) uranium enrichment technology. The SILEX technology, with its promise of cost-efficient uranium enrichment, may become of interest to other States. The IAEA should be prepared to apply safeguards at facilities using this advanced technology. A Task Proposal 11/CCA-001 was proposed in 2011 to assist in the development and testing of a model safeguards approach. Assistance with this proposal is still under consideration but is somewhat problematic due to commercial and proliferation sensitivity.

*Key Objective 3. Monitor and address any observed deficiencies or vulnerabilities in safeguards approaches.*

- Develop guidelines for the resolution of anomalies in States in which integrated safeguards has been implemented.

  Before integrated safeguards are implemented, anomalies have been traditionally evaluated based on the IAEA's ability to draw a positive safeguards conclusion for the individual facility where the anomaly occurred based primarily on nuclear material verification measures. In the context of integrated safeguards, more emphasis is being placed on drawing safeguards conclusions at the State level. By considering the significance of the anomaly in terms of State specific factors and technical objectives, the IAEA will be better able to assess the anomaly in the context of possible acquisition paths for developing a nuclear weapon. Preliminary guidelines were developed and have been tested. A more comprehensive basis for dealing with anomalies under integrated safeguards has been developed, based on experience gained in States where integrated safeguards are already implemented. The Anomaly Resolution Procedure is undergoing revision by IAEA staff (*Activity #5*).

- Review the IAEA's existing legal framework to assess whether the IAEA has adequate legal authority and access to all relevant information, persons, and locations.

  In order for safeguards implementation to be effective and efficient, the Agency must make full use of its existing legal authority. It is important to keep the Agency's legal authority under continual

review and to examine its responsiveness to emerging proliferation challenges. For example, the updating of Annexes I and II of the Model Additional Protocol to include additional technologies, activities, materials, and equipment, including dual use items, is essential. In general, the Safeguards Department would like to enhance its legal authority to one that is more universal, unambiguous and less susceptible to disputes and challenges.

Recent information regarding trade in uranium and thorium from unconventional sources has raised questions concerning the IAEA's rights to request information about and access to exports and imports of these materials. During the period of 2012-2013, IAEA staff will begin to develop proposals addressing these issues.

*Key Objective 4. Continue to improve safeguards working methods.*

- Maintain Relevance of the Long-Range Strategic Plan 2012-2023.

  During 2008, the Department of Safeguards developed a methodology for long-range strategic planning, which was implemented in 2009 to develop the first ever Departmental Long-Term Strategic Plan covering the period 2012-2023, approved for implementation in 2010. In 2010 the Long-Term Strategic Plan was implemented through providing input to the Major Programme 4: Nuclear Verification Programme component of the 2012-2017 Medium-Term Strategy and the associated 2012-2013 Programme and Budget.

  The long-Term Strategic Plan 2012-2023 served as the basis for the development of the first ever Long-Term R&D Plan 2012-2023 on which future biennial D&IS plans will be based.

  During the 2012–2013 period, both plans will be implemented; the External Environment analysis document that was used as input to the development of the Long-Term Strategic Plan 2012-2023 will be reviewed and updated to maintain its continued relevance and identify, inter alia, the impact of the 2010 catastrophe in Japan on nuclear energy use (*Activity #6)*.

*Key Objective 5. Strengthen cooperation between the IAEA and SSACs.*

- Provide guidance and assistance to States to improve their performance in the implementation of safeguards, and make guidance and other resources accessible to States through a dedicated web page on the IAEA website.

  To facilitate the cooperation between the IAEA and States in safeguards implementation, and to improve States' understanding and performance, the IAEA is preparing a new "Safeguards Implementation Series" comprised of a reference guide and detailed implementation practices. The reference guide, titled "Guide for States Implementing Comprehensive Safeguards Agreements and Additional Protocols," focuses strictly on the obligations of the parties to comprehensive safeguards agreements - the IAEA, the State, and, in some cases, a regional organization. It provides a comprehensive listing of obligations contained in the comprehensive safeguards agreement and protocols to it, and the model text of the subsidiary arrangements to the safeguards agreement. More detailed guidance, implementation practices, and specific measures to help States self-assess their performance will be provided in subsequent topical guides that will follow the basic structure of the reference guide. The series of Guides is intended for individuals responsible for safeguards implementation at regional, State and facility levels, as well as for IAEA staff and those involved in the design of new nuclear facilities and safeguards equipment. The Guide was published in late 2011. The first "Implementation Practice" will address the needs of States with Small Quantities Protocols, and will be published in 2012. The entire Series will be published by the end of 2013, in both paper copy and in a web-based format, on a webpage devoted to State safeguards regulatory authorities. Experts meetings will be held with representatives from safeguards authorities from a variety of States, to review drafts in detail, and provide feedback. Experts from States will also contribute substantially to the development of the implementation practices, by sharing their experiences and lessons learned that are relevant to each topic, and by reviewing the drafts and providing feedback. In addition to the topical guidance series, the IAEA is working with member States to prepare a reference text, suitable for use in a university course or for self-study, addressing the institutional

and technical aspects of international safeguards (Task Proposal 10/CCA-007). The development of Guidance and the interactions with States are coordinated with SGCP-102.

- Develop and implement approaches to make full use of the findings of State and regional systems in the evaluation, design and implementation of safeguards.

  Several years of safeguards implementation under the IAEA-EURATOM 'new partnership approach' have provided a foundation for developing concepts to evaluate and make full use of the findings of SSACs or RSACs in order to achieve efficiencies and increase effectiveness. The IAEA and EURATOM will convene a 'reflection group' to apply the lessons learned to the development of methods for, inter alia, evaluating inspectorate performance; accepting data; joint use of equipment, procedures and standards; and conduct of quality audits. The reflection group will develop and agree upon a work plan in 2011, and implement the plan during 2012. The IAEA will consider the results of this work in developing generic approaches for evaluating, planning and implementing enhanced cooperation with State and regional systems (*Activity #7*).

*Key Objective 6. Provide advice and assistance for the effective verification of nuclear arms control and reduction agreements, including nuclear disarmament on request.*

- Prepare for future nuclear arms control and reduction agreements.

  During 2010, the Department of Safeguards provided support to EXPO and in 2011, the Department of Safeguards was invited to participate in several 'Side events' organised by the Permanent Representatives of Australia and Japan to the Conference of Disarmament. On these occasions the Department of Safeguards made presentations and provided technical support to discussions on the verification of an the Fissile Material Cut-off Treaty (FMCT).

  In accordance with the formal request received from the authorities of USA and the Russian Federation, during the biennium 2010-11, the Department of Safeguards actively participated in the elaboration of Russia-US-IAEA agreement defining verification measures to be performed by the IAEA under the U.S.-Russia Plutonium Management and Disposition Agreement. This task is coordinated with project *SGTS-15 Technologies for New IAEA Verification Mandates*.

  During the 2012–2013 period, the IAEA plans to accomplish the following tasks (*Activity #8)*:

  – Continue to participate in efforts to develop verification schemes as requested under the Pu Management and Disposal Arrangement (PMDA) between the USA and the Russian Federation.

  – Continue to monitor general nuclear disarmament discussions and developments at various fora and, when requested, will contribute to technical studies on the verification of an FMCT.

### Key achievement targets

- Issue guidelines and models for State evaluation groups to use in the development and preparation of State-level objectives-based safeguards approaches. (Key Objective 1): March 2012.
- Update processes maps and finalize procedures needed to implement State-level objectives-based safeguards in 2013 (Key Objective 1): December 2012.
- Revise other key existing policies, procedures and guidance documentation to support the implementation of the State-level concept. (Key Objective 1): December 2013.
- Finalize the draft high level safeguards by design (SBD) principle document and distribute it to Member State Support Programmes for comment (Key Objective 1): December 2012.
- Issue updated study of "Long Term Strategic Planning – External Environment" (Key Objective 4): December 2013.
- Publish guidance to States to improve their performance in the implementation of safeguards (Key Objective 5):

- Publish "Guide for States Implementing Comprehensive Safeguards Agreements and Additional Protocols" in both hard copy and in a web-based format: December 2012.
- Publish the entire "Safeguards Implementation Series": December 2013.

- Implement methods and arrangements to enhance cooperation and make full use of the EURATOM system, including data generated by the EC. (Key Objective 5): December 2012.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### *5.1. Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| ARG | C 1770 | Guidance for Designers and Operators on Design Features and Measures to Facilitate the Implementation of Safeguards at Future Nuclear Fuel Cycle Facilities | Ongoing |
| BEL | C 1746 | | |
| BRZ | C 1767 | | |
| CAN | C 1739 | | |
| CPR | C 1748 | | |
| EC | C 1726 | | |
| FIN | C 1829 | | |
| FRA | C 1792 | | |
| GER | C 1780 | | |
| JPN | C 1738 | | |
| ROK | C 1724 | | |
| UK | C 1755 | | |
| USA | C 1734 | | |
| AUL | C 1208 | Re-Examination of Basic Safeguards Implementation Parameters | Provides support on an as-requested basis |
| BEL<br>CAN<br>CZ<br>EC<br>FIN<br>FRA<br>GER<br>HUN<br>NET<br>ROK<br>SWE<br>USA | JNT C 1611 | Application of Safeguards to Geological Repositories (ASTOR), Group of Experts<br>(BEL, CAN, CZ, EC, FIN, FRA, GER, HUN, ROK, SWE, USA(C.118)) | Ongoing |
| FRA | C 1904 | Consultant - Evaluations Supporting Making the IAEA Safeguards System Fully Information Driven | Proposed task completion in 2012 |
| GER | C 1473 | Development of Techniques to Estimate the Separative Capacity of R&D Isotope Separation Installation (A.33) | Provides support on an as-requested basis |
| GER<br>HUN<br>UK | JNT C 1871 | Acquisition Path Analysis Methodology and Software Package (GER(B.24), HUN, UK(A7(k))) | Ongoing |
| ROK | C 1761 | Support for Development of a Safeguards Approach for a Pyroprocessing Plant | Proposed task completion in 2012 |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| ROK | C 1885 | Contribution to a Safeguards Technical Report on Pyroprocessing | Ongoing |
| UK | C 1265 | Conceptual Development Support for Integrated Safeguards (A7(e)) | Provides support on an as-requested basis |
| USA | C 1134 | Consultant - Services Safeguards Issues (F32) | Provides support on an as-requested basis |
| USA | C 1451 | Consultant - Development Support for Integrated Safeguards. (C.112) | Provides support on an as-requested basis |
| USA | C 1677 | Consultant: Development of Safeguards Documentation (C.119) | Provides support on an as-requested basis |
| USA | C 1683 | Enhancement of Physical Model Conversion 1 and Conversion 2 Sections (C.120) | Ongoing |

### 5.2. *Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 10/CCA-002 | Improvement of IS Approaches for LWR with MOX | Outstanding with JPN |
| 10/CCA-003 | Assessment of Environmental Sampling Sensitivity and Defeat Strategies | Outstanding with UK |
| 10/CCA-004 | Acquisition Path Analysis Methodology and Software Package | Outstanding with BEL, EC, FRA, RUS, USA |
| 10/CCA-005 | Contribution to a Safeguards Technical Report on Pyroprocessing | Outstanding with EC, FRA, JPN, RUS, UK, USA |
| 10/CCA-006 | Support to Further Cooperation between the SSAC and the IAEA | Outstanding with JPN |
| 10/CCA-007 | Textbook on International Safeguards | Outstanding with ARG,AUL, EC, JPN, ROK, SWE, UK, USA |
| 11/CCA-001 | Support for Developing a Conceptual Safeguards Approach for an Enrichment Facility using the SILEX (Laser Enrichment) Technology | |

### 5.3. *Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | Develop an effective, efficient, and non-discriminatory approach to safeguards implementation taking into account State-specific factors |
| Activity #2 | Develop approaches for monitoring and evaluating the effectiveness of safeguards implementation |
| Activity #3 | Revise and update the Safeguards Policy Series and other guidance documents |
| Activity #4 | Support the Operations divisions in the development of State-level safeguards approaches |
| Activity #5 | Develop guidelines for the resolution of anomalies in States in which integrated safeguards has been implemented |
| Activity #6 | Maintain Relevance of the Long-Range Strategic Plan 2012-2023 |
| Activity #7 | Develop methodologies for evaluating and implementing enhanced cooperation with State and regional systems |
| Activity #8 | Prepare for future nuclear arms control and reduction agreements |

# SGCP-101

## Quality Management

### Project Manager: Haroldo Barroso Jr. Division: SGCP

### 1. Introduction

This document describes the plans for developing and implementing a quality management system and ensuring that it is compliant with the requirements of the management standard, ISO 9001:2008, within the Department of Safeguards for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017 1, and the Long-Term R&D Plan, 2012–2023 2.

This project supports in particular Strategy 5 – Changing the Way the Department Works, and fundamentally supports all Strategies of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

The scope of the project includes the development and implementation of a process-based management system that is compliant with ISO 9001:2008. The scope also includes activities to support the Department in using that system, until the system is mature. The end-users of this project range from staff in the Department of Safeguards, the Board of Governors, and States who receive reports on the outcome of the Secretariat's verification and evaluation activities.

As outlined in the Departmental Quality Policy, the implementation of a process-based management system supports the Department's commitment to provide soundly-based safeguards conclusions to the Board of Governors regarding the peaceful use of nuclear material. The process-based approach enhances the effectiveness and efficiency of the Department's activities, and ensures these activities are performed consistently and uniformly across the Department. This approach also provides a greater degree of transparency to Member States in terms of how the Department's activities are conducted and how much those activities cost.

Consistent with the scope of the project, this 2012–2013 biennium plan includes both the development of a new element of the management system, namely measurement systems for processes, and the wider implementation and support for the elements already in place to ensure they are integrated into the day-to-day activities of all Department staff.

The focus of the project over the next biennium and beyond will be on establishing the process-based approach fully within the Department. This involves not only ensuring that processes are adequately defined and have the appropriate documentation, but also developing measurement systems to monitor process performance, and ensuring the Department has the appropriate set of tools and techniques to continually improve those processes. These tools and techniques will be refined as experience with their use is gained.

The next two biennia will also be a period of transition and focused improvement as the Department makes the safeguards system more objectives based and information driven. During the 2012–2013 biennium, the Department will be modifying existing processes, and will also be developing new ones. Based on experience with these processes, improvement will then become a focus in the 2014–2015 biennium. As such, the quality management project plans for these two biennia will need to be designed taking into consideration new demands from the Department.

1 GOV/2010/66 dated 26 November 2010.

2 STR-370.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term direction for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Term R&D Plan, 2012–2023.

As a first step, the long-term direction of the current D&IS project was defined:

***Continue to implement a department-wide quality management system and monitor, analyse, and report on its effectiveness.***

In order to support the long-term direction, activities have to be initiated and developed during the biennium and can be structured under the following key objectives:

1. *Support implementation of the management system.*

2. *Develop, and implement fully, the process-based approach within the management system and continually improve its processes.*

3. *Orient the departmental working culture to support the achievement of the Department's Strategic Objective to continually improve and optimize departmental operations and capabilities to effectively carry out the IAEA's verification mission.*

4. *Improve the management of knowledge, and encourage knowledge sharing.*

5. *Enhance financial transparency and accountability by refining the methodology and process forevaluating the costs of safeguards implementation (e.g. State level approaches, annual implementation plans) and possible new verification missions, including refining the methodology to account for finances used.*

## 4. Activities

Most of the activities will be performed by Safeguards Department personnel. Assistance will be required from Member State Support Programmes in a number of these activities.

*Key Objective 1. Support implementation of the management system.*

Three main work areas are planned to help support implementation of the management system.

- Monitoring the implementation of the management system: In order to monitor the overall progress in implementing the management system, and to help indicate where more effort is required, an assessment is planned mid-way through the 2012–2013 biennium.
  - The Department will conduct an assessment of the maturity of the management system, using ISO 9004:2009 as a reference [Target date: Q4-2012]. Based on the result, a target maturity level to be reached at the end of the 2014-2015 biennium will be set, and a plan to reach it will be developed. A follow-up assessment will be conducted at the end of 2015 (Internal Activity #1).
  - MSSP support, in the form of a consultant with experience in assessing management systems (New Task Proposal #11/CPD-001), will be considered in order to help prepare the assessment

(e.g. help develop the methodology, customize the criteria, etc.), and to provide advice after the assessment in terms of interpreting the results, and setting a realistic target and plan.

- Supporting Management Review and Communications: Supporting regular Management Review, and communicating the importance of the management system to staff, will be done as needed. Regular budget funds and resources are used, and MSSP support is not envisioned at this time (Internal Activity #2).
- Management System Training: Introductory and advanced training of staff on the elements of the management system, and their role in it, is an on-going activity (Internal Activity #3). As part of the Department of Safeguards Training Programme, the training will be delivered using the regular budget funds and resources; however, MSSP support (USA JNT B 1277) for the costs associated with that training (e.g. training venue) will need to continue.
  - As a sub-activity, the existing QMS computer based training (CBT) module, which is used as part of the introductory training, will be revised to reflect organizational changes and experience to date [Target date: Q2-2012]. A new CBT module, which will incorporate all management system elements developed to date, will begin development at the end of the 2012–2013 biennium, and be ready for implementation early in the 2014–2015 biennium. Continued MSSP support (CAN B 1630) for this sub-activity will be needed.

*Key Objective 2. Develop, and implement fully, the process-based approach within the management system and continually improve its processes.*

To support this objective, activities are planned in five main work areas that focus on improving processes in terms of their effectiveness and efficiency, and ensuring that adequate documentation for these processes exists, is controlled, and is readily accessible by staff.

- The Internal Quality Audit (IQA) Programme: This programme is now an established element of the management system, and the audit methodology and capability will continue to be refined during the 2012–2013 biennium to better encompass process effectiveness, and evolve to meet the needs of the Department. The following activities are planned:
  - Audits will be conducted, based on approved plans for 2012 and 2013 (Internal Activity #4).
  - The use of other "assessment-like" structures, such as interdivisional/intradepartmental peer reviews and self-assessments, will be reviewed and, if deemed practical, the structures will be developed and implemented (Internal Activity #5) [Target date: Q3-2013]. MSSP support (New Task Proposal #11/CPD-001) will be considered in order to help develop these structures.
  - Utilizing the auditing capability and expertise developed within the IQA, the overall framework and methodology for conducting external audits of the verification findings of State or regional systems of accounting for and control of nuclear material (SSAC/RSAC) will be explored and developed (Internal Activity #6) [Target date: Q4-2013]. Pending departmental approval, a number of trial audits could be conducted after the 2012-2013 biennium. While the audits themselves would be conducted with regular budget funds and resources, MSSP support will be requested in terms of volunteering their SSAC or RSAC for trial audits.
- Corrective Action and Preventive Action Processes: The Corrective Action Process, which is designed to prevent undesirable events or conditions that have occurred from re-occurring, has been implemented as part of the management system. Refinements in this process will be done by regular budget funds and resources, and aside from the training needs outlined in Objective 1, MSSP support is not envisioned for the 2012–2013 biennium.

  ISO 9001:2008 also requires a process for undertaking "preventive action", which are actions taken pro-actively to prevent an undesirable event or condition from occurring in the first place, thereby managing business "risk". This process will be implemented as part of the Corrective Action Process [Target date: Q2-2012] (Internal Activity #7).

- Process Mapping and Documentation: The department's processes need to be adequately described and have an appropriate set of related documentation (e.g. policies, procedures, forms, etc.) (Internal Activity #8). As such, the following activities are planned:
  - Complete baseline mapping of the department's processes, and review, revise, and consolidate their respective set of documentation. These activities, in conjunction with the activity related to process performance indicators (see work area below), is planned to continue through the 2012-2013 biennium and beyond. The scheduling of these activities will be based on the Department's needs and consider the changes made to processes as a result of the Department's initiative to make the safeguards system more objectives-based and information-driven.
  - With specific regard to process documentation, the document management "system" will also continue to be developed and implemented through the following sub-activities, and will be accomplished using regular budget funds except where noted.
    - The existing electronic document storage and retrieval system will be improved based on experience gained, and released for use [Target date: Q1-2012].
    - A number of measures will be identified and implemented to ensure document quality is sustained; i.e. ensuring documents have the appropriate information and level of detail, minimizing duplicate or unnecessary documents, ensuring documents are kept current, etc. One measure may be the development of a writing and style guide to improve the clarity and conciseness of procedures.

  MSSP support, in the form of a technical writer (New Task Proposal #11/CPD-001) will be considered in order to help address the activities outlined above insofar as they relate to the process documentation.
- Process Performance Indicators: Develop and implement measurement and analysis systems that provide management with clear identification of trends in Department's processes, and whether the processes are operating effectively and efficiently (Internal Activity #9). MSSP support, in the form of a consultant (New Task Proposal #11/CPD-001), will be considered for the initial development of these systems and to validate the systems that have been developed so far [Target date: Q3-2013].
- Design and development of new processes and activities: Many of the Department's activities that come within the scope of "design and development" in the context of ISO 9001:2008, are managed as "projects". Although the main activity planned in this area is the development of guidelines for the management of such projects, no work is planned in the 2012–2013 biennium as a matter of priority and resources. The need for such work will be re-evaluated in 2012, but will otherwise be deferred until the 2014–2015 biennium (Internal Activity #10).

*Key Objective 3. Orient the departmental working culture to support the achievement of the Department's Strategic Objective to continually improve and optimize departmental operations and capabilities to effectively carry out the IAEA's verifications mission.*

- Considering the Department's effort over the 2012–2013 biennium to make the safeguards system more objectives based and information driven and the anticipated impact of that effort to positively influence the working culture, the formal assessment of the Department's working culture, which was planned for 2010-2011 (New Task Proposal 10/CPD-001), will be deferred until the 2014–2015 biennium.

*Key Objective 4. Improve the management of knowledge, and encourage knowledge sharing.*

To ensure that effective knowledge management practices are implemented in the Department, including enhancing the exchange of information, and the structures to share knowledge, work is focused on the following two areas:

- Retain job-critical knowledge from staff leaving the Department: Throughout the 2012–2013 biennium, support to the implementation of the departing and retiring staff knowledge retention

program, which began in the 2010–2011 biennium (Internal Activity #11) will continue. MSSP support (CAN B 1630) will be requested in advising and deploying video and text media, such as improving the computer based tutorial for supervisors [Target date: Q3-2012], and for videos used for the storytelling technique (~20 videos to be recorded during 2012–2013 biennium).

- Improve the "day to day" management of knowledge. The following activities are planned:
  - The knowledge oriented analysis methodology, which was applied to the Complementary Access process in the 2010–2011 biennium, will be used to analyse another core process [Target date: Q2-2012] (Internal Activity #12). Continued MSSP support, in the form of an expert in this methodology (USA X 1892), will be considered. A consultant to develop – where appropriate – IT solutions for deficiencies identified during the analysis, will also be considered (i.e. also within USA X 1892).
  - An information material/course on key knowledge concepts for managers, and setting management expectations for newcomers, and existing staff members, will be developed and delivered [Target date: Q3-2012]. This package/course will be delivered using the regular budget funds and resources (Internal Activity #13), but MSSP support (USA X 1892) will be considered in the form of an expert who would advise on the design of such material/course.
  - Review the use of, and develop as appropriate, structures that enhance the continual sharing of knowledge. For example, an operating experience programme that involves notifying staff of events or conditions that have occurred in a timely manner [Target date: Q2-2012], or organizing and facilitating seminars on shared divisional/sectional issues. While these structures would be implemented and operated with regular budget funds and resources (Internal Activity #14) the use of experts who have practical experience with such structures or programmes will be considered (USA X 1892).

*Key Objective 5. Enhance financial transparency and accountability.*

The cost calculation model and methodology for calculating safeguards implementation costs, as well as the comparison of costs of safeguards measures, will be reviewed and refined based on use and experience gained since the time that the methodology was implemented in 2011 (Internal Activity #15). This activity is on-going throughout the 2012–2013 biennium with continued MSSP support (USA F 1808) in the form of a consultant to conduct a peer review of the work done.

The following sub-activities are planned:

- Adapt the cost calculation model to the new Programme and Budget structure [Target date: Q1-2013].
- Assess the feasibility to use the cost calculation model for resource planning [Target date: Q4-2013].

### Key achievement targets

- Support the Department's transition to a safeguards system that is more objectives-based and information-driven:
  - Map or re-map the processes related to the implementation of the State-level concept, in line with the Departmental project for "Evolving the State-level Concept", so that the ability to calculate costs of the main safeguards products will be maintained (Key Objective 2): June 2013
  - Revise key process documentation, such as policies, procedures and guides, to reflect the changes made to the processes during the implementation of the Departmental project for "Evolving the State-level Concept" (Key Objective 2): Dec. 2013
- Develop, implement, and routinely monitor on a trial basis performance indicators for 4-6 safeguards processes (Key Objective 2): Dec. 2013

- Consolidate and improve process documentation (i.e. procedures, guides, forms, etc.) for 4-6 main safeguards processes (Key Objective 2): Dec. 2013
- Analyse and improve a second safeguards process (to be selected before the end of 2011) using the knowledge-oriented methodology (Key Objective 4): Sept. 2012

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### *5.1. Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| CAN | B 1630 | Computer-based Quality Management Training (CBQMT) | Task to continue into the 2014-2015 biennium |
| USA | JNT B 1277 | Workshop on Quality Assurance Techniques (USA) (B90) | Task to continue into the 2014-2015 biennium |
| USA | F 1808 | Consultant: Implementing Activity Based Costing (ABC) in the Safeguards Cost Calculation System (F.40) | Task to continue into the 2014-2015 biennium |
| USA | X 1892 | Implementing Departmental "Day to Day" Knowledge Management (KM) Using Practical Experience from a Variety of Experts (C.124.01) | Task to continue into the 2014-2015 biennium |

### *5.2. Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 10/CPD-001 (Key Objective 3) | Consultancy on assessment of organizational culture | Under review. Target to submit to MSSP is Q3-2013] |
| 11/CPD-001 (Key Objectives 1 and 2) | Implementation of a process-based management system using practical experience from a variety of experts | Planned task under review. Target to submit to MSSP is Q1-2012] |

### *5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 (Key Objective 1) | Conduct Maturity Assessment of the Management System |
| Activity #2 (Key Objective 1) | Support Management Review and Communications |
| Activity #3 (Key Objective 1) | Deliver Management System Training |
| Activity #4 (Key Objective 2) | Conduct Internal Quality Audits |
| Activity #5 (Key Objective 2) | Development of other "assessment-like" structures |
| Activity #6 (Key Objective 2) | Develop overall framework and methodology for conducing audits of SSAC/RSAC verification findings |
| Activity #7 (Key Objective 2) | Refine the Corrective Action Process, and extend it to include Preventive Action |
| Activity #8 (Key Objective 2) | Complete process maps and documentation |
| Activity #9 (Key Objective 3.2) | Develop process performance measurement systems. |
| Activity #10 (Key Objective 2) | Design and development of new processes and activities |

| Activity No. | Activity Title |
|---|---|
| Activity #11 (Key Objective 4) | Support implementation of knowledge retention program for departing and retiring staff |
| Activity #12 (Key Objective 4) | Analyse core process using the knowledge oriented analysis methodology |
| Activity #13 (Key Objective 4) | Deliver information package/course on key knowledge concepts to the Department |
| Activity #14 (Key Objective 4) | Review use of, and develop, structures to enhance knowledge sharing |
| Activity #15 (Key Objective 5) | Refine cost calculation model and methodology |

## Attachment


Figure 1: Department of Safeguards Quality Policy Statement, 3 August 2011.

# SGCP-102

## Training

### Project Manager: ean-Maurice Crété — Division: SGCP

### 1. Introduction

This document describes the plans for developing and implementing training within the Department of Safeguards for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building support to the non-proliferation regime, Strategy 2 – Coping with the workload, Strategy 3 – Safeguarding advanced and innovative nuclear fuel cycle, Strategy 4 – Taking on new mandates, Strategy 5 – Changing the way the Department works, Strategy 6 – Managing the workforce, Strategy 8 – Building political support* and *Strategy 9 – Making use of, and enhancing, legal authority* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

Safeguards staff and Member States personnel require skills and competence to effectively implement international safeguards.

With the developments in safeguards and nuclear fuel cycle related technologies, the increasing focus on the State-level approach, and the efforts towards evolving the safeguards system to be more objectives-based and information-driven, the expansion of tasks and responsibilities of safeguards staff, particularly inspectors and analysts, in combination with the introduction of new safeguards equipment and technologies, the training needs have significantly increased.

Figure 1: On-site training.

Full scope training on safeguards implementation at nuclear facilities and sites, and technical training involving nuclear material are only possible through Member State Support Programmes (MSSPs); this is a key factor in the process of qualifying safeguards inspectors to perform their tasks.

As underlined by an Office of Internal Oversight Services (OIOS) programme evaluation report, "Support from Member States has been essential to the safeguards training programme, particularly to host courses involving practical works on nuclear facilities and material. Without this cooperation, safeguards training activities would suffer seriously."

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

In addition, training courses for Member States' staff play an important role in the effectiveness and efficiency of safeguards activities both for Member States and for the IAEA. Reliable State Systems of Accounting for and Control of Nuclear Material (SSACs), along with proper administrative, legislative and regulatory systems, are fundamental for States to fulfill their nuclear non-proliferation obligations, while the IAEA greatly benefits from effective and efficient SSACs.

Implementation of increasing number of international, regional and national SSAC training courses and workshops, and organization of ISSAS (IAEA SSAC Advisory Service) missions during the following two years also requires strong support from Member States on logistical and technical matters.

The rationale underlying the SGCP-102 project is to establish competency profiles for current and future missions and challenges in the area of safeguards as identified by Departmental long-range strategic planning, and to transfer these competencies to safeguards staff and SSACs staff through courses built upon a systematic approach to training, emphasizing not only technical competencies but also behavioural competencies and including an assessment mechanism.

As a result, the safeguards training curriculum needs to be maintained and updated in a continuous and timely process. Three major challenges are:

- Providing safeguards staff with new skills and abilities while maintaining existing competencies, particularly in nuclear material accountancy;
- Offering a balanced training programme to meet the needs of safeguards staff, particularly inspectors and analysts, in the areas of both technical and behavioral competencies; and
- Meeting a very broad range and variety of Member States' needs in establishing and maintaining their SSACs through a relevant set of international, regional and national training courses taking into account common and specific needs, in particular for States developing nuclear energy.

The evolving nature of safeguards towards a system that is more objectives-based and information-driven requires structuring the project by an enhanced integration of all courses with the State level concept as a common driver.

This is an ongoing process, requiring a thorough monitoring of courses' relevance and effectiveness through a robust assessment mechanism and by keeping abreast of latest developments in safeguards-related issues ("opportunities and challenges" according to the SWOC approach[3] applied by the Department), from technical, legal and training methodologies standpoints, through permanent and close cooperation, communication and common understanding within all project stakeholders.

Figure 2: SSAC course in Chile.

[3] A SWOC analysis is a method to organize thinking on best opportunities and core strengths. It is the framework most strategic planning teams use to analyse their organization's opportunities, how to play to their strengths, what weaknesses to fix and what are the challenges they must prepare for. A SWOC analysis is straightforward and provides a method to talk through all the critical issues.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term direction for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023.

As a first step, the long-term direction of the current D&IS project was defined:

***Achieve the technical and behavioural competencies of IAEA safeguards staff needed to successfully carry out their assigned safeguards duties and to strengthen SSACs competencies in the fulfillment of their safeguards obligations.***

While pursuing such a long-term direction, the project will contribute to:

- Enhance capability to detect undeclared nuclear materials and activities and to resolve anomalies, questions and inconsistencies;
- Improve preparedness to safeguard GEN III and GEN IV reactors and innovative fuel cycles;
- Promote and support enhanced safeguardability in the design of nuclear facilities;
- Maintain IAEA readiness to contribute to international verification of nuclear disarmament, upon request;
- Further elaborate, develop and implement State-level safeguards concepts;
- Align the Department's human resources with the evolving needs of the Agency's verification mission and safeguards system;
- Seek to fully implement the Agency's legal authority in the implementation of safeguards);
- Increase States' understanding of IAEA safeguards and verification and correct misconceptions;
- Enhance cooperation with and support to States, including to newcomers to nuclear energy; and
- Enhance Agency-State cooperation in the implementation of safeguards.

In order to support the above long-term direction, activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Ensure adequate competence of safeguards staff, and ensure that safeguards-related activities are carried out in an efficient and effective manner, through the provision of appropriate, up-to-date training;*

2. *Maintain and update the relevant and necessary nuclear expertise within the Department; and*

3. *Help States to establish and maintain their SSACs and other relevant infrastructure as required by safeguards agreements.*

## 4. Activities

The D&IS activities relating to training activities are developed as follows:

- Identification of operational needs;

- Identification of the skills, knowledge and abilities to be developed through training in order to meet these operational needs;
- Preparation of relevant learning objectives;
- Design and preparation of training courses, including an assessment mechanism, keeping in mind the global objective of developing an integrated training programme with the State level Concept as a common driver.

The first three steps are mostly developed with internal resources, except for some specific cases requiring particular competencies not present internally (e.g. psychologists for the development of soft skills). It is important for the Department to have the capacity to identify and develop its needs regarding staff competencies development, particularly since safeguards-related activities are extremely specific.

Furthermore, being able to describe staff-required profiles is a clear indicator that an organization actually owns its processes. This is the reason why the training section works closely with all divisions, from the development of new conceptual framework to including lessons learned from the field *(Activities #4 and #5).*

Once the objectives of a training course are set and when their achievement requires additional resources, tasks are prepared and proposed to Member States Support Programmes for the implementation of the fourth step.

Funding for most of the described D&IS activities is foreseen to be provided by Member States Support Programmes (MSSP) which continue to play a major role in achieving the stated project objectives. The expertise and complementary resources brought by cost free experts are key elements for a successful implementation of the project.

*Key Objective 1. Ensure adequate competence of safeguards staff, and ensure that safeguards-related activities are carried out in an efficient and effective manner, through the provision of appropriate, up-to-date training.*

As recommended by OIOS, the development of an integrated training package for a more consistent training path and the use of a more robust evaluation mechanism are the priorities for the Training Section. As mentioned above, this will be conducted through internal resources to the extent possible and used as an input for the structuring of the training programme.

- Development of new teaching tools.

  The development of computer based training or virtual reality training tools is also a priority in order to take full advantage of modern techniques and to make training courses more available through e-learning and more interactive through simulation of activities in computerized models of


Figure 3: Classroom training.

nuclear facilities. Computer-based training has been applied to environmental sampling under task CAN B 1759. Support for the development of virtual reality tools for training has been requested through *task proposal 08/CTR-006*. A task is being developed with USA on the development of a

comprehensive computerized CANDU reactor including safeguards features. EC B 1876 aims at training facility officers and safeguards technicians in optimizing surveillance systems. ROK B 1907 offers a computerized model of a bulk handling facility for training inspectors on safeguards at this type of facility. How to use the software Freeze Frame in a training environment is an important component of the task proposal 11/SSD-001 "Freeze Frame Software Integration into Safeguards Secure IT Environment" under project *SGIS-01 Integrated Analysis*.

- Soft skills training.

  Tasks Enhanced Observational Skills, USA B 1446 and Enhanced Communication Skills, USA B 1245, continue to support inspectors training both for new inspectors and experienced inspectors.

  Training in and evaluation of the necessary soft skills for safeguards activities is a multi-phase joint project currently supported by FRA B 1708 and FIN B 1699. The first phase completed in 2009 under FRA B 1708 consisted in the identification of necessary and existing soft skills for safeguards activities through interviews and survey. The second phase will consist in designing training courses filling the gaps identified between necessary and existing soft skills. Support has been requested through *task proposal 05/TTR-008*.

  Analytical skills training is an important component of the training curriculum for State evaluation. It is provided by the USA under voluntary contributions. It should be expanded to include consistency analysis training. It will be required on a long-term basis.

  A negotiation skills training course is supported by UK B 1874. Its objective is to train all safeguards staff responsible for negotiating safeguards implementation documents like subsidiary agreements or facility attachments, or for dealing with States' authorities on a routine basis.

  A writing skills course (four sessions per year) has been developed through regular budget (*Activity #2*). Its objective is to enable safeguards staff to report of their activities in a clear, concise and factual manner.

- Nuclear material verification.

  The basic training in non-destructive assay (NDA) techniques is conducted in the USA with support provided under USA B 0086. This course is mandatory for newly recruited inspectors. An additional course EC B 1702, developed in coordination with Los Alamos, is provided by the EC for more experienced inspectors. This course, originally organized at JRC-Ispra, is being transferred to ITU Karlsruhe due to relocation of nuclear material between these two sites.

  The Spent Fuel Training provided under tasks CAN B 1688, FIN B 1435 and SWE B 1709 remains part of the training programme and will be required on a long-term basis. It is now organized on two sites, one for improved Cerenkov viewing device (ICVD) and one for gamma-neutron measurements for a better teaching process taking full advantage of available material on each site.

  The Advanced Plutonium Verification Course is conducted in the USA with support provided under USA B 0086 and in Russia under RUS B 1719. It is complemented by EC B 1750 "Plutonium diversion detection" which provides experienced inspectors who are in charge of coordinating activities at facilities processing plutonium with an integrated set of analytical concepts and practical tools and techniques. These courses remain part of the training programme and will be required on a long-term basis.

  A set of half-day seminars provides inspectors and analysts with the necessary background for understanding the mathematical rationales underlying safeguards verification strategies and the analytical treatment of quantitative data. It has been developed on internal resources with the support of SGIM (Activity #3).

  Nuclear Material Solution Accountancy and Verification Training, EC B 0620, and Training on Laser Range finder, EC B 1844, remain part of the training programme and will be required on a long-term basis.

With approximately 250 unattended and remote monitoring systems currently installed in the field, Training on Remote and Unattended Monitoring, USA B 1337, needs to be revised and expanded with a view to establish a comprehensive training curriculum for safeguards inspectors and technical staff. It will be required on a long-term basis.

- Nuclear activities verification.

  The Revision to Nuclear Fuel Cycle Training Manuals, AUL B 1782, FIN B 1900, JPN B 1713, UK B 1727, and USA B 1772, will make available a set of seven manuals providing a comprehensive technical background on the various steps of the nuclear fuel cycle to inspectors and analysts. A first document was published on "Fuel Fabrication".

  The Comprehensive Inspection Exercise for light water reactors is supported by CZ B 1431, HUN B 1065 and Slovakia, with BEL B 1433 as backup. These courses have been improved by strengthening the complementary access component. The successful completion of the course is mandatory for newly recruited inspectors after having completed the Introductory Course on Agency Safeguards (ICAS). Two courses per year will be required on a long-term basis.

  An Advanced Comprehensive Inspection Exercise at LWRs and CANDU reactors was successfully organized for the first time in 2010 in Republic of Korea. It is supported by ROK B 1872 and will be required on a long term basis.

  The Comprehensive Inspection Exercise at Bulk Handling Facilities is supported by UK B 1751, ROK B 1895 and SWE B 1328. At least two courses will be required per year on a long term basis.

  Design Information Verification Exercise at Bulk Handling Facilities, UK B 1618, remains part of the training programme and will be required on a long-term basis.

  Design Information Verification at Research Reactors, JNT B 1757 USA, BEL, CZ, was given in the USA for the first time in 2009. The course is now organized on a yearly basis at Mol in Belgium and is highly appreciated. Given the sensitivity of the topic, this task will be required on a long-term basis.

  Limited Frequency Unannounced Access (LFUA) at enrichment facility, UK B 1797, GER B 1896 and NET B 1852 will be required on a long-term basis.

  Training in implementation of safeguards at centrifuge enrichment plant RUS B 1053 has been reassessed in 2011 in order to avoid overlaps and gaps with other courses on the same topic and will take place in 2012 in Angarsk.

  The IAEA's requirements for Inspector Training for CANDU Facilities, CAN B 1624, have been revised in order to focus on safeguards considerations for CANDU plants including integrated safeguards and the fuel monitor system.

  Training for inspection activities at JNC-1 site facilities organized jointly with the operator and State inspectors JPN B 1812 focus on fuel cycle related activities at JNC-1 and relevant safeguards approaches. It will be required on a long-term basis.

  Workshop on Additional Protocol Activities, FIN B 1422, HUN B 1525, USA B 1415, and EC B 1563, designed as full scope training for the implementation of complementary access (CA), is based on realistic scenarios jointly developed by the Department and the MSSPs. It has been expanded to train the inspectors to a wide range of facility types and operational situations. Emphasis is also put on the identification and definition of CA technical objectives. EC B 1563 is being revised with the support of ITU Karlsruhe and will focus on CAs at R&D centres. These courses are key courses of the training programme and will be required on a long-term basis.

  Technical Visits to Uranium Mines, CZ B 1526 and Training Course on Nuclear Material Accounting in Action, CZ B 1558, should continue.

  The Safeguards for Support Staff Training Course is supported by the Czech Republic and Slovakia with visits to nuclear power plants in both countries. This course is a key component for providing all safeguards staff with the same necessary safeguards culture and knowledge. It will be required on a long-term basis.

Figure 4: Safeguards for Support Staff training.

With regard to reprocessing plants, Familiarization Visit to La Hague for Reprocessing Plant, FRA B 1562, has been conducted successfully in the previous years and should be kept available. A new task JPN B 1897 "Training on Safeguards at Reprocessing Plants" has been accepted by Japan in order to provide joint training on small-scale reprocessing activities. The first course will take place in Tokai in 2012.

*Key Objective 2. Maintain the relevant and necessary nuclear expertise within the Department.*

These activities are twofold:

- Expertise on nuclear fuel cycle facilities:

  The Nuclear Fuel Cycle and Proliferation Pathways, UK B 1698, and Advanced Training in Nuclear Fuel Cycle Facilities to Assist State evaluation, UK B 1903, previously UK B 1550: these courses are a mandatory part of the training programme and will be required on a long-term basis. They proved themselves as very effective platforms for integrated training for inspectors and analysts.

  The pyroprocessing course, USA B 1669, was conducted for the first time in 2007. The task is to be continued in coordination with the development of a safeguards approach for pyroprocessing facilities.

  Safeguards Training Course on Enrichment Technology, USA B 1001: this course remains part of the training programme and will be required on a long-term basis.

  Laser Isotopes Separation Technology, FRA B 1506, a course is planned for 2012 and will be part of the long-term planning, given the latest development in this technology.

- Expertise on collecting and processing safeguards relevant information:

  Training on Export Control Concepts and Standards from International Perspective, USA B 1800, is a key course, particularly for country officers and analysts. It will be part of the long-term planning. Training for Information Collection and Analysis for Additional Protocol Verification FRA B 1427 has been extremely useful. The task should continue and the course should be open to more participants.

  Training on Proliferation Analysis initiated by the AUL SP was successful. The course is organized on a yearly basis and is open to analysts and inspectors. The task should continue. Long-term support is requested through task AUL B 1828.

  A State Evaluation Strategy seminar was developed on internal resources in 2010 (Activity #1). This seminar is now a mandatory seminar for staff involved in State evaluation.

  Training for Open Source Information Collection, SWE B 1838 has been revised and includes a basic and an expert level training for inspectors and analysts. Long-term support is requested.

  Satellite Imagery Training Courses, CAN B 1483 and SWE B 1373 and Specialist Training for IAEA's Imagery Analysts, USA B 1442 and GER B 1456, managed under SGIM-002 project, should continue. The satellite imagery awareness training course has been reviewed in 2011 to focus more on how to

take full advantage of satellite imagery for state evaluation and on-site activities, as an integrated training for inspectors and analysts.

In addition, managing the roster of safeguards experts of the Department will require the development of specific training courses allowing experts to maintain and increase their expertise.

*Key Objective 3. Help States to establish and maintain their SSACs and other relevant infrastructure as required by safeguards agreements.*

Support for Member States, namely SSAC training and ISSAS missions are funded through different mechanisms, mostly MSSPs, the European Union Joint Action and the Nuclear Security Fund. Partnerships for organization, implementation and delivery of SSAC training courses and workshops, and specific training sets open to the participation of Member States personnel are the most used tools in this regard:

- In-Field Training in the Framework of the Safeguards Traineeship Programme provided by the Hungarian Support Programme has been extremely important in the process of preparing trainees for future safeguards activities in their national authorities or in the IAEA. This task should continue and support the 2012 Traineeship Programme, HUN B 0813;
- International SSAC training courses, including for SQP States, organized in the USA, funded by USA voluntary contributions;
- Regional Training Course on SSAC, AUL B 1693, AUL B 1823 and BRZ B 1811;
- International, Regional and National Training Courses and Workshops for SSAC Personnel, ESP B 1854
- Consultations and Support to Member States, FRA B 1447;
- Training Courses for SSAC Personnel, RUS B 1107.

It must be noted that there is a need for developing a harmonization mechanism between all stakeholders providing Member States with training to build their capacities for developing nuclear energy or for implementing safeguards in order to support the best use of stakeholder and Member State resources and to ensure consistency in the training material. Several initiatives have already been taken: exchange of lecturers; development of joint training material; sharing of schedules; and development of networks like INSEN (International Nuclear Security Education Network) and APSN (Asian Pacific Safeguards Network).

### Key achievement targets

Most of activities carried on under the project SGCP 102 "Training" are ongoing activities required on a long-term basis for a yearly implementation of the training programme.

However, the following activities are considered as priorities and constitute the key achievements expected during the biennium 2012-2013 from both training content and teaching methodologies standpoints:

Provide appropriate, up-to-date training (Key Objective 1):

- Integrate the State level concept in all courses: Dec. 2013.
- Integrate software Freeze Frame in the training environment: June 2012.
- Develop and deliver a virtual reality based training tool: Dec. 2012.
- Develop and deliver a soft skills training for State evaluation and activities in the field: Dec. 2013.

Help States to establish and maintain their SSACs (Key Objective 3):

- Develop and implement a harmonization mechanism between all stakeholders providing training to Member States developing nuclear programmes or for additional protocol implementation: Dec. 2013.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### *5.1. Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| AUL | B 1693 | Regional Training Course on State Systems of Accounting for and Control of Nuclear Material, Australia | Ongoing task |
| AUL | B 1782 | Revision to Nuclear Fuel Cycle Training Manuals (UK C1(t); USA B.104) | Ongoing task |
| FIN | B 1900 | | Ongoing task |
| JPN | B 1713 | | Ongoing task |
| UK | B 1727 | | Ongoing task |
| USA | B 1772 | | Ongoing task |
| AUL | B 1823 | Additional Protocol Implementation Training and Assistance for Malaysia | Ongoing task |
| AUL | B 1828 | Proliferation Analysis Workshop | Ongoing task |
| BEL | B 1433 | Comprehensive Inspection Exercise at LWRs | Ongoing task |
| CZ | B 1431 | | Ongoing task |
| BEL CZ USA | JNT B 1757 | Training Course for Safeguards at Research Reactors (BEL, CZ, USA(B.105)) | Ongoing task |
| BRZ | B 1811 | Regional Training Course on SSAC, Brazil | Ongoing task |
| CAN | B 1483 | Satellite Imagery Training Programme | Ongoing task |
| SWE | B 1373 | | Ongoing task |
| CAN | B 1624 | Inspector Training for CANDU Facilities | Ongoing task |
| CAN | B 1759 | Production of a Computer Based Training Course on Environmental Sampling | Ongoing task |
| CAN | B 1688 | Spent Fuel Verification Training Course | Ongoing task |
| FIN | B 1435 | | Ongoing task |
| SWE | B 1709 | | Ongoing task |
| CZ | B 1526 | Technical Visit - Uranium Mines | Ongoing task |
| CZ | B 1558 | Training Course on Nuclear Material Accounting in Action | Ongoing task |
| EC | B 0620 | Nuclear Material Solution Accountancy and Verification Training | Ongoing task |
| EC | B 1563 | Workshop on Additional Protocol Activities (USA B.96) | Ongoing task |
| FIN | B 1422 | | Ongoing task |
| HUN | B 1525 | | Ongoing task |
| USA | B 1415 | | Ongoing task |
| EC | B 1702 | NDA Training Course | Ongoing task |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| EC | B 1750 | Plutonium Diversion Detection | Ongoing task |
| EC | B 1844 | Training of Safeguards Inspectors on 3DLR (3D Laser Range Finder) | Ongoing task |
| EC | B 1876 | Development of Virtual Reality Tools for Safeguards Training | Ongoing task |
| ESP | B 1854 | Regional Training Course for SSAC Personnel, Chile, 2010 | Ongoing task |
| FIN | B 1699 | Training and Evaluation of the Necessary Soft Skills for Safeguards Activities | Ongoing task |
| FRA | B 1708 | | Ongoing task |
| FRA | B 1427 | Training for Information Collection and Analysis for Additional Protocol Verification | Ongoing task |
| FRA | B 1447 | Consultations and Support to Member States | Ongoing task |
| FRA | B 1506 | Support in Laser Isotopes Separation Technology | Ongoing task |
| FRA | B 1562 | Familiarization Visit to La Hague for RRP Inspectors | Ongoing task |
| GER | B 1896 | Limited Frequency Unannounced Access (LFUA) Training (GER B.25; UK C1(u))) | Ongoing task |
| NET | B 1852 | | Ongoing task |
| UK | B 1797 | | Ongoing task |
| HUN | B 0813 | In-Field Training in the Framework of the Safeguards Traineeship Programme | Ongoing task |
| HUN | B 1065 | Comprehensive Inspection Exercise Training (CIET) | Ongoing task |
| JPN | B 1812 | Training for Inspectors for the JNC-1 Site Facilities | Ongoing task |
| JPN | B 1897 | Training on Safeguards in Reprocessing Plants | Ongoing task |
| ROK | B 1872 | Advanced Comprehensive Inspection Exercise at CANDU and LWR Facilities | Ongoing task |
| ROK | B 1895 | Comprehensive Inspection Exercise at Bulk Handling Facilities | Ongoing task |
| SWE | B 1328 | | Ongoing task |
| UK | B 1751 | | Ongoing task |
| ROK | B 1907 | Development of Virtual Training for Bulk Handling Facilities | Ongoing task |
| RUS | B 1053 | Training in Implementation of Safeguards at Uranium Gas Centrifuge Enrichment Plants | Ongoing task |
| RUS | B 1107 | Training Courses for SSAC Personnel | Ongoing task |
| RUS | B 1719 | Training "Advanced PU Verification Techniques" | Ongoing task |
| SWE | B 1838 | Open Source Information Collection Training Course | Ongoing task |
| UK | B 1550 | Advanced Training in Nuclear Fuel Cycle Facilities (C1(i)) | Ongoing task |
| UK | B 1618 | Design Information Verification at Bulk Handling Facilities Training Course (C1(c)) | Ongoing task |
| UK | B 1698 | Training on the Nuclear Fuel Cycle and Proliferation Pathways (C1(f)) | Ongoing task |
| UK | B 1874 | Negotiation Skills Training Course (C1(v)) | Ongoing task |
| UK | B 1903 | Advanced Training on NFC Facilities to Assist State Evaluation | Ongoing task |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| USA | B 0086 | Training - IAEA Participation in US Sponsored Courses (B.93) | Ongoing task |
| USA | B 1001 | Safeguards Training Course: Enrichment Technology (B82) | Ongoing task |
| USA | B 1245 | Enhanced Communication Skills (B.88) | Ongoing task |
| USA | B 1337 | Training on Remote and Unattended Monitoring (B.91) | Ongoing task |
| USA | B 1446 | Enhanced Observation Skills (B.98) | Ongoing task |
| USA | B 1669 | Pyroprocessing Training Course (B.102) | Ongoing task |
| USA | B 1800 | Training on Export Control Concepts and Standards from International Perspective (B.106) | Ongoing task |

### 5.2. *Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 05/TTR-008 | Training and Evaluation of the Necessary Soft Skills for Safeguards Activities | Outstanding with SWE (2006) |
| 08/CTR-006 | Development of Virtual Reality Tools for Safeguards Training | Outstanding with US (2008) |

### 5.3. *Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title | Comments |
|---|---|---|
| Activity #1 | State Evaluation Strategy seminar | Successful pilot in 2010. Organized on a yearly basis |
| Activity #2 | Writing skill training course | Organized on a yearly basis (4 sessions per year) |
| Activity #3 | Set of half-day sessions on statistics, export information, accountancy related data processing and other specifics topics | Developed in a joint action SGIM-SGCP |
| Activity #4 | Providing of lecturers and technical training officers or coordinators | Support provided by all divisions, particularly Operations Divisions, for the implementation of the training programme |
| Activity #5 | Developing conceptual framework for an evolving safeguards system | Participation of training officers in related working groups |

# SGIM-02

## Commercial Satellite Imagery

**Project Manager: Karen Steinmaus** **Division: SGIM**

### 1. Introduction

This document describes the plans for development and implementation activities to support the analysis and exploitation of commercial satellite imagery within the Department of Safeguards. This plan is for the period 2012-2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building support for the Non-proliferation regime*, *Strategy 5 – Changing the way the department works* and *Strategy 6 – Managing the workforce* of the Long-Term Strategic Plan, 2012-2023.

### 2. Overview

The SGIM-02 project aims at developing and implementing improvements and enhancements to the safeguards use of commercial satellite imagery within the Department. Its focus is on:

- Contributing to the verification of States' declarations,
- Contributing to the evaluation of alleged and undeclared activities,
- Monitoring nuclear fuel cycle (NFC) sites and facilities through satellite imagery analysis, and
- Developing a Safeguards-wide Geospatial Exploitation System (GES).

The Agency's projections for nuclear power capacity suggest a growth of 45 to 115% by 2030[3]. This could bring many additional nuclear activities and facilities under safeguards, significantly increasing the Department's responsibility. Additionally, the constantly growing quantities of nuclear material and the verification of decommissioned status of increasing numbers of aging nuclear installations increase the Department's workload significantly, both in the field and at headquarters. This forthcoming situation motivates increased desk evaluation with improved satellite image processing and analysis techniques, especially aiming at machine processing to the extent possible to save time and manual effort without compromising quality and efficiency. Some of these techniques, such as automatic change detection, feature extraction and photogrammetry for 3D perspective site views, have demonstrated potential with semi-operational status to integrate into the Commercial Satellite Imagery project operations.

High resolution commercial satellite imagery has demonstrated its value in providing a visual analysis of NFC facilities for generating a baseline report, reporting the chronological changes or evaluating the State declarations in support of safeguards verification. Geographic Information System (GIS) technologies further advance the use of satellite remote sensing and information technologies to generate site plans and store and manage critical information related to sites and facilities. High resolution radar imagery with all-weather capability and thermal imagery with its response to temperature difference are complementary sensors to the operational high resolution visible and near infrared sensors in safeguards applications. Over the last decade, significant improvements in spatial resolutions of the commercial satellite imagery have led to new and improved processing techniques resulting in better quality image products in terms of accuracy and precision.

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1 GOV/2010/66 dated 31 August 2010.

2 STR-370.

3 This figure is based on data published from the IAEA Department of Nuclear Energy in the Nuclear Technology Review 2011, GC(55)/INF/5.

These developments prompted the IAEA to adopt the latest techniques using the expertise available with the Member States through well-defined Member States Support Programme tasks. Under various MSSP tasks, significant achievements were made that include intensive training on NFC facilities using satellite imagery (UK D 1329), high resolution radar imagery analysis of nuclear facilities (GER D 1313, JPN D 1345), awareness courses on the potential of thermal and hyperspectral imagery (CAN B 1484) for safeguards applications, 3D modeling for nuclear facilities (SWE D 1706) and technical visits to NFC facilities (FRA D 1296, CAN B 1484, SWE B 1504, GER B 1456) for the imagery analysts.

The increased workload on the Department of Safeguards is foreseen in view of increased demand for nuclear energy by the Member States. This leads to increased reliance on information driven safeguards for both declared and undeclared sites/facilities. This in turn necessitates more efficient, faster and more accurate image processing and semi-automatic imagery analysis approaches to meet the increased demands. Additionally, creation and maintenance of a geospatial database of information derived from all sources is of paramount importance to meeting the increased workload, knowledge retention and transfer. Therefore, continuous improvements in image processing and analysis and creation of a Department-wide Geospatial Exploitation System of safeguards relevant information form the major issues of this D&IS area in the short term timeframe (2012–2013). These issues will be addressed in the D&IS project plans for the 2012–2013 biennium and beyond.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term direction for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan 2012–2023.

As a first step, the long-term direction of the current D&IS Plan was defined. It is considered the vision / target of the project and can be summarized as follows:

***Continuously improve the IAEA's ability to acquire, analyse and exploit satellite imagery and geospatial information to support verification activities.***

In order to support this long-term direction, activities have to be initiated, continued and/or finalized during the biennium and can be structured under the following key objectives:

1. *Continuously improve capability in satellite image processing and analysis of NFC related sites/facilities.*

   Organize and participate in scientific meetings/workshops with other organizations on a periodic basis in the areas of mutual concern (analysis, geospatial data management etc.) for improved interaction, information and knowledge exchange,

   Carry out case studies on processing and analysis of advanced high-resolution satellite imagery using photogrammetric, SAR polarimetric and interferometric techniques,

   Participate in technical visits to NFC facilities and establish a mechanism for SIAU imagery analysts to participate (as observers) in safeguards inspections, and

   Provide training on stereo-image data processing and exploitation.

2. *Enhance geospatial data storage, management, dissemination.*

Establish a Geospatial Exploitation System (GES) with a well-organized NFC site specific database populated with multi-source and multi-temporal information for Department-wide users.

Develop enhancements to the Division's new GES.

## 4. Activities

Funding for the described D&IS activities is foreseen to be provided by Member States Support Programmes (MSSP), which continues to play a major role in achieving the stated project objectives.

*Key Objective 1. Continuously improve capability in satellite image processing and analysis of NFC related sites/facilities.*

- Organize and participate in scientific meetings/workshops with other organizations on a periodic basis in the areas of mutual concern (analysis, geospatial data management etc.) for improved interaction, information and knowledge exchange:
  - The IAEA proposes to convene a brainstorming workshop/meeting in 2012 with the support of the Japanese Support Programme (JNT D 1657 JPN) on 'The use of satellite imagery in support of safeguards verification activities – Future challenges' in Tokyo with an agenda that is similar to the 2008 meeting in Paris.
- Carry out case studies on processing and analysis of advanced high-resolution satellite imagery using photogrammetric, interferometric Synthetic Aperture Radar (SAR) and polarimetric SAR techniques:
  - Continue the ongoing study under the Swedish Support Programme (SWE D 1706) on 3D modelling for nuclear facilities.
  - Continue the ongoing study of object based imagery analysis techniques under the German Support Programme (GER D 1313) for high resolution imagery interpretation of nuclear facilities.
  - Continue the ongoing study under the German Support Programme (JNT D 1657 GER) to evaluate, develop and adopt change detection techniques using high spatial resolution X-band SAR data.
  - Continue the ongoing study on the combined use of X and C band high SAR imagery under the German (JNT D 1657 GER) and Canadian (JNT D 1657 CAN) Support Programme tasks. Implementation of coherent and non-coherent change detection techniques using high resolution SAR imagery is planned for December 2012.
  - Continue to derive the benefit of experimental work carried out using multi-sensor radar imagery on geological repositories and their monitoring application under the Support Programme tasks (CAN D 1675, FIN D 1614, GER D 1632, and JPN D 1831). A joint report of the final results of the studies conducted under these tasks is due to be released in the fourth quarter 2011.
  - Develop a satellite-based monitoring approach (Task Proposal 05/IIS-004), based on the review of the outcomes of the present tasks (CAN D 1675, FIN D 1614, GER D 1632, and JPN D 1831) that are being conducted on detection and monitoring of geological repositories.
- Participate in technical visits to NFC facilities and establish a mechanism for satellite imagery analysts and NFC experts to participate (as observers) in safeguards inspections:
  - Continue to derive benefit from the technical visits to NFC sites/facilities with the active support of Member States to further the knowledge of NFC facilities to aid in the imagery analysis (CAN B 1484, GER B 1456, NET B 1851, SWE B 1504, JNT D 1657 AUL, JNT D 1657 EC and JNT D 1657 FRA). It is proposed to continue to conduct such visits to other nuclear fuel cycle facilities.

- Provide training on image processing and exploitation:
  - Evaluate the increased availability of high-resolution stereo pairs that greatly enhances opportunities for information exploitation (USA B 1442). Technology is operational and can easily be integrated in to the satellite imagery analysis workflow.
  - Under the ongoing support programme task (NET B 1851), the imagery analysts will continue to benefit from training on the industrial facilities.
  - Continue to develop interpretation tools using high resolution satellite imagery under the ongoing support programme task (GER D 1313) and demonstrate their usefulness to IAEA SIA analysts.
  - Continue to benefit from the expert lectures on imagery analysis of NFC sites/facilities under the ongoing support programme task (UK B 1655).
  - Derive benefit from a subject expert under the ongoing support programme task (UK D 1819) on priority tasks and on an ad-hoc basis.

*Key Objective 2. Enhance geospatial data storage, management and dissemination.*

- Establish a Geospatial Exploitation System (GES) with a well-organized NFC site specific database populated with multi-source and multi-temporal information for Department-wide users (USA D 1477). The GES is scheduled for roll-out within the Safeguards Information Management division before December 2012.
- Develop and implement a Safeguards-wide capability for exploiting geospatial data in the Department of Safeguards. Extension of GES to the whole Department of Safeguards will take place in 2013 and be finalized by December 2013.
- Develop enhancements to the GES. For example tasks EC D 1664 and GER D 1457 will be reactivated once GES is deployed and will provide capability of implementing information integration tools such as the GeoWIKI.
- Continue to benefit from the UK Support Programme task (UK D 1329) in the procurement of high-resolution satellite imagery and establishment of Geospatial Exploitation System

All activities related to GES will be closely coordinated with the D&IS project *SGIS-01 Integrated Analysis*.

### Key achievement targets

- Integrate more tools and methods for better exploitation of SAR data to support day/night and all weather monitoring (Key Objective 1): December 2013.
- Implement automated (semi-automated) change detection tools and methods within the satellite imagery exploitation system (Key Objective 1): December 2013.
- Deploy the Geospatial Exploitation System in the Division of Information Management, including integrated linkages with other Division resources (i.e. AP data, Open Source data/information, etc.). This effort will begin in January 2012 and continue through 2012 (Key Objective 2): December 2012.
- Deploy the Geospatial Exploitation System to the Department of Safeguards. This is planned as an iterative effort, and is expected to be complete by December 2013 (Key Objective 2): December 2013.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### 5.1. *Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| CAN | B 1484 | Specialist Training for IAEA's Imagery Analysts (GER B.13; USA D.149) | Desired completion date: December 2013 |
| GER | B 1456 | | Ongoing |
| SWE | B 1504 | | Desired completion date: December 2013 |
| USA | B 1442 | | Ongoing |
| EC | D 1664 | Software, Hardware and Database Provision for Satellite Imagery Analysis Support (GER B.14; USA D.152) | On hold until GES deployed |
| GER | D 1457 | | On hold until GES deployed |
| SWE | D 1706 | | Desired completion date: June 2012 |
| USA | D 1477 | | Desired completion date: December 2011 |
| CAN | D 1675 | Use of Satellite Imagery Data for Geological Repositories Monitoring (GER B.21) | Desired completion date: December 2011 |
| FIN | D 1614 | | |
| GER | D 1632 | | |
| JPN | D 1831 | | |
| FRA | D 1296 | Commercial Satellite Imagery Analysis and Photo Interpretation Support (GER A.27; UK A6(d)) | On hold |
| GER | D 1313 | | Desired completion date: December 2012 |
| UK | D 1329 | | Ongoing |
| NET | B 1851 | Training on Satellite Imagery for Safeguards Applications | Desired completion date: May 2014 |
| UK | B 1655 | Consultant: Training on Satellite Imagery Analysis for Safeguards Applications (F1(d)) | Ongoing |
| UK | D 1819 | Nuclear Fuel Cycle Specialist Assistance (F1 (f)) | Ongoing |

### 5.2. *Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 05/IIS-004 | Use of satellite imagery data for geological repositories monitoring | Outstanding with SWE (2005) |

### 5.3. *Current Active and Planned D&IS Activities Supported through Regular Budget*

Nil

## Attachments

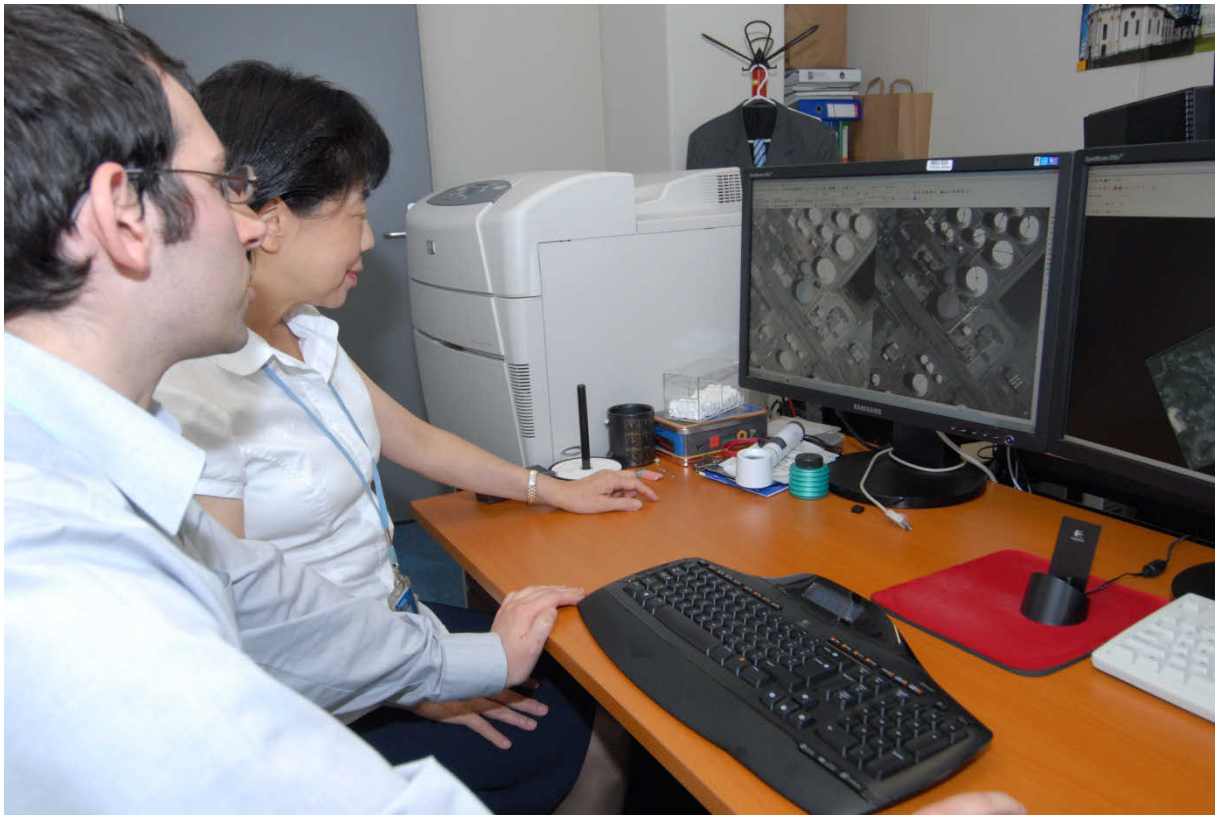


Figure 1: Collaborative analysis of NFC facilities.

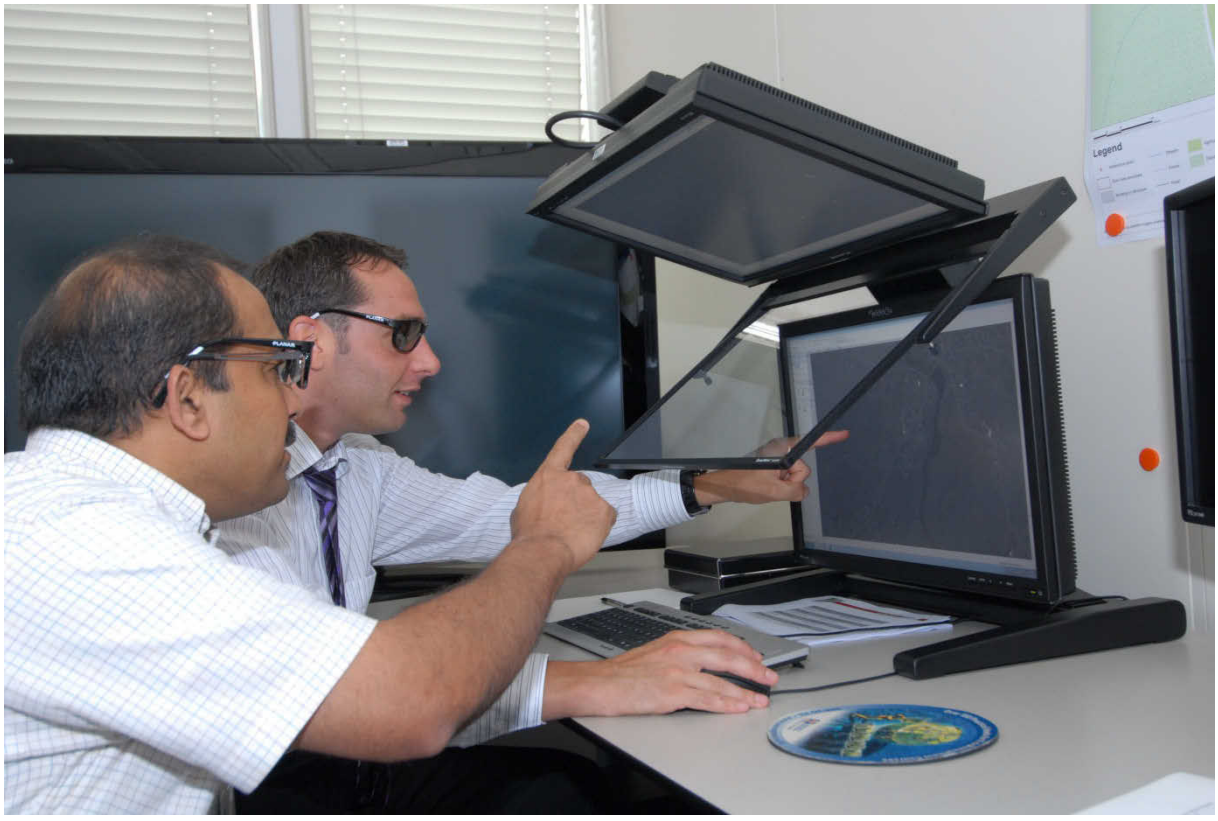



Figure 2: 3D visualization and analysis of NFC facilities.

# SGIM-03

## Information from Open Sources

### Project Manager: Matthew Ferguson — Division: SGIM

### 1. Introduction

This document describes the plans for developing and implementing processes and technologies for the collection, analysis, dissemination and management of open source information within the Department of Safeguards for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building support to the non-proliferation regime, Strategy 2 – Coping with the workload, Strategy 5 – Changing the way the Department works* and *Strategy 8 – Building political support* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

The collection and analysis of open source information is an essential element in the State evaluation process and for a safeguards system that is more objectives-based and information-driven, including support of in-field activities. An effective safeguards system requires the integration of relevant information from all available sources, including not only from States' declarations and information resulting from field activities, but also from open and other sources, such as trade and export control data. Such information must be collected, organized, analysed and disseminated in a timely manner in support of the State evaluation process and other safeguards activities. Information is collected from a wide range of open sources, including international and national news media, commercial data and government reports, and scientific and technical literature. Activities under this project contribute to the information analysis required to support the evaluation of States' nuclear activities provided in the State Evaluation Reports (SERs) and to support activities in the field, such as complementary access. In addition, the IAEA-wide dissemination of open source highlights on a daily basis maintains ongoing awareness of safeguards and non-proliferation developments and issues.

The growing volume of information sources and the diverse forms of information available (text, audio, visual) poses significant challenges. Meeting these challenges requires ongoing development and long-term investment in technology and tools that effectively collect relevant information, filter out "noise" and organize valuable information in a clear and accessible manner. This project aims to enhance these aspects of information collection, processing, analysis and dissemination.

Most of the funding for routine open source collection and analysis comes from the regular budget. MSSP support will be requested to focus on specific areas, including technology and tool development, assistance in diversifying sources, and development of analytical capabilities in coordination with project *SGIS-01 Integrated Analysis*.

While SGIM is responsible for developing open source processes, all Divisions within the Department are end users of such information, with a significant portion of the information used, in collaboration with the Operations Divisions, for the State evaluation process and for support of in-field activities.

This biennial plan fits into a longer term vision for the project area to maintain credible assurance that declared nuclear material remains in peaceful uses and that States have no undeclared nuclear material and activities

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

by enhancing information collection from multiple sources and analysis capabilities. It also contributes to the development of a safeguards system that is more objectives-based and information-driven to promote effective and efficient implementation of all IAEA safeguards required functions.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term direction for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023.

As a first step, the long-term direction of the current D&IS project was defined. It is considered as the vision/target of the project and can be summarized as follows:

***Enhance the IAEA's ability to collect and analyse information in support of the IAEA's verification mission, in particular with respect to the State evaluation process and support of in-field verification activities.***

In order to support the long-term direction, activities have to be initiated, continued and/or finalized during the biennium and can be structured under the following key objectives:

1. *Optimize information utilization.*

   The challenges for 2012–2013 are similar to those of previous years. The large volume of information and diverse information sources makes regular monitoring for potential safeguards-relevant items a complex and labour-intensive problem. Improved information collection and processing methodologies are required and so are streamlined systems for building and maintaining State files and for supporting the State evaluation process. New technologies investigated and tested in collaboration with project *SGIS-01 Integrated Analysis* during the period of 2010–2011 are expected to be ready for implementation in 2012–2013.

2. *Expand and Diversify Sources.*

   Rapid changes in the information marketplace require continuous monitoring and review of multiple information sources. This is particularly the case with respect to scientific conferences, business, commercial, trade, and industrial databases for use in State evaluations. There is an on-going need to acquire information globally, in multiple languages, and from diverse media outlets, from blogs to scientific journals. Doing so requires not only new technology, but also enhanced access to sources available via MSSPs, as well as access to subscription and other limited-access databases or sources.

3. *Enhance Information Evaluation and Analysis.*

   Indicators of undeclared nuclear activities or nuclear material may in some cases be observable via open source information collection and analysis. This will continue to be a high priority for SGIM and requires increased focus on elaborating research strategies and methodologies to efficiently and effectively detect and analyse such indicators through open source information collection and integration with other sources of information available to the IAEA. Given the large quantity of information that must be reviewed, the development of analytical methods and tools is an on-going process. Inputs from

specialized technical consultants can also play a role in enhancing the Department's capability to evaluate new technologies and complex issues. On-going training in information collection and analysis is required to continue.

## 4. Activities

Funding for most of the described D&IS activities is foreseen to be provided by Member State Support Programmes (MSSP) which will continue to play a major role in achieving the stated project objectives.

*Key Objective 1. Optimized information utilization.*

Significant work has already been carried out to enhance information collection by introducing new data collection methodologies (*Activities #1 and #2*).

- Streamlining information handling within the Department of Safeguards.

  The European Commission Joint Research Centre (Ispra) has agreed to facilitate the release to SGIM of their Rapid News Service (RNS) tool which works together with the European Media Monitor (EMM) to monitor news and create newsletters, aiding therefore an efficient and less time consuming SGIM Daily Highlights production and the related article retrieval. At present RNS is being used on a trial basis (Task EC D 1880, Target date: early 2012).

- Review of Scientific and Technical (S&T) literature.

  Analysis of scientific and technical literature can provide indications of undeclared nuclear activity. To that end, a scientific and technical literature monitoring system will be developed, grounded in professional bibliometry and semantic searching. It will generate search strategies and methodologies optimized to identify safeguards-relevant articles and to disseminate them to Safeguards staff responsible for their evaluation. Coordination with the IAEA library and INIS will be an integral part of this task (Tasks FRA JNT D 1902 and *Task Proposal 10/ICA-008*, target Date: end 2013).

Development of open source indicators of undeclared nuclear material and activities, both technical and non-technical, will be closely coordinated with the scientific and technical literature monitoring task (10/ICA-008). This will also complement the related work taking place under projects *SGIM-02 Commercial Satellite Imagery, SGIS-01 Integrated Analysis,* and *SGIM-09 Early Detection of Proliferation Activities through Trade Indicators*. Initial work has been done under task FRA D 1417 and as part of *Activities #3 and #4*. This input will be used to implement new research and analysis strategies in 2012–2013 (Target Date: May 2012).

*Key Objective 2. Expand and Diversify Sources.*

- Continuous supply of diverse national and regional information by Member State Support Programmes.

  A continuing aspect for 2012–2013 is an increased emphasis on access to regional scientific and technical information, including additional translations of relevant non-English language information and retrieval of information from new media. On-going tasks include: BEL D 1478, ROK D 1213, RUS D 1414, RSA D 1489, FRA D 1417, UK D 1728 and UK D 1730 (Target Date: On-going).

- Expansion and diversification of open source information sources.

  This work has been on-going since 2008–2009 with regular budget funding and will be continued in 2012–2013 (*Activity #5*). Member State support requested will include assistance in the identification and evaluation of sources, possibly through a limited number of consultancies in 2012 (Tasks: AUL D 1378, JPN D 1733, ROK D 1213, RUS D 1414, FRA D 1417).

*Key Objective 3. Enhance Information Evaluation and Analysis.*

- Consultancy on open source analysis.

  Provision by Member States: USA D 1126 and FRA D 1417 and, in the future, by the European Commission Joint Research Centre (EC D 1880), of consultants with extensive experience in open source analysis has allowed SGIM to provide a broader and deeper range of high-quality analytical products. In addition, the opportunity to interact with outside experts will enable SGIM analysts to improve their knowledge of analytical approaches and technical issues. Support for visits by experienced open source analysts will therefore continue to be an essential element in developing SGIM capabilities in this area. This is proposed as an on-going activity for the duration of the project plan (*Task Proposal 11/ICA-004*).

- Development of Information Analysis Reference Package.

  This activity may require support from various Support Programmes in the area of provision of reference images and other material, and in the development of software to provide an interactive basis for assessing information against proliferation indicators. Foreseen are also consultancy visits by IT specialists. At present there is a close interaction with the French Support Programme under task FRA D 1417 to embark on joint activities associated with state-of-the-art image processing and recognition, and text information technology. A number of practical steps have been agreed upon, while the human resource implications of this project are being examined (*Task proposal: 10/ICA-002*, target date: mid-2012).

### Key achievement targets

- Test technologies (in collaboration with SGIS) to increase the efficiency of the collection and management of information (Key Objective 1): August 2013.
- Implement technologies that will increase SGIM's ability to collect and manage information from disparate information sources (Key Objective 1): December 2013.
- Test, and possibly implement, the Rapid News Service to monitor news and streamline information management processes (Key Objective 1): March 2012.
- Implement a scientific and technical literature monitoring system grounded in professional bibliometry and semantic searching (Key Objective 1): July 2013.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

*5.1. Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| AUL | D 1378 | Open Source Information Collection (B.17) | On-going. The proliferation analysis workshop element was transferred to the training section of the Department. A sub-task for technical consultancies has been submitted to the AUL SP. |
| BEL | D 1478 | | Completion date: 2012 |
| FRA | D 1417 | | On-going |
| RSA | D 1489 | | On-going |
| RUS | D 1414 | | On-going |
| SWE | D 1380 | | On-going |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| EC | D 1880 | Collection, Analysis and Dissemination of Open Sources | On-going |
| FRA | JNT D 1902 | Scientific and Technical Information Management | Accepted in June 2011 |
| JPN | D 1733 | Provision of Open Source Information | On-going |
| ROK | D 1213 | | On-going |
| UK | D 1728 | Regional Information Collection Centre-East Asia (A8(f)) | On-going |
| UK | D 1730 | Regional Information Collection Centre-Middle East (A8(e)) | On-going |
| USA | D 1126 | Consultant - Assistance on Information Collection and Information Systems (D.137) | On-going |

### 5.2. *Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 02/IIS-004 | Open Source Information Collection | Outstanding with NET (2011) |
| 10/ICA-002 | Development of Information Analysis Reference Package | Outstanding with AUL, EC, FRA, RUS, UK, USA (2010) and CAN (2011) |
| 10/ICA-008 | Scientific and Technical Information Management | Outstanding with CAN, RUS, UK and USA (2010) |
| 11/ICA-004 | Consultant - Assistance on Information Collection and Analysis | Submitted to AUL in 2011. |

### 5.3. *Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | Research on identification and search strategies for indicators of undeclared activities |
| Activity #2 | Development of a regular review and alert service for scientific and technical literature |
| Activity #3 | Identification and evaluation of new open source information collection and analysis tools |
| Activity #4 | Development of open source search terms and indicators based on the physical model |
| Activity #5 | Expansion and diversification of open source information sources |

## Attachment

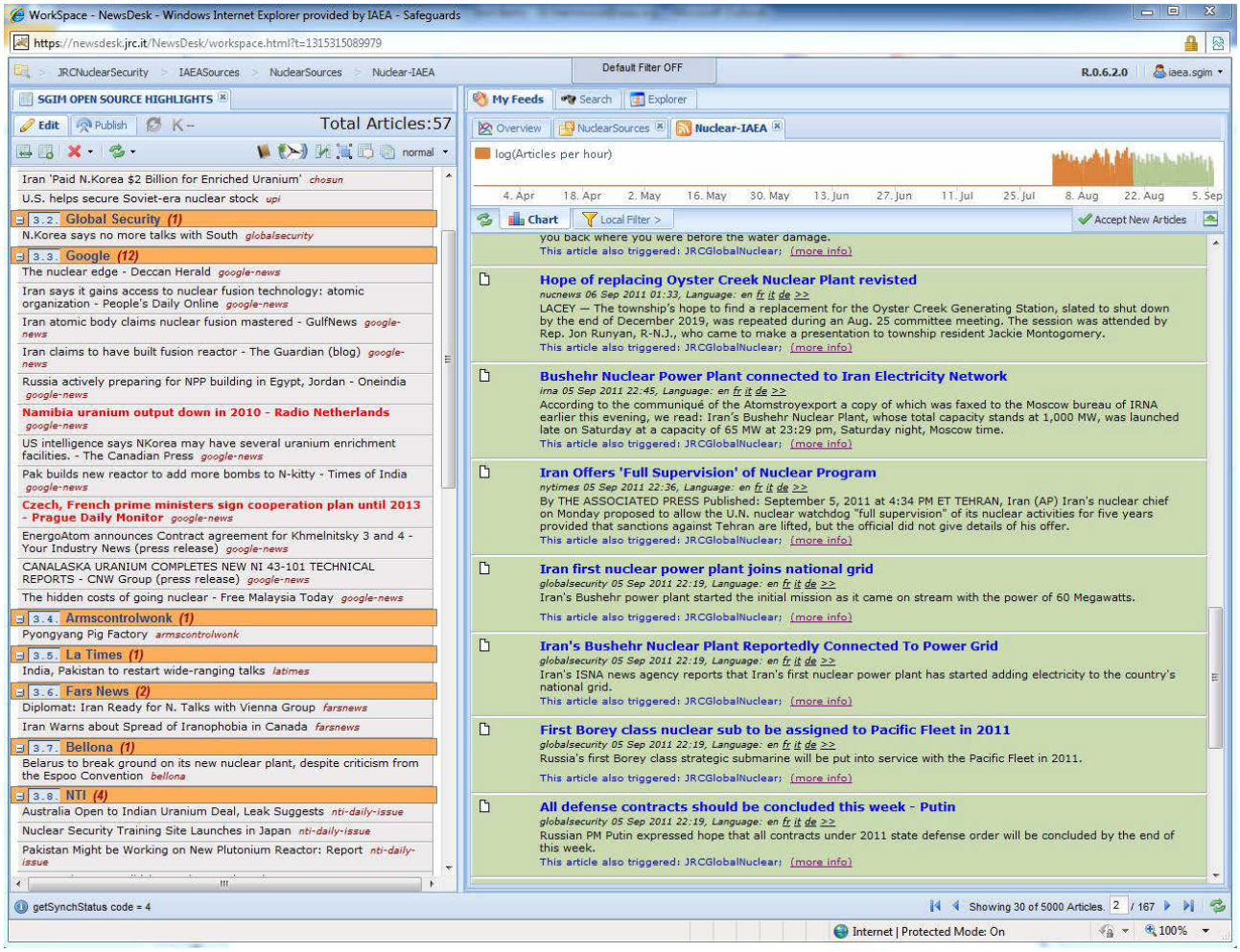



Figure 1: Screenshot of front page of NewsDesk application that is being tested for implementation in the Department of Safeguards.

# SGIM-07

## Evaluation of Data from Environmental Sampling and Destructive Analysis

**Project Manager: Maxim Perkin** **Division: SGIM**

### 1. Introduction

This document describes the plans for implementing improvements and enhancements to the evaluation of results from environmental sampling and destructive analysis of nuclear material samples within the Department of Safeguards for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building Support for the Non-Proliferation Regime* and *Strategy 2 – Coping with the Workload* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

This project covers the development and implementation of new capabilities for the assessment of results of environmental sampling (ES) as well as of the enhanced destructive analysis (DA) of nuclear material and other samples collected for nuclear safeguards. The SGIM-07 project is closely related to and coordinated with the three SGAS D&IS projects aimed at improving quality and reliability of the laboratory analyses of safeguards samples (*SGAS-01 Destructive Analysis of Nuclear Materials, SGAS-02 Environmental Sample Analysis Techniques and SGAS-03 Sampling Logistics, Analysis Support and NWAL Coordination*). The ES and DA are essential for implementing a safeguards system that is more objectives-based and information-driven. The outcome of the ES and DA evaluations have a major impact on the drawing of sound safeguards conclusions. In view of advances in possible deception scenarios, the Agency will continue to experience challenges in maintaining an effective and efficient safeguards verification system. Therefore, all aspects of the ES and DA planning, implementation and evaluation require continual development to improve the verification capability and reliability. This includes investigating sampling strategies, processing and evaluation of sample-related information and laboratory analysis results, as well as quality control of the entire process.

The main areas of the tasks supported by the MSSPs for this project are: upgrade of the software tools used for handling and evaluation of sample-related information and all types of analysis results; improvements to the codes simulating physical nuclear-fuel-cycle processes, such as isotope enrichment and reactor irradiation; investigation of fingerprinting signatures of nuclear materials during their chemical processing; assessment of new sampling approaches; and provision of expertise in the data evaluation otherwise unavailable to the Agency.

The project plan in particular addresses Departmental strategies: (i) by enhancing its capability to detect undeclared nuclear materials and activities, to verify non-diversion of the declared nuclear material, and to resolve related anomalies, questions and inconsistencies; (ii) by developing capability to detect any misuse of advanced reactors, innovative fuel cycles and relevant nuclear material, and (iii) by establishing procedures and developing expertise needed to make the Agency technically ready to contribute to verification of nuclear arms control and disarmament.

The most recent achievements of the project include: thorough revision of International Target Values for DA of nuclear materials; successful qualification of IRD/CNEN laboratory (BRZ SP) for ES bulk analysis; long-term MSSP support that resulted in improvements in quality of evaluations (USSP); provision of licensed

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

software and training ES evaluators on use of *SCALE/ORIGEN* reactor code (USSP); provision of *WIMSD* calculations modelling numerous reactor/fuel irradiation scenarios (UK SP); review and assessment of wide-area air-particulate sampling field trials (UK SP); and significant progress made in the investigation of trace element behaviour during uranium conversion processes (CAN SP, EC SP).

Since 2011, all tasks related to the qualification of candidate laboratories for the Agency's NWAL have been transferred to the recently created SGAS-03 project. The SGIM-07 project is now focused on the development and implementation support activities aimed primarily at improving the evaluation of analysis data. This will *inter alia* include a major upgrade of the ES database used by the safeguards evaluators, update of the *MSTAR* enrichment code, continuation of the studies of trace element behaviour during uranium concentration and conversion processes, as well as populating a reference database of elemental and isotopic signatures of uranium ore concentrates originating from different sources.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term directions for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023.

As a first step, the long-term directions of the current D&IS project were defined:

***Enhance analysis and evaluation capabilities for data obtained by the environmental sampling and destructive analysis of nuclear materials through:***

- the further development of existing and acquisition of new tools for more systematic information handling and comprehensive evaluation;
- the constant improvement of the analytical processes aimed at the optimization of the use of available information and expertise.

  Further investigate signatures of nuclear fuel cycle activities and expand their use through ES and DA. Continue to develop processes and tools to maintain the knowledge required for the Department to produce credible conclusions.

In order to support the long-term directions, activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Improve the confidence level of conclusions regarding the absence of undeclared nuclear material and activities.*

   During the last two years, significant progress was made in the updating of irradiation code calculations used in the ES evaluations. The variety of reactors/fuels in the library of typical irradiation scenarios now include not only the most typical power reactors but also a number of research reactor designs. The IAEA needs to complete the current developments focusing in particular on MOX fuel irradiation and the thorium fuel cycle. The enrichment code which has been an extremely useful aid in evaluating ES data from uranium enrichment plants also needs upgrading, in particular to take into account the fundamental differences between gaseous diffusion and gas centrifugation processes.

   The current ES database (ESDB), which is the main working tool used for storage and retrieval of the ES data, and is crucial for the effective administration of the ES programme, was designed about 10

years ago. As the ES programme has developed, a number of new requirements related to functions and design of the database have accumulated and need to be updated.

Since the 1990s, the Agency holds annual technical meetings of the laboratories involved in the ES analysis. These workshops proved to be important fora to review laboratory performance, share up-to-date knowledge in the ES analysis, and address specific analysis and evaluation challenges, that all leads to continuous improvement in the confidence of the ES results and the derived conclusions. It is planned that such meetings will continue to be organized throughout the 2012–2013 biennium.

2. *Improve the confidence level of conclusions regarding the non-diversion of the declared nuclear material, in particular at the bulk-handling facilities.*

As a result of a thorough work on updating the International Target Values (ITV) for analysis of nuclear material, the Agency, in cooperation with international experts, issued in 2010 a new edition of the ITV; it will further remain the technically sound and commonly recognized international reference for assessing the quality of accountancy measurements.

However, the IAEA still needs to improve its capability to assess performance of the facility operator's measurement systems, in particular at facilities handling $UF_6$. It is foreseen that a task proposal would be formulated and submitted to MSSP in 2012.

3. *Develop capabilities to fingerprint nuclear materials and verify their declared origin.*

During the last two years, significant achievements were obtained in the development of capabilities to characterize nuclear material through analysing its elemental and isotopic composition. A progress was made in studies aimed to understand the trace elements behaviour during typical uranium conversion processes.

Further research will be needed to investigate the behaviour of trace elements during uranium ore concentration, to build up a reference database of uranium concentrates of different origins, and to enhance the data evaluation. A round-robin exercise on analysis of elemental impurities in uranium ore concentrates (UOC) matrices has already been initiated by the Agency in order to investigate analytical problems, accelerate development of standardized procedures, and thus increase the reliability of analysis results and credibility of the derived safeguards conclusions.

## 4. Activities

Funding for most of the described D&IS activities is foreseen to be provided by Member States Support Programmes which continue to play a major role in achieving the stated project objectives. Some of the activities will be performed by Safeguards Department personnel.

*Key Objective 1. Improve the confidence level of conclusions regarding the absence of undeclared nuclear material and activities.*

Activities related to Key Objective 1 will concentrate on completing the currently active tasks:

- The task UK A 1853, "*WIMSD* processor" will continue with emphasis on the calculations of irradiation of MOX fuel in light-water power reactors as well as on the thorium fuel cycle. The task will be extended until October 2012.
- Under task USA A 1498, "Environmental Sampling Evaluation Support", the *MSTAR* uranium isotope enrichment code will be updated in 2012, to take in account the differences in the $UF_6$ diffusion and centrifugation processes. It is also planned that under the same task the ESDB will be upgraded. The update will include the expansion of the database to accommodate new data requirements, as well as expanding the graphical functions, and upgrading of statistical tools to

monitor historical ES performance and status of outstanding results and evaluations. This requires changes to the fundamental data structure, graphical user interface, and generation of important status and evaluation reports. The expected completion date is April 2013.

- Technical Meetings on Bulk and Particle Analysis of Environmental Samples for Safeguards will be organized by the Agency in 2012 and 2013, respectively. The meetings will review the operation of the Network of Analytical Laboratories, discuss the experience collected in analyzing environmental samples, new developments and related research plans, and provide relevant recommendations. All this will lead to further improvements in the efficiency of sample analysis, quality of the analytical results, and effectiveness of the data evaluation (*Internal Activities #1 & 2*).

*Key Objective 2. Improve the confidence level of conclusions regarding the non-diversion of the declared nuclear material, in particular at the bulk-handling facilities.*

- A task proposal will be submitted to MSSP in 2012 for development activities aimed at improving the Agency's capability to assess an operator's measurement system at $UF_6$-handling facilities (*New Task Proposal #1*). The proposed work shall (i) include a survey of the $UF_6$ sampling systems at uranium conversion and enrichment plants; (ii) identify major factors contributing to unrepresentative sampling; (iii) summarize the operator's experience in obtaining representative $UF_6$ samples for the determination of uranium content, impurity concentrations, and uranium isotope enrichment; (iv) quantify $UF_6$ sampling uncertainties under typical sampling conditions by conducting experimental studies and/or evaluating available data; and (v) provide recommendation on best practice of $UF_6$ sampling for safeguards.

*Key Objective 3. Develop capabilities to fingerprint nuclear materials and verify their declared origin.*

- The generic *task proposal 08/IDS-001* "Experimental Investigation of Behaviour of Trace Elements in Uranium during the Concentration and Conversion Processes" was accepted by various Support Programmes (AUL, BRZ, CAN, CPR, EC, RSA and RUS) and is at different stages of implementation. It is also being considered by the USSP.
  - It is expected that for tasks CAN A 1796 and EC A 1753 the first phase (which covers conversion facilities) will be completed by February 2012. The next step will be a study of the ore concentration processes (planned to be carried out throughout 2012–2013).
  - Under task RUS A 1873 a laboratory-scale conversion experiment was carried out in 2011; the sample analysis is in progress. It is expected that a full-scale study will commence in 2012 and be completed by March 2013.
  - Initial discussions have been held with AUL, BRZ, and RSA SP task officers aimed at developing work plans. It is expected that sampling at the uranium concentration facilities in the respective countries will be performed in 2012–2013.
- Development of *iDAVE* search engine for assessing origin of uranium ore concentrates (UOC) is carried out by US DOE. It is planned that testing of the *iDAVE version 2* will be completed by the Agency staff by March 2012 (*Internal Activity #3*).
- A round-robin interlaboratory comparison on analysis of elemental impurities in UOC matrices has been initiated by the Agency in August 2011. It is planned that the results of the exercise will be evaluated, and summarized by February 2012 (*Internal Activity #4*).
- A Technical Meeting on Analysis of Elemental Impurities in Uranium Samples will be organized by the Agency in May 2012; it will review technical requirements and challenges of the laboratory analyses, consider approaches to the data evaluation and provide relevant recommendations. All this will allow the Agency to improve credibility of conclusions with regard to the verification of declared material origin and contribute to the facility design verification (*Internal Activity #5*).

### Key achievement targets

- Deliver the upgraded *MSTAR* uranium isotope enrichment code (Key Objective 1): June 2012.
- Deliver the *WIMSD* irradiation code calculations for MOX and thorium fuel (Key Objective 1): Oct. 2012.
- Implement the upgrade of the Environmental Sampling Database software (Key Objective 1): April 2013.
- Analyse results of the CAN SP study of trace elements behaviour during U conversion (Key Objective 3): April 2012.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### 5.1. *Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| AUL | A 1783 | Experimental Investigation of Behaviour of Trace Elements in Uranium during the Concentration and Conversion Processes | Sampling at U concentration facility to be performed in 2012 |
| BRZ | A 1766 | | Sampling at U concentration facility to be performed in 2013 |
| CAN | A 1796 | | First phase to be completed in 2012; second phase may be requested |
| CPR | A 1749 | | Sampling at U concentration facility to be performed in 2013 |
| EC | A 1753 | | First phase to be completed in 2012; second phase may be requested |
| RSA | A 1790 | | Sampling at U concentration facility to be performed in 2012 |
| RUS | A 1873 | | First phase started in 2011; second phase to be commenced in 2012; expected completion in March 2013 |
| UK | A 1853 | Reactor Calculations Using *WIMSD* Processor | First phase completed in 2011; second phase to be carried out through 2012 |
| UK | A 1822 | Review and Assessment of Air-particulate Sampling Field Trials | Expected to be completed in 2011 |
| USA | A 1498 | Environmental Sampling Evaluation Support | *MSTAR* to be upgraded in 2012; ESDB upgrade to be completed in 2013 |

### 5.2. *Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 08/IDS-001 | Experimental Investigation of Behaviour of trace Elements in Uranium during the Concentration and Conversion Processes | Outstanding with USA (2008) |
| New Task Proposal #1 | Assessment of Operator's Measurement Systems at $UF_6$-handling Facilities | To be submitted in 2012 |

### 5.3. *Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Internal Activity #1 | 2012 Technical Meeting on Bulk Analysis of Environmental Samples |
| Internal Activity #2 | 2013 Technical Meeting on Particle Analysis of Environmental Samples |

| Activity No. | Activity Title |
|---|---|
| Internal Activity #3 | Testing of the *iDAVE* search engine for assessing origin of uranium ore concentrates |
| Internal Activity #4 | Round-robin exercise on analysis of impurities in UOC (in cooperation with SGAS) |
| Internal Activity #5 | 2012 Technical Meeting on Analysis of Elemental Impurities in Uranium Samples |

## Attachments

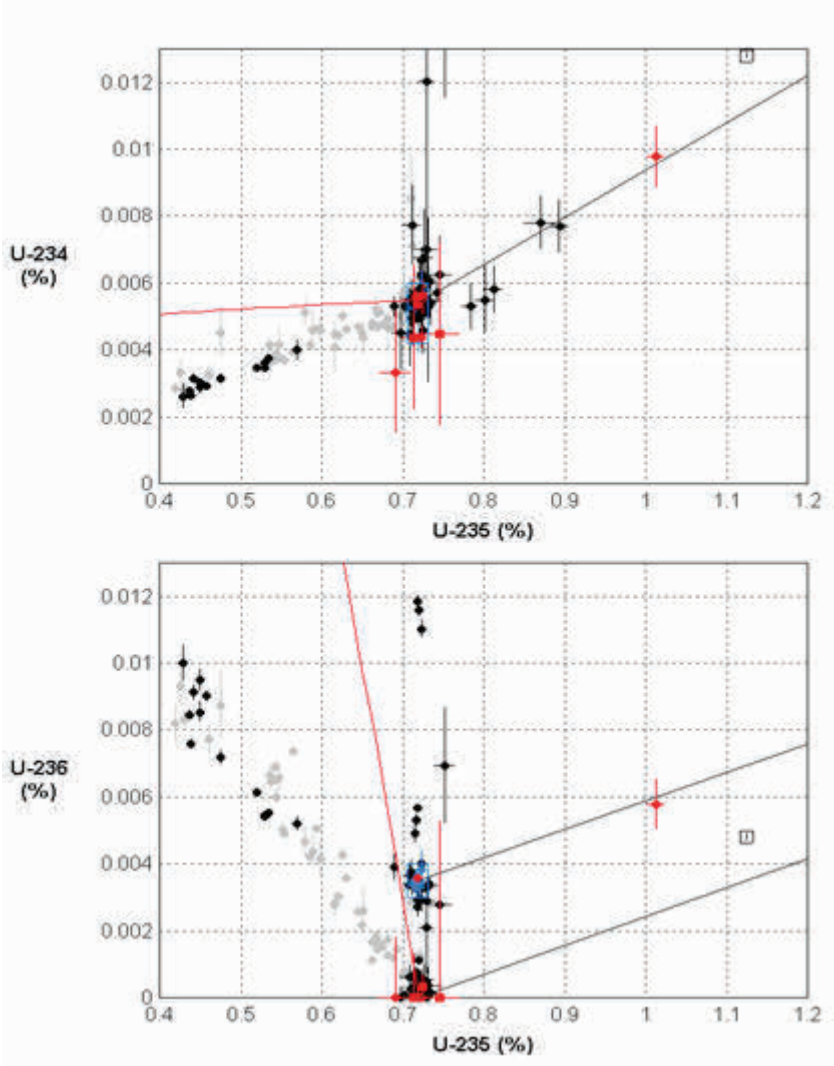



Figure 1: Comparison of current and past sampling results with calculations simulating processes such as nuclear material mixing, irradiation, isotope enrichment, and radioactive decay is an essential part of the ES evaluation. The upgrade of ES database software shall provide for improved graphical plotting of the measured parameters and model calculations. Updated MSTAR code and WIMSD calculations will allow for more accurate process modelling for the gaseous uranium isotope enrichment and irradiation of various nuclear fuel and targets.

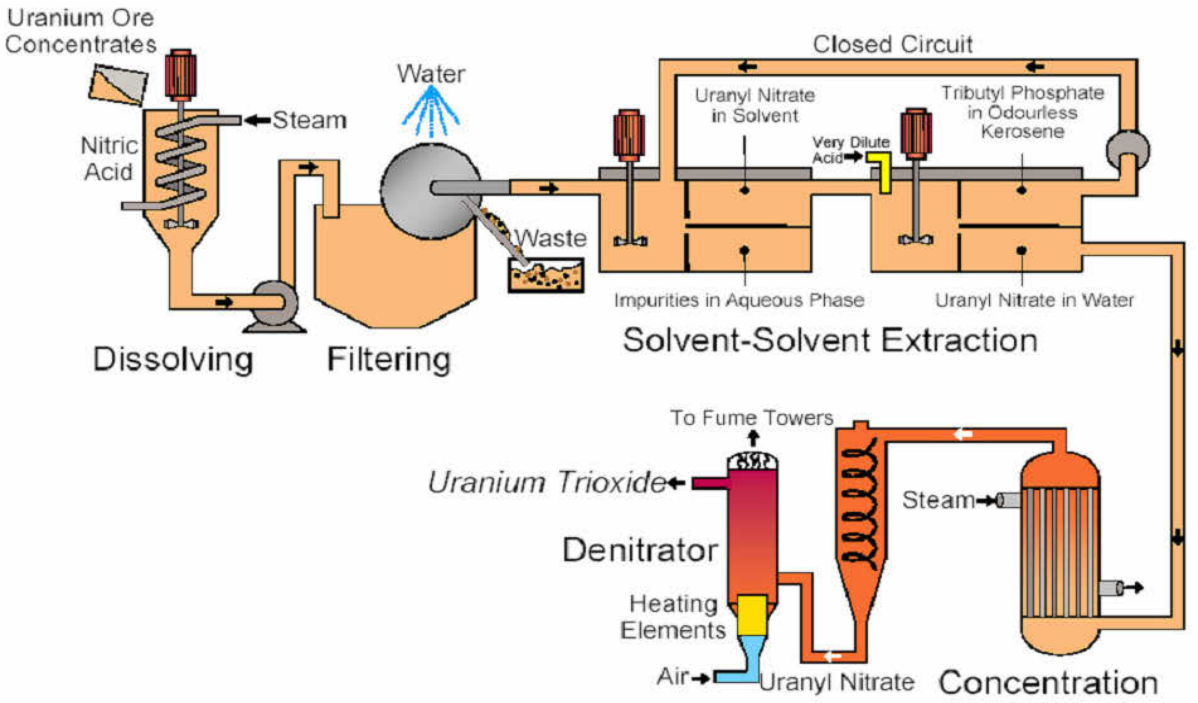



Figure 2: Schematic flowchart of first stages of a typical conversion process. Experimental investigation of the trace elements behaviour during uranium concentration and conversion will increase IAEA's ability to assess information about the origin of sampled uranium materials and to monitor for changes in the process design.

# SGIM-08

## Statistical Analysis

### Project Manager: Claude Norman — Division: SGIM

### 1. Introduction

This document describes the plans for developing and implementing new statistical analysis tools and for upgrading and documenting the existing statistical tools used to perform the evaluation of safeguards declared and verified data and to support safeguards activities that involve statistical concepts within the Department of Safeguards for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building support to the non-proliferation regime, Strategy 2 – Coping with the workload, Strategy 3 – Safeguarding advanced and innovative nuclear fuel cycle, Strategy 4-Taking on New Mandates* and *Strategy 5 – Changing the way the Department works* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

The main purposes of the statistical analysis activities within the Department of Safeguards is, on the one hand, to provide credible assurance that no nuclear material is diverted through material imbalance (MUF – Material Unaccounted For) or falsification of operators' declarations (D) in bulk handling facilities (BHF) and, on the other hand, to contribute to the optimization of safeguards approaches by designing effective and efficient random verification methodologies (e.g. sample size calculations, development of random inspection schemes).

In this framework, the scope of the SGIM-08 project is to review and, when appropriate, to upgrade existing statistical methodologies, to design new methodologies for the evaluation of verification data from safeguards implementation schemes and/or from innovative nuclear fuel cycle facilities, to develop new computerized evaluation tools for streamlining the evaluation process and increasing its detection capabilities and to support the development of optimum random verification schemes. The end users are the Division of Information Management, the Operations Divisions and the Effectiveness Evaluation Section of the Deputy Director General Office. The SGIM-08 project is consistent with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy 2012–2017 and the Long-Term R&D Plan, 2012–2023 since it provides methodologies and tools to support the evaluation of verification data and the optimization of resources. Furthermore the project addresses the enhancement of information analysis and investigates approaches to changing the way the Department works in the context of a growing number of nuclear activities and facilities under safeguards including sensitive facilities and new types of facilities.

The evolution of safeguards concepts in the last decades as well as the considerable increase in the amount and type of information to be processed and analysed in a context of limited resources has called for the development and implementation of statistical and probabilistic tools to support effective and efficient verification approaches and evaluation methodologies. In particular, optimized data collection and analysis tools are needed to guarantee timely detection of process imbalances in sensitive facilities such as large plutonium Bulk Handling Facilities (BHFs). Substantial progress has been made in the development of complex Near Real Time Accountancy (NRTA) systems developed in house. To further optimize their detection capabilities, simulation and sensitivity analysis tools are essential.

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

The project also reviews a number of probabilistic algorithms and procedures used by the Department to support different sampling and random verification schemes, enhancing them when appropriate and updating the associated technical documentation.

Given the growing number of facilities under safeguards, the increasing quantity of data to be processed and the diversification of the safeguards information obtained from all sources and from new types of facility, the project also investigates innovative methodologies for optimizing the use of inspection resources and supporting conclusions and decisions through intelligent information analysis.

The expected outcomes of the project will also enable the Department to take on new verification mandates by enhancing the capabilities of statistical methodologies and tools.

### 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term directions for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023.

As a first step, the long-term directions of the current D&IS project were defined:

***Review, enhance and develop statistical verification and evaluation methodologies and tools to optimize verification implementation plans and information analysis in support of the State evaluation process.***

***Investigate the application of state-of-the-art data analysis methods and computerized tools to the evaluation of a large amount of all-source information in order to support the State evaluation process and draw credible safeguards conclusions.***

In order to support the long-term directions, activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Develop Near Real Time Accountancy (NRTA) systems for Pu Bulk Handling Facilities.*

   Implementation of a NRTA system is a requirement for large Pu BHFs to provide a higher detection sensitivity based on accurate material accountancy measures as well as on-site evaluation capabilities for immediate follow-up. This has been requested for Rokkasho Reprocessing Plant and J-MOX by the Operation Division.

2. *Develop a generic software system capable of simulating the material flows and inventories for Pu reprocessing plants, MOX plants and LEU fabrication plants*

   Such a system can be used to compare safeguards implementation schemes by testing their sensitivity to different diversion scenarios and the power of different statistics in order to achieve the optimal detection probability.

3. *Update and consolidate sampling-plan references and develop an upgraded sampling plan code.*

   Several Safeguards Technical Reports (STRs) related to sampling plan design and implementation will be reviewed and revised appropriately. The final product will be a new document.

   The upgraded sampling plan code should incorporate the following features: Calculation of achieved detection probability, two-stage sampling and follow-up inspection sample sizes. The two-stage sampling feature is a useful sampling approach when the verification of a stratum can be simplified by clustering items into primary and secondary units (e.g. fuel rod magazines). The goal of the follow-up inspection feature is to devise a follow-up inspection sampling plan in the event that defects are identified in the initial sample. These features would make it possible to solve sampling problems in the field and to have full knowledge of the achieved goals in comparison with the initial plans by means of a single tool.

4. *Investigate the use of advanced mathematical methodologies and computerized tools for safeguards applications.*

   Explore mathematical tools for designing optimal verification implementation schemes including random unannounced inspections and optimized allocation of inspection resources for state level approaches. Furthermore, investigate the application of state-of-the-art data analysis methods and computerized tools to the evaluation of a large amount of all-source information in order to support the State evaluation process and draw credible safeguards conclusions.

## 4. Activities

Funding for most of the described D&IS activities is foreseen to be provided by Member States Support Programmes (MSSPs), which continue to play a major role in achieving the stated project objectives. Activities under Key Objective 1 will be performed by Safeguards Department personnel.

*Key Objective 1. Develop Near Real Time Accountancy (NRTA) systems for Pu Bulk Handling Facilities.*

- The development of NRTA systems (*Activity #1*), in conjunction with project *SGOA-02 Safeguards System for JNFL MOX Fuel Fabrication Plant (J-MOX),* is in line with the requirement of the overall RRP and J-MOX project. A first version of the NRTA system for RRP is ready for implementation. The NRTA system for J-MOX is currently in the conceptual design phase.

*Key Objective 2. Develop a generic software system capable of simulating the material flows and inventories for Pu reprocessing plants and MOX and LEU fabrication plants.*

- A draft report and programme (UK D 1878) were sent to the IAEA for MOX facilities. Continuation of this task is requested to revise the code package to include the enhancements requested by the IAEA.

*Key Objective 3. Update and consolidate sampling-plan references and develop an upgraded sampling plan code.*

- A first draft of a newly structured edition of STR 261-"Algorithms to Calculate Sample Sizes for Inspection Sampling Plans" was delivered and discussed in October 2010 (USA D 1807). The next draft is expected to be delivered in October 2011 whereas the final version will be available at the

end of 2012. The publication will be registered in the Quality Management System (QMS) document control system and obsolete STRs withdrawn from use.

- As soon as the new document is available MSSP support will be requested for the development of an upgraded sampling plan software (*New Task Proposal #1*).

*Key Objective 4. Investigate the use of advanced mathematical methodologies and computerized tools for safeguards applications.*

Activities under Key Objective 4 will focus on the following:

- Explore the use of game theoretic approaches to efficient routine inspection design, random unannounced inspection design and allocation, and state level distribution of inspection resources (*Task Proposal 11/IDS-002*).
- Demonstrate feasibility of intelligent systems for analysing non-quantitative data, eliciting analyst conclusions, and aggregating analyst conclusion across multiple disparate data sources in order to draw broad state-level conclusions with a measured degree of confidence (*Task Proposal 11/IDS-001*).

### Key achievement targets

- Implement and validate a Near Real Time Accountancy (NRTA) system for the Pu Bulk Handling Facility at RRP (Key Objective 1): 3 months after restart of RRP.
- Develop and validate a generic software system capable of simulating the material flows and inventories for Pu reprocessing plants and MOX and LEU fabrication plants (Key Objective 2): June 2012.
- Update Safeguards Technical Reports (STR) related to sampling plan design and in-the-field implementation (Key Objective 3): December 2012.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### 5.1. *Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| UK | D 01878 | Development of Software Tool to Simulate the Nuclear Material Accountancy System of MOX Facilities | To be completed in February 2012 |
| USA | D 1807 | Revision of STR 261 "Algorithms to Calculate Sample Sizes for Inspection Sampling Plans" (D.177) | To be completed in December 2012 |

### 5.2. *Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 11/IDS-001 | Demonstration of Intelligent Decision Analysis Support in Safeguards Evaluation | Submitted to BEL (2011) |
| 11/IDS-002 | Exploring the use of game theoretic approaches to safeguard verification activities. | Submitted to GER (2011) |
| New Task Proposal 1 | Development of an upgraded sampling plan software | To be submitted in 2012 |

*5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | Develop Near Real Time Accountancy (NRTA) systems for Pu Bulk Handling facilities |

## Attachments

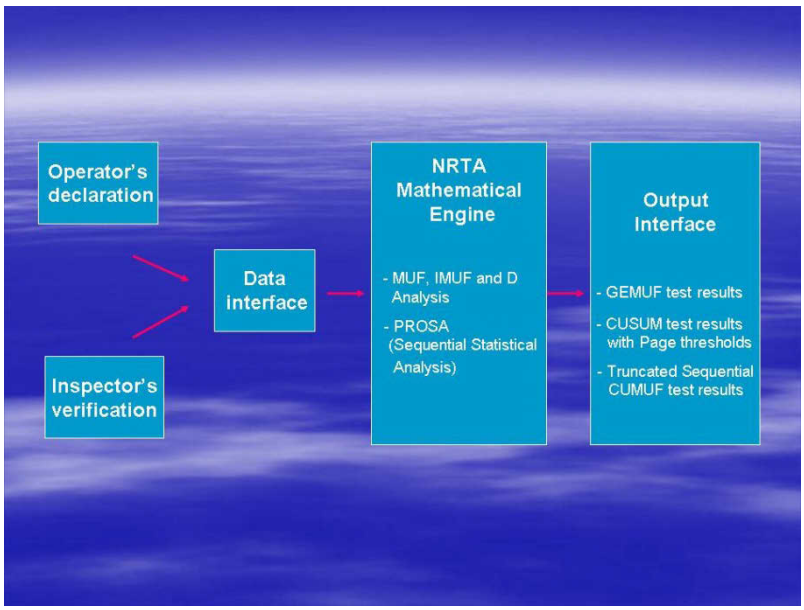



Figure 1: Schematic of a Near Real Time Accountancy System for large Bulk Handling Facilities.

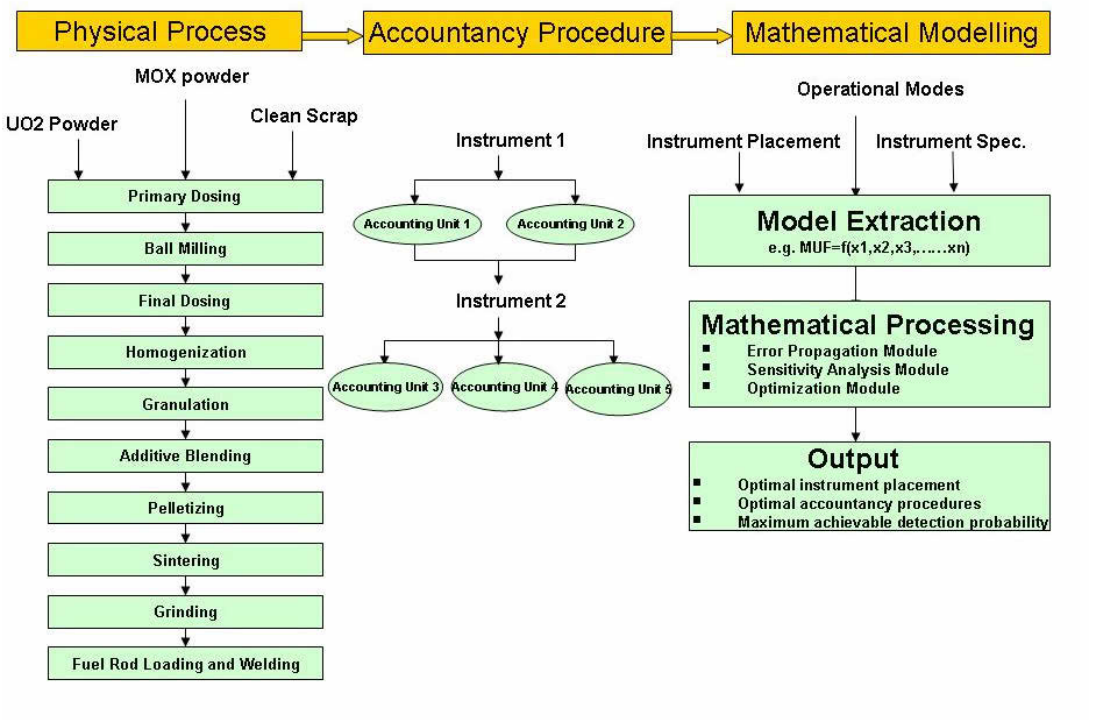



Figure 2: Simulation of material flows and inventories for a MOX fabrication plant.

# SGIM-09

## Early Detection of Proliferation Activities through Trade Indicators

**Project Manager: Matthew Ferguson** **Division: SGIM**

### 1. Introduction

This document describes the plans for developing and implementing knowledge and methodologies to analyse proliferation networks and international covert trade in nuclear related goods and technology. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building support for the non-proliferation regime, Strategy 2 – Coping with the workload, Strategy 5 – Changing the way the Department works* and *Strategy 8 – Building political support* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

The analysis of trade data is useful to detect early indications of potentially undeclared nuclear activities. With the help of Member States progress has been made during the preceding years to obtain relevant complementary data, securely store and prepare these data in a manner conducive to analysis, develop proper analytical methodology and establish reporting in support of safeguards activities. Information derived from the analysis of trade data is increasingly used by the Department to support the State evaluation process, in particular to help establish the completeness of State declarations.

The development of a safeguards system that is more objectives-based and information-driven calls for improvements that are equally appropriate to enhance analysis of trade data and a better understanding of proliferation networks. In particular future challenges in this area include enhancing the capabilities to handle the continuous flow of safeguards-relevant trade data, maintaining state-of-the-art analytical tools, and further diversifying information sources.

Therefore a new data-handling and analysis software system will be implemented to enable a more efficient use of collected trade data and enhance proliferation network analysis. Predictive analytical methodologies using non-technical indicators will be developed to help early detection of proliferation activities.

Much work has been done to diversify the sources available to safeguards for trade analysis, both through the Procurement Outreach Programme to Member States and industry, and publicly available sources. The Procurement Outreach Programme engages Member States to contribute relevant trade available to State authorities and through contacts with industry to the IAEA on a voluntary basis. To continue the increasing success of outreach and trade analysis, further development of the scope of these activities is planned.

The activities in the Procurement Outreach Programme, already dependent on a relation of trust and good communication, also provide opportunities to build enhanced partnerships with Member States through sharing of experience gained in the course of this programme. New approaches need to be identified and developed to make best use of this experience.

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term direction for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023.

As a first step, the long-term direction of the current D&IS project was defined:

***Improve analysis of international (covert) trade in nuclear related goods and technology and of proliferation networks. Both the activities of State actors and of non-State actors are addressed. This will result in an enhanced capability within the Department of Safeguards to detect early indications of undeclared national and transnational proliferation activities.***

In order to support the long-term direction, activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Enable a more efficient use of data.*

   During the last two years, important steps have been taken to make more efficient use of the data available. This included training of trade analysts to make use of new software and analytical techniques, updating the current Procurement Tracking System (PTS) and developing and implementing new visualization tools to make better use of the available data. A choice has also been made to implement a new information analysis system ("Palantir"). In 2012–2013 Palantir will be implemented as part of an information architecture that takes into account future needs, such as integration with other parts of the IAEA, enabling wider knowledge management of proliferation activities, while maintaining the need for information security.

2. *Enhance analysis.*

   Staying abreast of the latest developments in analytical techniques is a prerequisite for professional analysts that will become even more important in the context of the further development of a safeguards system that is more objectives-based and information-driven. In the past two years several Member States have supported this effort with training courses and expert advice, e.g. in the course of the workshops in September 2010 and June 2011 that were organized as part of the development and implementation support effort. This is an on-going need that will also be covered in the 2012–2013 D&IS project plan. During the last year work was started to develop methodologies that will allow more predictive analysis of proliferation risks, also increasingly taking into account non-technical indicators in the analysis of such risks and activities. At the end of the 2012–2013 biennium it will be possible to judge and, if proven fruitful, implement these new methodologies, through MSSP assistance and new workshops to be organised in 2012 and 2013. With the help of the European Commission (EC) Support Programme in particular the area of trade analysis was able to expand its scope during the past period. Further expansion of methodologies and validation of new sources is on-going, for which the support of the EC will again be sought.

3. *Further diversify information sources.*

The past years have seen an increased success for the Procurement Outreach Programme as part of the Department's strategy to diversify its information sources, providing reliable first-hand information on possible proliferation activities and helping to improve the Agency's capability to assess the completeness of declared information and help establish the veracity of information provided to the Agency. Through the current D&IS project plan approaches will be defined how best to further expand the Procurement Outreach Programme to new members. The return on outreach activities (the volume of data received on average per company visit) is expected to improve during the 2012–2013 biennium.

4. *Enhance trust/communication with Member States.*

The Procurement Outreach Programme is entirely based on the voluntary sharing of relevant information by Member States with the IAEA. Developing ideas and activities that help build a relation of trust and good communication with participating Member States was therefore already integral part of the outreach activities. During the 2012–2013 biennium new ways will be explored and implemented for building enhanced partnerships to better respond to the needs of Member States and companies. The benefits of closer contacts with other international organizations will be examined; these will be expanded if considered of value.

## 4. Activities

Funding for most of the described D&IS activities is foreseen to be provided by Member States Support Programmes (MSSP) which continue to play a major role in achieving the stated project objectives.

*Key Objective 1. Enable a more efficient use of data.*

- Continued MSSP assistance is sought to train trade analysis staff in data preparation and handling; there is an on-going need to maintain a high standard, gaining hands-on knowledge of state-of-the-art, more efficient tools. The current French support task (FRA B 1768) will be continued.
- In 2012–2013 new software will be implemented to support the analysis of trade data and proliferation networks to replace the current Proliferation Tracking System (PTS; a task previously performed through the USSP). It will be used for tracking, analysing, combining, storing and visualizing data needed for analysis of proliferation activities. Through it, the IAEA's institutional memory for (covert) trade activities will be maintained. Most of the cost of this implementation will be financed from the regular budget (*Activity #1*). To make best use of this new system, assistance from MSSPs would still be required. A new MSSP task (*Task Proposal #1*) will be defined to collect best practices on the use of the software and modify these for use in this specific context and test these during implementation.
- Because it will take at least another one to two years before a new system is fully implemented, continued support is needed from MSSPs to upgrade the current dedicated software for proliferation analysis, the Procurement Tracking System (PTS) and enable a smooth transition to the new software (*Task Proposal #2*).
- The development phase of the VITA visualization tool for Departmental use has been completed successfully (CAN D 1623). Continued support will be asked from the CAN SP to further optimize this tool for use in the specific trade and proliferation analysis context (*Task Proposal #3*).

Whenever needed, activities under Key Objective 1 will be coordinated with project *SGIS-02 Information Security*.

*Key Objective 2. Enhance analysis.*

- There is an on-going need to train trade analysts to stay abreast of developments in (proliferation and trade) analysis, enabling also a critical evaluation of currently employed analytical techniques. Assistance from MSSPs is needed for this training in coordination with project *SGCP-102 Training* (in the past provided through the Australian Support Programme (AUL B 1828) and the USSP (USA B 1800) that helped develop this area; also through the on-going German Support Programme task GER B 1560). A workshop to share experience in proliferation analysis will be organised with Member States (financed through the Regular Budget, *Activity #4*).
- Several basic concepts are currently in use that need further study. One of the issues that need addressing is to define and better understand with the help of MSSPs the concept of "networks". The current definition works well when analysing the activities of existing networks but the capability to recognise emerging networks needs to be improved (a task that may fit the on-going French support programme task FRA B 1768). Another support task to improve the proper understanding of the material at hand is to advance the awareness of the varying shapes and names of nuclear relevant equipment in different parts of the world and produced by different manufacturers (a task that has been discussed with the International Science and Technology Center in Moscow in the past years according to 09/ICA-003 but will be reformulated as *Task Proposal #4*; a similar proposal was also discussed with Argonne National Laboratories in the US).
- There is an on-going need for further development of trade analysis methodologies to make them more comprehensive and increase efficient use of available data. We will seek continuation of the EC SP task (EC D 1662). MSSP assistance is also needed to investigate the special nature of free trade zones and how to take account of that in trade analysis. A third trade analysis issue that needs further development is how to take into account the trade in nuclear-related, second-hand equipment. Both tasks will be pursued in the context of EC D 1662.
- During a workshop in June 2011 on trade analysis organized by the IAEA, the subject of proliferation financing as an indicator for proliferation activities and analysis of proliferation networks was discussed with the thirteen Member States participating. Through this discussion it became apparent that data to enable analysis in this field would be difficult to obtain for the IAEA. However, an approach similar to the current trade analysis making use of internationally available statistical data seemed to hold some promise. To further develop this idea, a feasibility study is needed with MSSP support (*Task Proposal #5*).
- To enhance the capability of early detection of proliferation activities and networks, predictive analytical models and techniques need to be developed. These would take into account non-technical indicators for proliferation activities, such as social, political, geographic and demographic factors (Task Proposal 09/ICA-012 proposed to the AUL SP). A second approach would be a risk model based approach (Task Proposal 11/ICA-001, discussed with the BEL SP). More MSSP will be invited to participate in both of these proposed tasks (also Austria will be approached, having shown relevant competencies in the past). In 2012 a workshop will bring together Member State representatives, researchers from universities and IAEA staff to debate progress (*Activity #5*). The strategic goal of enhancing early detection of undeclared nuclear activities through risk based approaches is also of interest to other Safeguards Divisions; an intense interdivisional cooperation in this task will therefore be pursued.
- A task will again be proposed to identify and study relevant social networks in the internet to determine if and how the information gained through observing these networks would help early detection of proliferation activities (*Task proposal #6).*

*Key Objective 3. Diversify information sources.*

- Through the D&IS activities in the past two years a number of sources for trade data have been identified and evaluated for use. Support is needed to continue this process, including data to track safeguards relevant shipments (as part of task EC D 1662).

- The Procurement Outreach Programme so far has addressed Member States with an industry manufacturing relevant nuclear items and good export controls. For the study of proliferation networks, an approach to Member States not manufacturing these items, but crucial in the trade in relevant dual use items needs to be made. MSSP assistance is sought to identify opportunities to engage these States involved in trade, develop new ideas to approach them and relevant companies located there and engage the authorities of the selected trading States to develop a basis for outreach activities. Where opportune, companies already participating in the Procurement Outreach Programme will also be approached to provide advice (*Task Proposal #7*).
- The increased success for the Procurement Outreach Programme as part of the IAEA's strategy to diversify its information sources was largely due to an increase in the number of Member States offering to voluntarily provide the information to help proliferation analysis (which will continue to be pursued in Task Proposal 10/ICA-006). Most of the information received is provided by companies. Because the number of companies providing information has not grown to the same extent as Member State participation, we seek MSSP assistance to develop strategies and concrete actions that will help improve the communication with and increase the flow of information from companies visited in the Procurement Outreach Programme (*Task Proposal #8*). One issue identified for further study is to facilitate secure communication between participating Member States, companies providing information and the IAEA.

*Key Objective 4. Enhancing trust/communication with Member States.*

- Most of the activities in the Procurement Outreach Programme have been directed towards Member States providing complementary information to the IAEA. In contacts with Member States it was recognized that competencies and experience of IAEA trade analysts would help Member States develop their own safeguards and compliance programmes. MSSP assistance is sought to investigate the possibility of building partnerships to consciously and systematically offer assistance in addition to asking for voluntary information and develop a methodology if viable. In this, the Procurement Outreach Programme will seek worldwide coverage: activities of proliferation networks are not constrained by geographical boundaries. (*Task Proposal #9*).

Additional development activities, largely not linked to MSSPs

- The principal system to review TC projects and procurements from a safeguards perspective is the Technical Cooperation Review System (TCRS). TCRS has improved considerably over the past two years with the assistance of the USSP, and was largely able to cope with the increased demand for TC reviews. TCRS still needs further improvement, mainly to keep up with software developments in TC that in some cases will lead to inconsistencies. This task will be completed mostly through IAEA resources (*Activity #2*).
- It has been noted that a number of international organizations present in Vienna have similar objectives and analytical needs to those of the IAEA. This is also true for organizations like the UNSCR 1540 Committee in New York. An exploration will be made (*Activity #3*) to see where approaches to relevant international organizations could be of use to the IAEA, e.g. to learn from analytical methodologies used, learn from approaches to Member States used or obtain relevant information not yet available to the IAEA.

### Key achievement targets

- Implement a new software system replacing the current Procurement Tracking System (PTS) (Key Objective 1): December 2013.
- Report on the ability to judge to what extent non-technical indicators analysis can be implemented as part of the State Factors analysis (Key Objective 2): June 2013.
- Report on the ability to use risk-based approaches as part of the State Factors analysis (Key Objective 2): December 2012.

- Formulate a strategy to successfully pursue outreach to trading hubs (Key Objective 3): June 2013.
- Define and utilize new instruments to enhance building partnerships with additional Member States that are willing to provide voluntary information, using the expertise and knowledge of the IAEA (Key Objective 4): December 2012.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### 5.1. *Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| CAN | D 1623 | Further Development of VITA to Support Nuclear Trade Analysis | First version successfully completed; new work plan for implementation in TTA context |
| EC | D 1662 | Improving Analysis of Covert Nuclear Trade | Ongoing |
| FRA | B 1768 | Nuclear Trade Analysis - Support and Training | Ongoing |
| GER | B 1560 | Nuclear Trade Analysis Related Support and Training for Trade and Technology Analysis Unit (B.20) | To be completed in March 2012 |

### 5.2. *Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 08/ICA-015 | Understanding Nuclear Trade Mechanism | Outstanding with the US, in part realized as USA B 01800 |
| 09/ICA-003 | Collection and Analysis of Nuclear Trade Related Data to Strengthen Safeguards | Outstanding with RUS (2009); a new adapted task proposal will be presented (Task Proposal #7) |
| 09/ICA-012 | Improving the Analysis of Trade Data and Non-technical Indicators for Safeguards Relevant Proliferation Activities | Outstanding with AUL(2010); look for additional MS support |
| 10/ICA-006 | Collection and Analysis of Nuclear Trade Related Information to Strengthen Safeguards | Outstanding with ARG, BEL, BRZ, CPR, ESP, FIN, HUN, JPN, ROK, RSA and SWE (2010); continue this effort to finance dedicated contacts and national effort for outreach activities |
| 11/ICA-001 | Feasibility of safeguards relevant non-technical indicators to reveal covert nuclear activities | Under review; Belgium made comments on the task proposal and will likely accept; look for more MS support e.g. Austria |
| New Task Proposal #1 | Development and implementation of new software system replacing PTS | To be submitted before July 2012 |
| New Task Proposal #2 | PTS update | To be submitted before the end of 2011 |
| New Task Proposal #3 | VITA adaptation to TTA | To be submitted before the end of 2011 MSSP(s): CAN |
| New Task Proposal #4 | Proliferation analysis: advanced awareness of the varying shapes and names of nuclear relevant equipment (adapted from 09/ICA-003) to better discern non-nuclear-related trade from nuclear-relevant trade | To be submitted before the end of 2011 |
| New Task Proposal #5 | Proliferation analysis: analytical approaches to proliferation financing | To be submitted before December 2012 |
| New Task Proposal #6 | Proliferation analysis: feasibility of studying internet communication / social networks | To be submitted before the end of 2011 |

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| New Task Proposal #7 | Information sources: approaches to major trading hubs | To be submitted before July 2012 |
| New Task Proposal #8 | Information sources: improved company feed-back | To be submitted before the end of 2011 |
| New Task Proposal #9 | Communication: enhanced partnerships for improved safeguards and non-proliferation systems | To be submitted before July 2012 |

### 5.3. *Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | Implement Palantir |
| Activity #2 | Enhance TCRS |
| Activity #3 | Enhance cooperation where appropriate with international organizations |
| Activity #4 | Workshop on Advances in Proliferation Analysis |
| Activity #5 | Workshop on Risk Based Approaches to Proliferation Analysis |

# SGIS-01

## Integrated Analysis

**Project Manager: Jean-Michel Becar** **Division: SGIS**

### 1. Introduction

This document describes the plans for developing and implementing integrated information analysis processes and architecture within the Department of Safeguards for the period 2012–2013. Due to different issues in the implementation of the initial project *SGIM-01 Integrated Safeguards Environment (ISE)*, it was decided to merge all tasks of that project with *SGIM-06 Integrated Analysis,* now renamed SGIS-01. As SGIM-01 outcomes are the foundation for *SGIS-01 Integrated Analysis* in terms of architecture and information, having all the tasks under one project only will make the management of the project more coordinated and more efficient.

This document has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building Support for the Non-proliferation Regime*, *Strategy 2 – Coping with the Workload* and *Strategy 5 – Changing the Way the Department Works* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

The implementation of a safeguards system that is more objectives-based and information-driven requires further deployment of analytic processes coupled with an array of advanced information technologies to support the collection and evaluation of information about States' nuclear activities.

The initial project SGIM-01 "Integrated Safeguards Environment" has created the architecture and the information environment to enable all-source analysis in the Department of Safeguards, particularly with the fusion of all key data sources and the improvement of the key business processes in collecting data from Member States.

ISE, delivered in 2008 by the ISIS Re-engineering project (IRP), is a highly secure and modern infrastructure allowing the centralization of all Safeguards information and provides a Service Oriented Architecture platform on which all software supporting the Safeguards business processes can be developed. Some implementation projects still need to be completed to allow the analysis processes to be fully operational.

ISE is hosting the Safeguards portal (SG portal project) promoting collaboration and the implementation of new analytical processes. Through the portal many tasks will not require manual work and will be automated with the support of the new software delivered by the project SGIS-01.

2010 and 2011 were the years of the design and of the implementation of the main components, unfortunately the IAEA had many contractual issues with the main contractor involved in the project SGIM-01 and many tasks has have been delayed beyond the end of 2011. In the meantime the IAEA has implemented (Data Migration project) the infrastructure to move the information stored on the mainframe into ISE and that infrastructure will be used as soon as the sub-projects deliver the components to manage the data. With this infrastructure the IAEA will be also able to keep the information synchronized on both platforms, the mainframe and ISE, in order to allow the legacy software top continue to be functional.

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

2011 has also seen the implementation of the Role Based Access control (RBAC) components in ISE allowing a centralized control of who has access to the information on a "need to know" principle. Any new software delivered from now on, by the project SGIS-01 or any other projects related to Safeguards business, will be secured by those components.

Once the information is centralized into ISE the analytical methodologies and the Safeguards portal will provide access to all relevant high value information sources, including state declared information, and open sources on a need to know basis not only for safeguards analysts but also to authorized users across the entire Department.

Member State research and development activities in all functional activities of the project will continue to be essential and will help in reaching a larger Departmental goal of fostering a more comprehensive analytical culture within the Department of Safeguards.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term direction for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023.

As a first step, the long-term directions of the current D&IS project were defined:

***Enhance information and system integration**:*

- Migration of all information available today from an outdated mainframe platform to a centralized and modern infrastructure (ISE).
- Implementation of the key Safeguards business processes in a Service Oriented Architecture supporting business process improvement and a single view of the information.

***Support information analysis:***

- Develop the capability to correlate the wide variety of information collected, stored and processed in various formats and in numerous locations within the Department (such as design information, State declarations, commercial satellite imagery, site layouts and topographic data, etc.);
- Develop Information Technology tools to discriminate pertinent information relevant to proliferation out of the information background noise.

In order to support the long-term directions, activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Deliver an integrated, service oriented, analysis-friendly information architecture, as an effective base to collect, evaluate, analyse, structure, secure and disseminate safeguards-relevant information.*

2. *Continue to design and define enhanced information analysis architecture.*

3. *Support a collaborative analytic platform that enhances the Department's ability to draw sound safeguards conclusions.*

4. *Ensure information is appropriately classified and secure (in conjunction with project SGIS-02).*

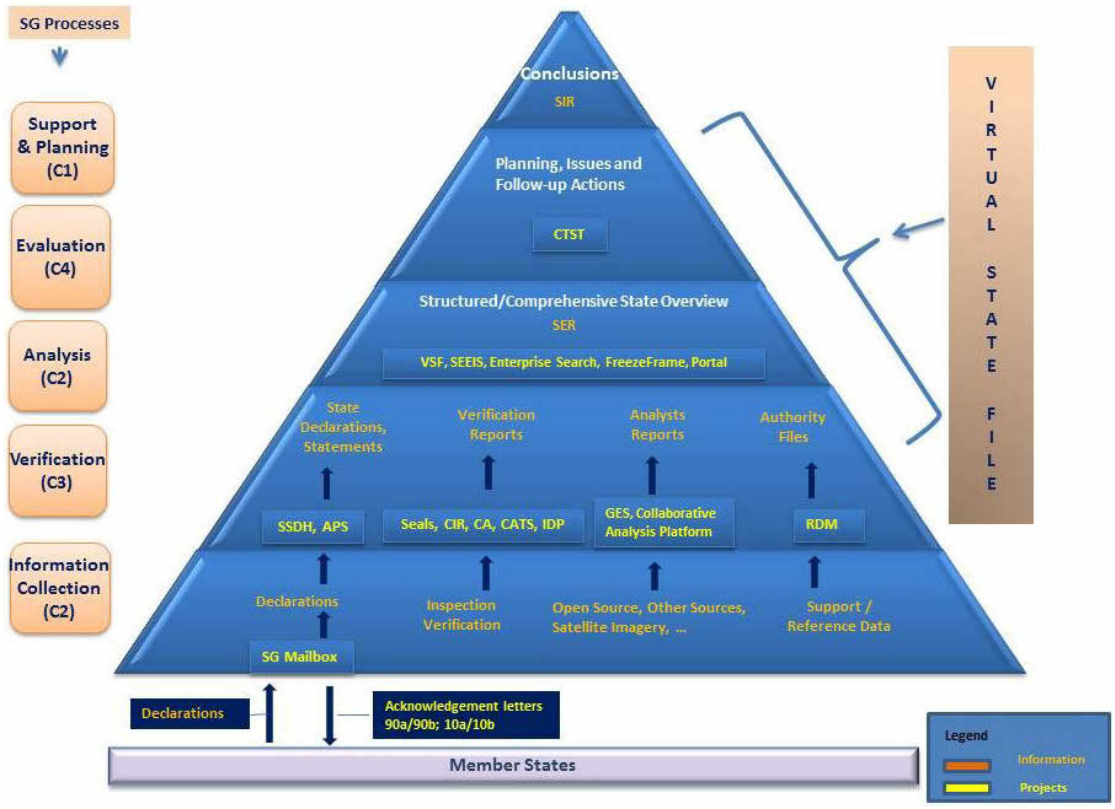



Figure 1: Relationship between the Safeguards information and SGIS IT projects.

## 4. Activities

*Key Objective 1. Deliver an integrated, service oriented, analysis-friendly information architecture, as an effective base to collect, evaluate, analyse, structure, secure and disseminate safeguards-relevant information.*

- Currently the ISIS Re-engineering project (IRP) is in the implementation phase. Detailed requirements gathering part of the implementation phase was completed and coding of the requirements will be finished by 2012 with some delays due to issues discovered during that phase and the department's move toward a State Level approach which needs to be integrated in the requirements. With the completion of the implementation phase all key functionalities will be in place including information architecture, information management and business process services. This will be the basis of an integrated safeguards IT infrastructure that will reduce compartmentalization of information and implement integrated information systems to support activities in the field and at headquarters.
- ISIS Re-engineering Project (Tasks CZ D 1512, FRA D 1676, GER D 1455, UK D 1449, USA D 1461). The tables list the IRP sub-projects with their expected start and end dates. The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes.

| Projects Name | Start | End |
|---|---|---|
| State Supplied Data Handling | | |
| State Supplied Data Handling (SSDH) | 05/2010 | 12/2012 |
| • Implementation of the requirements collected in the State Supplied Data Handling (Requirements) project | | |
| Support | | |
| Reference Data Management (RDM) | 03/2010 | 06/2012 |
| • Implementation of the functionality to support reference data for safeguards. | | |

| Projects which need a complete requirement revision | Start | End |
|---|---|---|
| Verification | | |
| Containment and Seals Verification | 11/2011 | 12/2012 |
| • Implementation of the functionality to support containment and seals verification | | |
| Analysis | | |
| Safeguards Effectiveness Evaluation Information System (SSEIS) | 11/2011 | 12/2012 |
| • Implementation of the functionality to support state evaluation and safeguards implementation report | | |

The following tasks are listed separately as they initially were not covered under the IRP. However, they either provide direct support to the IRP or they use the IRP infrastructure and framework to perform activities defined in the task:

The IAEA is working on several projects in parallel in order to cover the full scope of a fully integrated IT solution for the Department of Safeguards to be delivered in the timeframe 2012-2013:

- Comprehensive Safeguards Tracking, Scheduling and Tasking System → CTST;
- Review of the processes around all fields activities (Reporting, Communication with the Member States) → Field Activities Reporting;
- Review of the requirements on how to integrate the information received from the in-field instruments.

UK D 1412 Consultant - Assistance in ISIS Re-engineering Project (F1c) (Target Date: December 2012). A consultant helped the IRP project team to put governance in place to run IRP. Continuous support is provided during the project.

SPRICS 2.0 (Tasks AUL D 1538, CAN D 1536, CZ D 1517, FIN D 1518, FRA D 1527, GER D 1522, HUN D 1592, JPN D 1546, ROK D 1528, RSA D 1670, SWE D 1537, UK D 1511, USA D 1617,) Development of the SPRICS 2.0 system has started in March 2007. SPRICS 2.0 is a new collaboration software to be used for the business activities of the Department of Safeguards with the Member State Support Programmes (MSSPs). It will be internet-based and shall allow both access to safeguards staff (within the IAEA) and to MSSPs representatives and contractors (from outside of the IAEA). The system will be deployed at the end of 2011. 2012 will be a year of transition to allow the MSSPs to get trained and to test the new system.

The USSP expressed its intention to accept Task proposal 10/IAP-002 Enhancement of the Safeguards Additional protocol. The current additional protocol system processes were established based upon older technologies. With the introduction of an enhanced data architecture and new analysis software significant system improvements can be achieved. For example one common database for all additional protocol declarations would dramatically reduce loading efforts. The ability to cross reference, link to other declarations and produce comprehensive summary reports will allow for improved analysis of additional protocol activities. In addition the new role-based access system delivered by IRP in 2011 will allow for authorized staff to access all relevant AP data from their desktops (Target Date: Significant improvement in all functional areas by fourth quarter 2012).

*Key Objective 2. Continue to design and define an enhanced information analysis architecture.*

- The need to provide an easy to use interface or pathway to other tools such as geographic information systems, scientific literature, business databases and technological and scientific reference material is essential for the department of Safeguards to have a global view on all the information available to the department.
- The Geographical Exploitation System was delivered in October 2011 (in collaboration with project *SGIM-02 Commercial Satellite Imagery*) and will be the interface allowing the Safeguards department to

have a localisation of all the relevant information. That interface will be deployed first for the satellite imagery analysts and then in 2012 for the overall Safeguards department. All the information will be available through it, including information delivered through the activities of the Objectives 1.

- The State File project: In order to respond to the urgent need for the department to move ahead towards a State level Approach, the Department of Safeguards needs some tools to support that evolution. A working group has been created and will allow the investigation via the prototype how the information and the tools can support the State Evaluation process (Target for end 2012). That work will draw the path to the Virtual State File which will be the complete product for the complete integration and the support of all source of information available analysis (Target for end 2013).
- State Declared Information (SDI): SDI includes nuclear material accountancy data, design information, Additional Protocol declarations, Voluntary Scheme Report information, Neptunium and Americium data, as well as data shared by the facility operator (mailbox declarations). In 2011, the Department identified the need to coordinate, centralize and, whenever possible, automate the handling of State Declared Information throughout the Department in a central repository, the State Declared Information portal to be fully integrated into the Virtual State File (Figure 2). The benefits of the SDI portal will be to ensure that SDI is safely stored and can be easily retrieved, to facilitate SDI timely and reliable dissemination within the Department, to facilitate integration of SDI within the Virtual State Files and ultimately to integrate the outcomes of the SDI analysis into the state evaluation process. All the IRP components are designed to facilitate that integration.

  During the biennium, the related activities will consist of the specification, development and implementation of an SDI portal, hosted by the SG portal, to collect, process and distribute SDI within the department in a consistent, systematic, efficient and timely manner for further analysis. Interfaces between the SDI portal and the Virtual State Files will be clearly identified and managed.

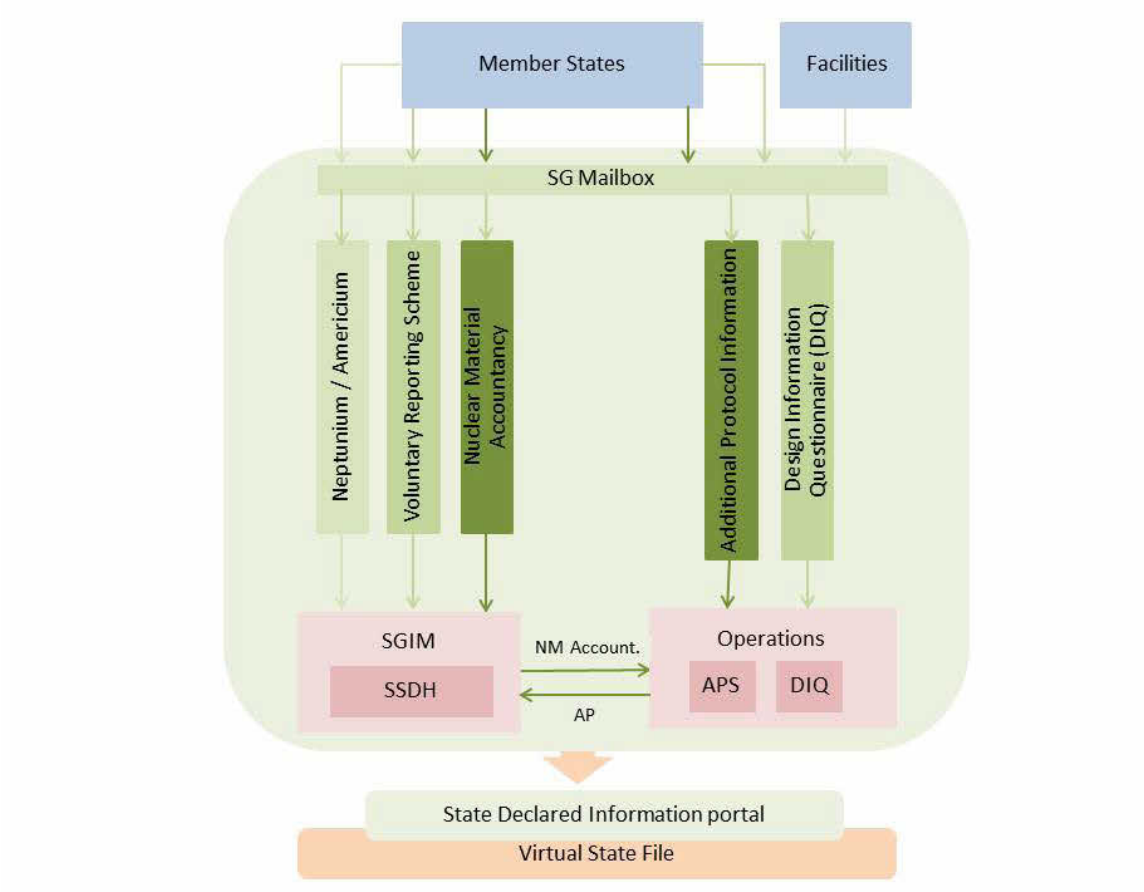



Figure 1: Enhanced coordination of the State Declared Information using an SDI portal to be fully integrated into the Virtual State Files.

Based on the Role-based Access Control, different types of users will have an SDI summary view through the Virtual State File. These activities will be performed in the context of the State Supplied Data Handling projects like SSDH, but also in combination with RDM, SSEIS, the SG Mailbox and all on-going projects (Activity #4).

The SG Mailbox is a tool allowing the Member States to send directly to the IAEA their declarations which will then be processed and stored in the SDI part of the Virtual State files.

The SG Mailbox is currently already used by Member States' operators; all the elements allowing its extended use for all official communication with the IAEA are being prepared by SGIS and expected to be delivered by mid-2012.

- USA D 1910 Freeze Frame Software Integration into ISE: This task will allow the use of a graphical representation of a State Nuclear Fuel Cycle and allow the authorized Safeguards users to collaborate on the documentation and the analysis of any step of the cycle of a State. This will improve the picture the Virtual State File will draw for a given country.

*Key Objective 3. Develop a collaborative analytic platform that enhances the Department's ability to draw sound safeguards conclusions.*

- With the support through tasks AUL D 1568, CAN D 1651, SWE D 1579 and USA D 1564 the goal is to implement the Palantir platform into the ISE environment in order to provide a central place for the department of Safeguards to be able to work on all available information – including open source information – to be able to draw sound conclusions. In 2011 the procurement actions have taken place, and the task will be able to start at the end of 2011 with a target date of end of 2012. Training on the Palantir product in coordination with project *SGCP-102 Training* will be necessary during the year 2012 and onwards to allow the best usage of it.

*Key Objective 4. Ensure information is appropriately classified and secure (in conjunction with project SGIS-02).*

- In conjunction with project *SGIS-02 Information Security* the longer term goal is to develop a comprehensive enterprise-wide search capability making all safeguards data easily accessible and secure for authorized users on a role-based access for evaluation purposes. A first prototype will be deployed early 2012 and further developed in 2012 and 2013 (*Activity #1*) (Target Date: End of 2013).

### Key achievement targets

- Test and implement new technologies to increase the efficiency of the collection and management of information (Key Objective 1):
  - Deliver Comprehensive SG Tracking, Scheduling and Tasking (CTST) v1.0 — February 2012
  - Test SPRICS 2.0 with the MSSP — March 2012
  - Test Reference Data Management (RDM) — April 2012
  - Test State Supplied Data Handling (SSDH) — September 2012
- Enhance access to diverse information sources (Key Objective 1):
  - Deliver re-engineering of the Additional Protocol System (APS) — December 2012
- Enhance collaboration and visualization of all information for each country (Key Objective 2): — December 2013
  - Deploy Geographical Exploitation System — December 2012
  - Deliver State File to support the IAEA State Evaluation Groups — February 2012
  - Integrate Freeze Frame into the Virtual State File — September 2012
- Implement an analytical laboratory supported by IT tools (Key Objective 3) — December 2013
- Test, develop and implement a state-of-the-art enterprise search engine making all safeguards data easily accessible and secure for authorized users on a role-based access for evaluation purposes (Key Objective 4). — December 2012

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### 5.1. *Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| AUL | D 1568 | Design and Definition for an Enhanced Information Analysis Architecture (USA D.159) | Target end date 12/2013 |
| CAN | D 1651 | | Target end date 12/2013 |
| SWE | D 1579 | | Target end date 12/2013 |
| USA | D 1564 | | Target end date 12/2013 |
| CZ | D 1512 | IAEA Safeguards Information System Re-engineering Project (IRP) | Target date 12/2012 |
| FRA | D 1676 | IAEA Safeguards Information System Re-engineering Project (IRP) | |
| GER | D 1455 | IAEA Safeguards Information System Re-engineering Project (IRP) (B.15) | |
| UK | D 1449 | IAEA Safeguards Information System Re-engineering Project (IRP) (E15) | |
| USA | D 1461 | IAEA Safeguards Information System Re-engineering Project (IRP) (D.151) | |
| UK | D 1412 | Consultant – Assistance in ISIS Re-engineering Project (F1©) | |
| AUL | D 1538 | SPRICS 2.0 | Target date 06/2012 |
| CAN | D 1536 | SPRICS 2.0 | |
| CZ | D 1517 | SPRICS 2.0 | |
| FIN | D 1518 | SPRICS 2.0 | |
| FRA | D 1527 | SPRICS 2.0 | |
| GER | D 1522 | SPRICS 2.0 (B.18) | |
| HUN | D 1592 | SPRICS 2.0 | |
| JPN | D 1546 | SPRICS 2.0 (JB-7) | |
| ROK | D 1528 | SPRICS 2.0 | |
| RSA | D 1670 | SPRICS 2.0 | |
| SWE | D 1537 | SPRICS 2.0 | |
| UK | D 1511 | SPRICS 2.0 | |
| USA | D 1617 | SPRICS 2.0 (D.160) | |
| USA | D 1910 | Freeze Frame Software Integration into Safeguards Secure IT Environment | Target date 12/2012 |

### 5.2. *Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 10/IAP-002 | Additional Protocol System Implementation (Re-engineering) | Outstanding with USA (2010) |

*5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | Information Security Technical Implementation supported by SGIS-02 |
| Activity #2 | RBAC: Role Based Access Control Administration and Engineering |
| Activity #3 | Finalize the Data Migration from the mainframe into ISE |
| Activity #4 | SG portal: to support the Virtual State File projects |
| Activity #5 | CTST: Comprehensive Safeguards Tracking, Scheduling and Tasking System |
| Activity #6 | FAR: Review the business processes around all in-field Safeguards activities (CIR, CA, Seals) |
| Activity #7 | Review of the integration requirements with in-field data collected |

# SGIS-02

## Information Security

### Project Manager: Peter Chow — Division: SGIS

### 1. Introduction

This document describes the plans for developing and implementing the project *SGIS-02 Information Security* within the Department of Safeguards for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 5 – Changing the Way the Department Works and Strategy 8 –Building Political Support* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

The security of the Department's information systems is vital to the credibility of safeguards conclusions and to the reputation of the IAEA. While the Department has achieved significant improvements in its operational security, the continual evolution of security threats and the high profile of the IAEA require continued vigilance in information security. To this end SGIS-02 has been defined to ensure this vigilance is maintained and that the Department's information security measures continue to evolve to address the changing threat landscape.

The majority of the activities in the scope of SGIS-02 are focused on developing practical solutions that improve the security posture of the IAEA, such that considerations for best practices and optimal investment in security technologies can be demonstrated. Only a small number of activities are focused on research, as these technologies may have long-term strategic importance and thus warrant early efforts to understand their impact to the Department.

The desired outcome from SGIS-02 is to provide its end-users, i.e. the Department of Safeguards as a whole, with the means to conduct its business securely and serve as an enabler to achieve the Department's long-term strategic plan.

The SGIS-02 project plan was prepared with full consideration of the Department's wider programme and its various long-term and medium-term plans. In particular strategies 5 and 8 of the *Departmental Long-Term Strategic Plan 2012-2023* have a direct impact on SGIS-02. Under strategy 5 one of the long-term R&D directions is to "further elaborate, develop and implement information-driven safeguards concepts that improve intradepartmental collaboration and communication". Implicit in this statement is that the improved collaboration and communication must be performed securely; as such SGIS-02 has identified one of its long-term directions as "providing an appropriate balance between the need-to-know and the need-to-share". Under strategy 8 one of the long-term R&D directions is to "continue to improve physical and information security", which constitutes the majority of the activities in this D&IS project.

SGIS-02 is a continuation of *SGIM-10 Information Security* from the R&D Programme for Nuclear Verification 2010-2011, which produced the following achievements:

- *Core Firewall and Network Backbone Upgrade* (Task Proposal 10/ICO-003) – This activity was completed using funds from the regular budget. The upgraded network backbone and core firewall ensures

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

growth innetwork activity in the medium-term can be accommodated with no end user impact. It has been removed from SGIS-02.

- *Safeguards Data Centre* (Task Proposal 10/ICO-004) – The cost estimates were increased due to the need to resurface the floors to increase the floor load capacity and HVAC systems. The shortfall in funding has prevented further progress on this activity. As this is an important activity that has long-term impact on the operational stability of the Department's information systems, this task remains below as one of the activities of SGIS-02.
- *Establishment of a Safeguards Forensic Laboratory* (Task Proposal 10/ICO-005) – The Safeguards IT Forensic Laboratory was established using funds from the regular budget and has already made significant contributions to the security incident handling capabilities of the entire IAEA. However, as there is a need to continue to update the lab and train staff in new computer forensics techniques to cover the latest attack methods, it has been included below as one of the activities of SGIS-02.
- *Sponsorship of a Safeguards Security Assessment* (Task Proposal 10/ICO-006, Task FRA D 1901) – The activity has been funded by the French Support Programme with the focus of providing an external assessment of the role-based access control products selected and performing security assessments of new applications. This activity is expected to be concluded in mid-2013 to ensure an adequate number of applications can be assessed.
- *Public Key Infrastructure Deployment in Safeguards* (Task CAN D 1576) – The IAEA PKI project was a great success; all IAEA staff are able to use their digital certificates to sign and encrypt email communication between staff members. In 2010 the IAEA PKI was enhanced to provide certificates for additional uses, including: SSL certificates for web servers, certificates for secure communication between domain controllers, and code-signing certificates. In addition a disaster recovery plan was established and demonstrated for the IAEA PKI infrastructure, an activity which was funded with regular budget and conducted by Safeguards Department personnel with assistance from the PKI vendor. SGIS-02 is expected to continue this activity by providing support to SGTS in the deployment of digital certificates for secure communication with devices in the field.
- *Next Generation Intrusion Detection Systems* – This activity was completed in 2010 as part of the *Core Firewall and Network Backbone Upgrade* and was funded using the regular budget. It has been removed from SGIS-02.
- *Safeguards Secure Desktop and Mobile Computers* – During the past two years significant progress has been made towards improving the security of desktop and laptop computers. As a result of the Departmental upgrade to Windows 7 all desktops have been "locked down", with administrative privileges available only to IT Service Desk personnel. In addition all laptop computers are being "locked down" and their hard drives are now encrypted; preventing access to the information contained on them should the laptops be stolen. Research to investigate the use of virtual computing technologies to create a virtual air gap between the Integrated Safeguards Environment and less secure networks has been completed and implementation is now in progress. This virtual air gap provides the means by which staff may continue to perform their work with external parties in a secure environment. In SGIS-02 this activity has been removed, but related activities *Enhance Remote Productivity with Mobile Devices* and *Evaluate Risk of Mobile Computing Devices* remain.
- *Secure Application Development Process* – A project was started in spring 2011 to define the activities required to establish the Safeguards Secure Development Lifecycle, an update of internal processes to ensure security is embedded in all stages of software development. The project is planned to continue into mid-2013 and is included below as one of the activities of SGIS-02.
- *Security Awareness Training* – By February 2011 all staff have completed an online security awareness training programme, including an assessment test to verify the understanding of 24 elements. The certification is valid for two years after which the training and assessment must be repeated. An activity has been included in SGIS-02 to update the security awareness training content with the latest information.

While these achievements have made significant contributions towards improving IT security, they also highlight the major challenge of the SGIS-02 project in the years to come, namely the need to shift the focus from *IT Security* to *Information Security*. The primary difference between the two is that IT Security is concerned with the security technologies that protect an information system and thus is IT-centric in nature, whereas Information Security is concerned with the data stored within these information systems and must be business-centric in nature. So while IT Security is a component of Information Security, much more needs to be done to ensure that security is incorporated into the business processes and thus fully addressing "information security".

SGIS-02 is making the shift towards information security by defining the long-term directions for the 2012-2013 biennium as listed in the following section. In addition, this project provides the IT security policies, guidelines, and infrastructure to other projects, in particular *SGIS-01 Integrated Analysis*.

### 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term directions for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023.

As a first step, the long-term directions of the current D&IS project were defined:

***Ensure that security measures in the Department of Safeguards are developed in accordance with 'best practice' in the field of security and incorporate, wherever possible, the latest technology and procedures to combat the developing threats to information and mission (IT focus).***

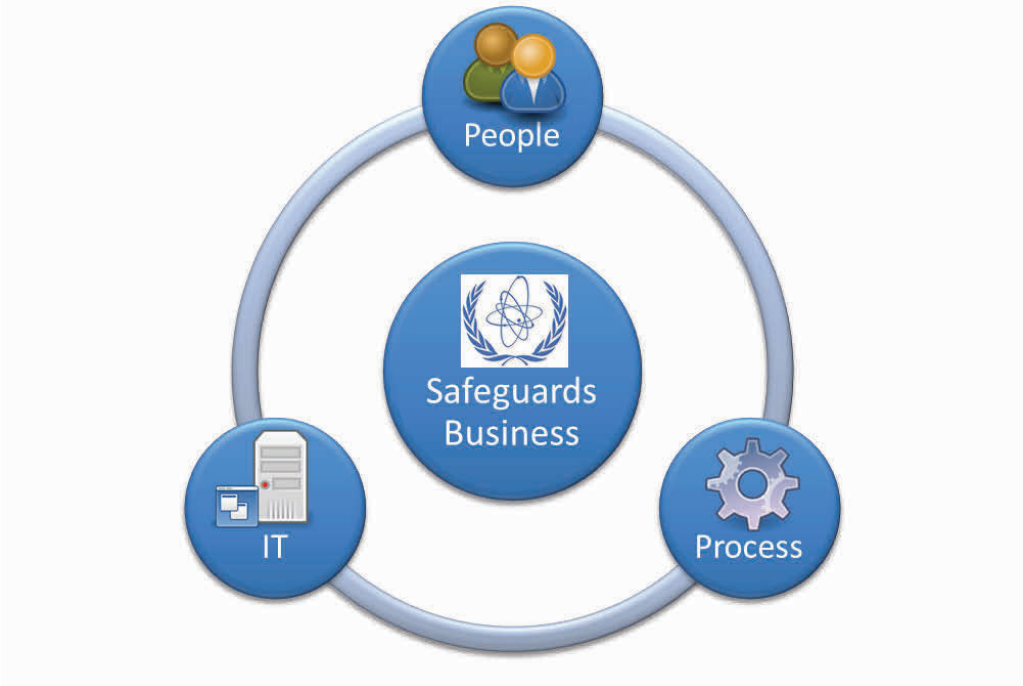
***Ensure information security supports a Safeguards system that is more objectives-based and information-driven, providing an appropriate balance between the need-to-know and the need-to-share (Business focus).***

***Establish the Department as a centre of excellence within the IAEA for security expertise, and to disseminate its ideas and procedures across the wider house, in accordance with the 'one house approach' (Process focus).***

***Update the information security policies, procedures, and awareness training to ensure staff members in the Department are able to conduct their work securely (People focus).***

The long-term directions for SGIS-02 have been defined to balance the IT focus with the equally important focuses on the business, process, and people. By defining categories for Business, IT, People, and Process, SGIS-02 aims to develop the proper mix of activities to ensure coverage of all aspects important to establishing an effective information security programme.

The four long-term directions for information security are visualized in the figure below, with the IT, People and Process focuses all supporting the Safeguards business.




In order to support the long-term directions, activities have to be initiated, continued and/or finalized during the biennium and can be structured under the following key objectives:

1. *Enhance security capabilities to facilitate Safeguards business (Business focus).*

   As the Department implements a Safeguards system that is more objectives-based and information-driven, it must ensure an appropriate level of information security is applied. This key objective ensures information security provides capabilities that serve to enable the business for the Department and permit it to achieve its long-term strategic goals.

2. *Refine the Safeguards Information Security Management System (Process focus).*

   The Department already has a well-established information security management system that leverages best practices in the field of security. This key objective serves to further refine the information security management system by focusing on improving existing processes and establishing new processes that address remaining gaps. The activity will help Safeguards to achieve the proper balance between need-to-know and need-to-share.

3. *Improve prevention, detection, and availability capabilities (IT-Infrastructure focus).*

In order to ensure the availability of information required for the business of Safeguards, the Department has in place a variety of technologies that serve to prevent and detect security incidents. As the threats to the Department are constantly evolving the adequacies of existing technologies must be evaluated, improved or replaced. This key objective focuses on improving the technical capabilities for information security in order to maintain an acceptable level of risk.

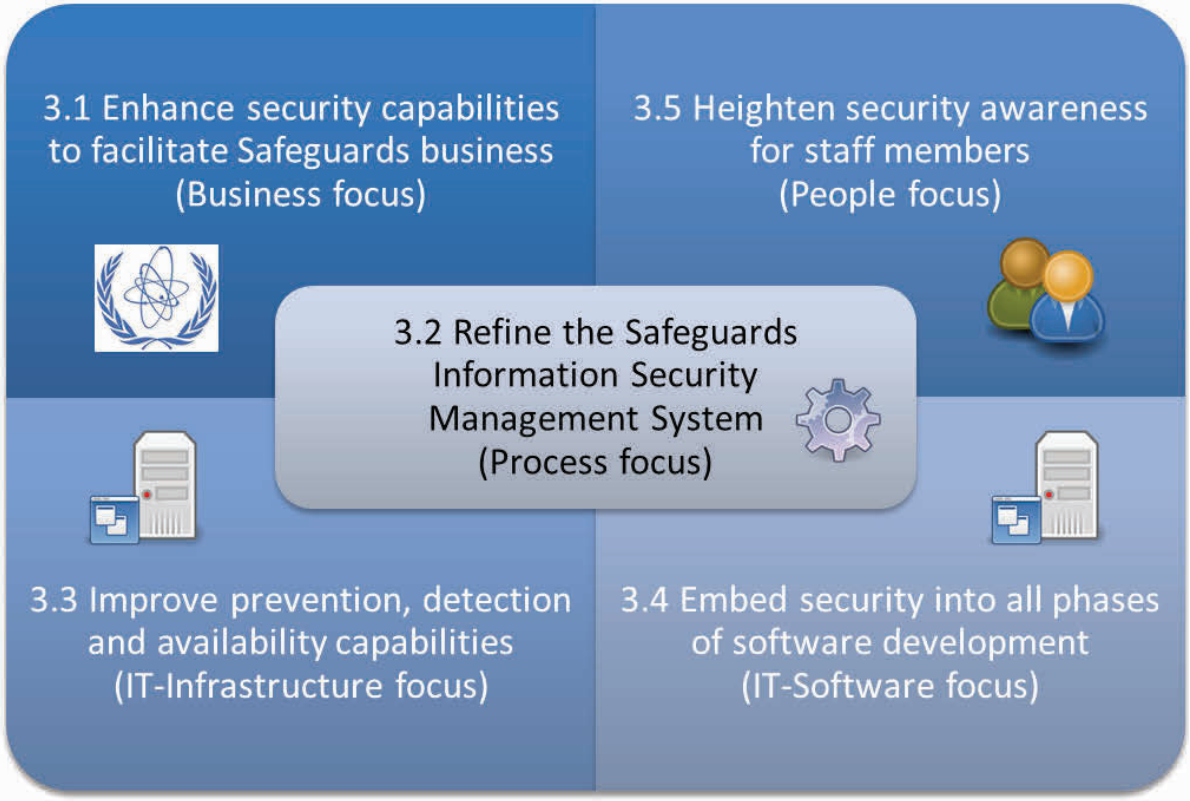
4. *Embed security into all phases of software development (IT-Software focus).*

Information security protection technologies have traditionally focused on network and computer systems, but as defences around these systems matured the focus of cyber-attacks has shifted towards the weakest link, typically the software applications and the people with access to the information. This key objective focuses on revising the software development process to embed security into Safeguards solutions, thereby further reducing the level of risk to the Department.

5. *Heighten security awareness for staff members (People focus).*

During the last two years a security awareness web site was established to check and reinforce knowledge and understanding of key areas of security across the Agency. All staff members and consultants are required to successfully complete the Information Security Teach and Test, which assesses understanding of 24 elements, and repeat the certification every two years. This key objective focuses on updating the content of the security awareness web site to keep up with changing threats and revisions to security policies and procedures.

Each of the five key objectives can be directly mapped to the four long-term directions for the project, and can be visualized as in the following diagram.



## 4. Activities

Funding for most of the described D&IS activities is foreseen to be provided by Member States Support Programmes (MSSP) which continue to play a major role in achieving the stated project objectives.

*Key Objective 1. Enhance security capabilities to facilitate Safeguards business.*

The activities associated with key objective 1 develop new information security capabilities that permit Safeguards to adapt its business activities to leverage the latest technologies, while still ensuring security is properly maintained.

- Enhance Remote Productivity with Mobile Devices

  Supporting Safeguards staff in the field is a high priority for the Department. Staff in the field must have secure, reliable, and convenient network connection to IAEA headquarters in order to effectively perform their job functions. Mobile devices, such as tablet computers, smartphones, and ultra-lightweight laptops, with wireless and 3G mobile network technologies are being considered for field use, as the devices have the necessary communications technologies to connect wherever a telephone signal is available. The low weight and long battery life of such devices are also important considerations given the multitude of field equipment often required and the time spent on duty. In New Task Proposal #1, MSSPs are requested to support the investigation of the security and practicality of utilizing mobile devices with existing Safeguards processes and applications, with particular focus on developing a secure access method and evaluating the related risks.

- Implement a Secure Printing Solution

  Assess, design, procure and implement a secure printing solution for the Integrated Safeguards Environment. Such a solution must protect the confidentiality and integrity for systems which produce hard copy data (paper copies). Potential solutions include networked printers which support encrypted traffic, automated document marking, and personal identification number (PIN)-based printout retrieval. In *New Task Proposal #2,* MSSPs are requested to support the implementation of a secure printing solution that can enhance the security of hard copy data.

- Secure Communication for Staff in the Field

  Staff in the field is currently limited in the number of secure communication channels with which to connect with IAEA headquarters, thereby limiting the level of real-time collaboration that can be achieved or doing so at the expense of security. This activity aims to address this problem by designing solutions that provide both secure data and voice communications between staff members, whether at headquarters or in the field, such that Safeguards business can be conducted securely regardless of geographical location. These solutions serve to provide the Department with the means to collect, integrate, and analyse information at greater speed, facilitating the ability to fulfil its mandate. MSSPs can support this activity by providing expertise, and hardware and software support to implement such solutions *(New Task Proposal #3)*.

- Secure Information Flow

  The Department must increase the level of security throughout the Safeguards network, but must face the reality that a fully-disconnected network will never be possible due to the data acquisition aspects of its business. Therefore, it is necessary to develop a means of secure data interchange between trusted and non-trusted networks either through the use of commercial products, custom-developed solutions or both.

  The secure data interchange will be coordinated with the project *SGTS-14 Remote Monitoring and Data Processing Systems* to allow effective and efficient data transfer from the field. Furthermore the implementation of a security policy with standardized hardware/software for collection of Non-Destructive Assays (NDA) and Containment and Surveillance (C/S) data from unattended systems (related equipment developments being managed under the projects *SGTS-11 Unattended*

*Measurements Techniques, SGTS-13 Universal NDA Data Acquisition Platform (UNAP) and SGTS-03 Surveillance Techniques* will follow a standard information security platform to be harmonized between the SGTS and SGIS divisions.

This work activity is expected to be performed by Safeguards Department personnel (*Activity #1*), but MSSPs can provide support for the hardware and software required for implementation, as well as with specialist solutions than can work with monitoring devices (*New Task Proposal #4*).

*Key Objective 2. Refine the Safeguards Information Security Management System.*

The activities associated with key objective 2 address gaps in the Safeguards information security management system. These activities provide better linkages between the multiple facets of a comprehensive information security programme, and the means by which to gauge its effectiveness. Gaps are understood and addressed through further refinement of the information security programme.

- Update Security Policies and Procedures

  A constant challenge for information security is providing assurances that security policies are understood and properly applied by staff members. The aim of this activity is to review and enhance security policies and procedures, and then wherever possible embed them into business processes by design, such that compliance is assured as a part of normal business operations. A redrafted set of information security policies and procedures will provide the guidance for all staff within the Department to conduct their work securely. These standards are being enhanced as a result of the other activities within this project (*Activity #2*).

- Establish a Comprehensive Risk Management Programme

  Design and implement a formal and comprehensive risk management programme that addresses both risk identification and risk reduction. Based on IAEA and Safeguards policies, the programme must produce a set of standards, procedures and guidelines to aid the Department to manage risks to an acceptable level and effectively balance the need-to-know and the need-to-share.

  – Formulate a *Statement of Threat* that addresses the threats to the data which could negatively impact the Department from completing its mission.

  – Develop procedures which lay the ground work for the development and maintenance of use and misuse cases. These cases will be used to identify security risks to the data.

  – Develop a *Risk Register* which lists current information security risks which have been identified and mitigated as result of the Safeguards Information Security Management System.

  – Establish a *Controls Catalogue* that are effective in mitigating the identified risks and which can be referenced for future activities. By leveraging past experience from similar situations, the level of effort required for mitigation of new risks can be reduced.

  Monitor progress and improve results of the risk management programme through the use of internal and external security assessments (as begun with *Task Proposal 10/ICO-006*).This work activity is expected to be performed by Safeguards Department personnel (*Activity #3*), but MSSP can provide support by providing specialists with expertise in developing such a comprehensive risk management programme (*New Task Proposal #5*).

*Key Objective 3. Improve prevention, detection, and availability capabilities*.

The activities associated with key objective 3 focus on improving the technical platform that forms the core of the information security management system. This includes improving prevention and detection capabilities, and ensuring the availability of Safeguards information to prevent interruptions to business operations.

- Enhance IT Forensic Capabilities

During the past two years the Department has recognized the importance of establishing an internal computer forensics capabil ity and has utilized regular IT budget to do so (*Activity #6*), rather than delay this important activity by waiting for support from *Task Proposal 10/ICO-005* which has since been withdrawn. The Safeguards IT Forensics Laboratory has played an instrumental role in identifying the source of a number of security incidents, thereby significantly reducing response times and the scope of impact. The services of the Safeguards IT Forensics Laboratory are available to the entire IAEA.

As the threat landscape continually changes due to new technologies and attacker resourcefulness, it is necessary to further augment intrusion detection, monitoring and forensic capabilities for the Safeguards IT Forensics Laboratory to maintain and improve its effectiveness. In addition the support which has been provided to the IAEA as a whole has been significant and the need and requests for forensic investigations is increasing.

There are two ways in which Member States can assist in order to address these challenges. First, provide support for the continued training of SGIS staff so that system administrators and security engineers are prepared to detect and respond to the latest security attack techniques (*New Task Proposal #6)*. Second, to validate SGIS' forensic efforts, an external review by a company specialising in IT forensics and incident response would be beneficial to help identify where gaps in the forensic capabilities exist and the best way forward for evolving the forensic service *(New Task Proposal #7).*

- Evaluate Application Whitelisting

  Malicious software, such as computer viruses, takes advantage of the user's ability to run any software to attack a system. One method of defending against this form of attack is known as application whitelisting, which explicitly lists the software programs that are permitted to run on a machine. The Department would like to evaluate whether application whitelisting is a suitable technology to control this risk, and whether the potential administrative burden of maintaining such a list outweighs the benefit it provides. MSSPs can support this effort by providing knowledge or technology transfer in this area *(New Task Proposal #8)*.

- Evaluate Risk of Mobile Computing Devices

  The popularity and availability of mobile computing devices (personal digital assistants, smart phones, USB drives, and music players) can potentially be a security threat to the safeguards network. SGIS intends to conduct a risk assessment to determine the policies and controls that should be applied to such devices. MSSP can support this activity by providing knowledge or technology transfer that can help mitigate this risk *(New Task Proposal #9)*.

- Deploy Network Access Protection

  The Department implemented Network Access Control in 2009, which greatly improved the security of the Safeguards Network by ensuring that only Department authorized devices are permitted to connect to the network. However security risks remain even with authorized devices, as they may not have received the latest security updates or were subject to attacks while out in the field. To address these risks the Department would like to implement Network Access Protection, which includes capabilities to automatically patch systems, update antivirus definitions, remediate risks, quarantine devices that fail system health checks, and verify devices comply to Departmental information security policies before such devices are permitted access to secured resources. MSSPs can support this project by providing the necessary resources for hardware and software which may be required (*New Task Proposal #10*).

- Develop and Demonstrate Business Continuity

  There is a need for the Department to be able to continue normal operations in the event of a major disaster in the data centre at the VIC, when access to the data and infrastructure is not possible or not available. The data and backup infrastructure shall be available elsewhere for safeguards operations to resume in the shortest possible time; this is a critical component to ensure the availability of the Integrated Safeguards Environment. The SGIM Crisis Recovery Plan and the overall IAEA business

continuity also mandate the establishment of business continuity and disaster recovery facilities built using appropriate infrastructure and technology, to save and secure the data and make it available for safeguards purposes. SGIS intends to study the use of virtual server technologies for disaster recovery and remote disaster recovery infrastructure.

This security initiative will be performed in two phases. The first phase is the establishment of an alternate data centre within the VIC that will address failure scenarios with the primary data centre. The second phase will focus on the establishment of a remote alternate data centre that can provide business continuity in the event of a regional disaster. *New Task Proposal #11* requests Member States' support to provide additional network equipment and cabling in the VIC to connect the primary and alternate data centres. *New Task Proposal #12* requests support for a business continuity and disaster recovery expertise and guidance to aid in successfully delivering this project.

- Build a Tier-3 Compliant Safeguards Data Centre

  Design and build a tier-3 compliant data centre to house the Department's systems and servers, in particular the Integrated Safeguards Environment. The data centre shall have the necessary infrastructure built in with room for expansion, with appropriate access control and monitoring capabilities. The work on a new data centre for safeguards has already started, however Member States' assistance is being sought to complete and to make it tier-3 compliant (*Task Proposal 10/ICO-004 "Safeguards Data Centre"*).

*Key Objective 4. Embed security into all phases of software development.*

The activities associated with key objective 4 address the shift in focus from attacking networks and systems to attacking software applications. This includes changes to the software development process to embed security in from the beginning of development, rather than relying on firewalls and other security technologies that may be ineffective against such attacks. A variety of tools that can increase the efficiency of secure software testing is also to be evaluated.

- Establish a Safeguards Secure Development Lifecycle

  As software development follows processes that are specific to each organization, there are no quick fixes that could be achieved by purchasing a product. The Safeguards Secure Development Lifecycle project was initiated in spring 2011 to evaluate the maturity of the current software development process against the Open Software Assurance Maturity Model (OpenSAMM) - a best practices guide to improving security during all phases of software development. A roadmap to reach maturity 2 in each of the 12 security practices defined in OpenSAMM has been defined, with the objective to achieve this goal by mid-2013 (Activity #4). While this activity is primarily internal to the Department, MSSP can provide support by sponsoring knowledge transfer from security experts in areas such as: design review, code review, and security testing (New Task Proposal #13).

- Evaluate and Implement a Static Code Analysis Tool

  Many security vulnerabilities at the code level are complex to understand and require careful inspection for discovery. However, there are many useful automation solutions available to automatically analyse code for bugs and vulnerabilities. In New Task Proposal #14, MSSP are requested to support the purchase of a suitable static code analysis tool that can facilitate the efficient identification of security vulnerabilities in software code.

- Evaluate and Implement Automated Security Testing Tools

  In order to test for security issues, a potentially large number of input cases must be checked against each software interface, which can make effective security testing using manual test case implementation and execution unwieldy. Automated security testing tools can be used to automatically test software, resulting in more efficient security testing and higher quality results. In New Task Proposal #15, MSSP are requested to support the purchase of suitable automated security testing tools that can facilitate the efficient security testing of software.

*Key Objective 5. Heighten security awareness for staff members.*

The activities associated with key objective 5 address the last line of defence for Safeguards information security, the staff members who have access to Safeguards data. A constant vigilance in security awareness is necessary for staff to properly handle the Safeguards data they have been entrusted with, and the activities below serve to reinforce this awareness to keep up with the latest social attacks.

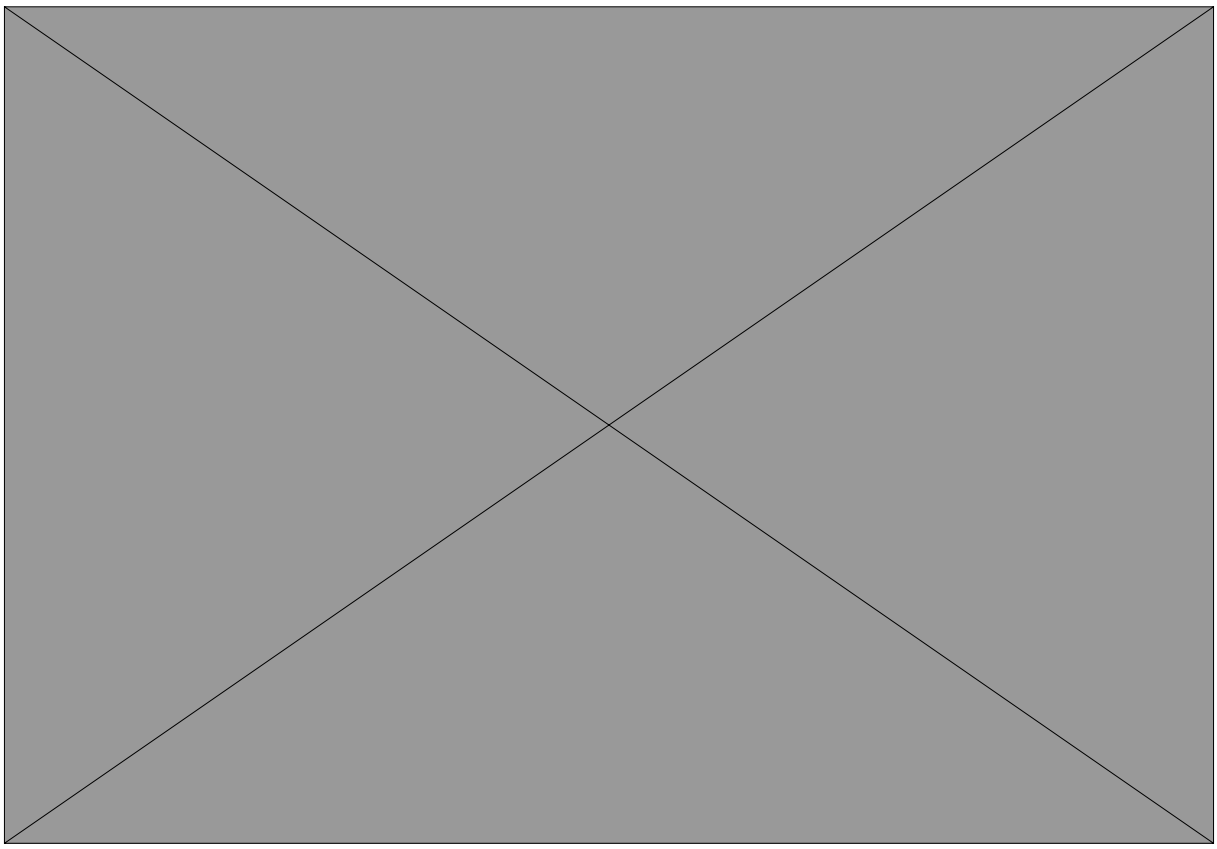
- Update the Security Awareness Training Content

  As threats evolve the need for security awareness training will continue to be a top priority for the IAEA. The training will be enhanced and bespoke training modules for specific categories of staff will be created. The training must be reinforced on a regular two-year cycle for all staff as well as incorporated into the IAEA's staff orientation programme (Activity #5), in coordination with project SGCP-102 Training.

- Enhance the Security Policy and Ensure Communication and Adoption

  As described above under Update Security Policies and Procedures (Activity #2), wherever possible the security policies and procedures must be embedded within the business processes in order to ensure compliance is a part of normal business operations. In situations where it is difficult to modify business processes to embed security policies, additional communication effort will be applied to ensure staff awareness and adoption.

The set of activities mapped to each key objective is shown in the diagram below.



### Key achievement targets

SGIS-02 has defined an ambitious list of activities to be achieved within this biennium. As the amount of resources available is finite, MSSPs are requested to consider the activities that can deliver the most value for the Department. A shortlist has been identified below for your convenience.

- Assess the security and practicality of utilizing mobile devices with existing Safeguards processes and applications (Key Objective 1): September 2012.
- Implement a secure printing solution to protect the confidentiality and integrity of hard copy data (Key Objective 1): December 2012.
- Deploy Network Access Protection to automatically update systems before permitting access to secured resources (Key Objective 3): December 2012.
- Develop and demonstrate business continuity to enable the Department to continue normal operations in the event of a major disaster in the data centre at the VIC (Key Objective 3): December 2013.
- Build a tier-3 compliant Safeguards Data Centre to meet the growth, security, and availability requirements of the Department (Key Objective 3): December 2013.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### 5.1. *Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| FRA | D 1901 | Sponsorship of a Safeguards Security Assessment | To be planned and completed in 2013 |

### 5.2. *Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 10/ICO-004 | Safeguards Data Centre | Outstanding with ESP (2010) |
| 10/ICO-005 | Establishment of a Safeguards Forensic Laboratory | Outstanding with ESP and JPN (2010) |
| 10/ICO-006 | Sponsorship of a Safeguards Security Assessment | Outstanding with UK and USA (2010) |
| New Task Proposal #1 | Enhance Remote Productivity with Mobile Devices | To be submitted to MSSP in 2012 |
| New Task Proposal #2 | Implement a Secure Printing Solution | To be submitted to MSSP in 2012 |
| New Task Proposal #3 | Secure Communication for Staff in the Field | To be submitted to MSSP in 2013 |
| New Task Proposal #4 | Secure Information Flow | To be submitted to MSSP in 2013 |
| New Task Proposal #5 | Establish a Comprehensive Risk Management Programme | To be submitted to MSSP in 2013 |
| New Task Proposal #6 | Enhance IT Forensic Capabilities – Training | To be submitted to MSSP in 2012 |
| New Task Proposal #7 | Enhance IT Forensic Capabilities – External Assessment | To be submitted to MSSP in 2012 |
| New Task Proposal #8 | Evaluate Application Whitelisting | To be submitted to MSSP in 2012 |
| New Task Proposal #9 | Evaluate Risk of Mobile Computing Devices | To be submitted to MSSP in 2013 |
| New Task Proposal #10 | Deploy Network Access Protection | To be submitted to MSSP in 2012 |
| New Task Proposal #11 | Develop Business Continuity – Equipment and Cabling | To be submitted to MSSP in 2012 |
| New Task Proposal #12 | Develop Business Continuity – Expertise | To be submitted to MSSP in 2012 |
| New Task Proposal #13 | Establish a Safeguards Secure Development Lifecycle – Knowledge Transfer with Expertise | To be submitted to MSSP in 2012 |

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| New Task Proposal #14 | Evaluate and Implement a Static Code Analysis Tool | To be submitted to MSSP in 2012 |
| New Task Proposal #15 | Evaluate and Implement Automated Security Testing Tools | To be submitted to MSSP in 2012 |

### 5.3. *Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | Secure Information Flow |
| Activity #2 | Update Security Policies and Procedures |
| Activity #3 | Establish a Comprehensive Risk Management Programme |
| Activity #4 | Establish a Safeguards Secure Development Lifecycle |
| Activity #5 | Update the Security Awareness Content |
| Activity #6 | Establish a Safeguards IT Forensics Laboratory |

# SGOA-02

## Safeguards System for JNFL MOX Fuel Fabrication Plant (J-MOX)

**Project Manager: Christophe Creusot** **Division: SGOA**

### 1. Introduction

This document describes the plans for developing and implementing an effective and efficient safeguards system for the J-MOX Fuel Fabrication Plant in Japan within the Department of Safeguards for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building Support to the Non-proliferation regime* and *Strategy 3 – Safeguarding Advanced Reactors and Innovative Nuclear Fuel Cycles* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

The JNFL-1 site located at Rokkasho in the north of Japan currently houses a large scale reprocessing plant (RRP) and will include in the near future a number of additional facilities including a MOX fuel fabrication plant (J-MOX), additional UO3 storages and various low level waste treatment and storage facilities.

The preliminary design information for J-MOX was submitted in June 2005 when the project was started. The construction of the plant was officially started in October 2010 but has been again delayed following the March 11th major earthquake in Japan. The start of commercial operation is foreseen in 2016. The J-MOX safeguards systems will be jointly developed with the Japanese State System of Accounting for and Control of Nuclear Material. The J-MOX safeguards approach will include an integrated safeguards approach at site and State level. This will also include design information examination and verification (DIE/DIV), near real time accountancy (NRTA), containment and surveillance (C/S) measures, process radiation monitoring, sampling for destructive and non-destructive analyses (DA), and in-situ unattended and attended non-destructive assay (NDA) methods.

During the 2012-2013 biennium, the project activities will focus mainly on:

- Developing/consolidating an integrated safeguards approach.
- Developing/manufacturing equipment necessary equipment to support the integrated safeguards approach.
- Defining the requirements specification and architecture for the integrated data collection and evaluation system, and
- Developing the plan and procedures for Design Information Verification (DIV) during the construction and commissioning phases of the facility.

### 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term direction for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023.

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

As a first step, the long-term direction of the current D&IS project was defined:

> ***Develop and Implement effective and efficient safeguards systems by the beginning of the J-MOX plant commercial operation.***

In order to support the long-term direction, activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Develop an integrated safeguards approach for J-MOX based on the basic elements agreed with Japan and start of the preparation of procedures for implementation.*

2. *Design, test and install safeguards equipment (NDA, C/S) that provide high quality, independent and reliable results.*

3. *Design, test and implement an integrated data collection and evaluation software for J-MOX, using synergies with RRP Information System.*

4. *Establish and implement DIE/DIV procedures that assure that the facility is constructed and will operate as declared and that the safeguards approach remains adequate and robust. Carry out DIE/DIV activities from construction to MOX commissioning phases.*

## 4. Activities

The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes. A number of MSSP umbrella tasks are active (refer to the section 5.1.) and contribute or will contribute in the future to the design and testing of the Safeguards systems for J-MOX. The particular domains where support is expected include:

- Expert review of design of hardware (HW) and software (SW);
- Assistance with development and testing of new systems (NDA, C/S, ID readers);
- Assistance with authentication/protection of data;
- Assistance with development of an integrated data acquisition and evaluation system;
- Assistance with development and testing of evaluation software modules.

In addition, a number of other D&IS projects within the Safeguards Department will potentially contribute to the development of the J-MOX systems like *SGTS-01 NDA Techniques*, *SGTS-03 Surveillance Techniques*, *SGTS-11 Unattended Measurements Techniques*, *SGTS-13 Universal NDA Data Acquisition Platform (UNAP)* and *SGTS-14 Remote Monitoring and Data Processing System*.

Key Objective 1. Develop an integrated safeguards approach for J-MOX based on the basic elements agreed with Japan and start the preparation of procedures for implementation.

An integrated safeguards approach based primarily on the use of random interim inspections supported by unattended non-destructive assay (NDA) and C/S measures has been prepared for the J-MOX plant. In order to finalize its development and prepare its implementation a number of steps need to be pursued:

- The inspection arrangements, based on short notice random interim inspections (RII) will be further developed. The procedures for RII will be developed for each sector (2012–2015).

- The type and number of safeguards equipment will be updated, if needed (ongoing).
- Near Real Time Accountancy (NRTA) concept for J-MOX to be developed (2012–2015).
- The adequacy of the operators' accountancy system and procedures will be checked and confirmed (2012–2016).
- DA sampling and analyses arrangements will be specified (2012–2016).
- Data to be declared by the operator and required for inspection activities (RII, physical inventory verification (PIV) and NRTA) will be identified (2012–2013).

MSSP support might be requested for the development of DA sample treatment, analysis and transportation procedures as well as for the development of simulation tools for NRTA.

The task UK D 1878 aims at providing a software tool to simulate the nuclear material accountancy system for MOX facilities in order to facilitate the IAEA's review of the J-MOX operator's accountancy system design and in order to help evaluate the effectiveness of the IAEA's verification system in the design phase including the NRTA tools.

*Key Objective 2. Design, test and install safeguards equipment (NDA, C/S) that provides high quality, independent and reliable results.*

The development, testing and installation of safeguards systems (HW and SW) are coordinated by a Joint Technical Committee (JTC) including all stakeholders involved in these activities. The JTC is responsible for the standardization of equipment and software and for the coordination of their implementation. The JTC ensures that the joint use hardware and software meet the requirements of all users. A number of milestones within the development and testing phase of the systems have been defined which will need to get approval by the JTC before moving to the next step.

The main steps for any equipment are as follows:

- Users requirements (carried out in 2007/2010);
- Detailed technical specifications (2008/2012);
- Continuous design review (2009/2012);
- Manufacturing and factory acceptance tests (2010/2014);
- Installation and cold tests (2013/2015);
- Tests with U and MOX (2015/2016).

The development of safeguards equipment began in 2008. The conceptual design of one of the key NDA systems developed by the IAEA for J-MOX (the Advanced Material Accountancy Glove Box system – AMGB) has been peer-reviewed in 2009 under the task USA A 1801. A prototype of the AMGB verification NDA system was produced in 2010. Testing of the prototype AMGB detector system is expected to be executed at the JRC-Ispra in 2011/2012 under the task EC A 1778. Initial tests were performed in Japan under the task JPN A 1721 to evaluate the potential use of new generation detectors (i.e. EMC-HPGe, CdZnTe and neutron liquid scintillator) for J-MOX. In parallel, some work was done under UK A 1887 to provide a signal processor for liquid scintillator detection pulses. A prototype, referred to as a Mixed Field Analyser (MFA) has been extensively tested.

Further support will be requested for other systems, especially in relation to rods verification in 2012, possibly also under the task EC A 1778. It is also expected to perform additional testing in Japan under the task JPN A 1721, in particular to pursue the long term testing of electromechanically cooled HPGe detector as well as testing of specific equipment developed by NMCC and LANL for J-MOX, i.e. Advanced Verification for Inventory sample System (AVIS) and Advanced Fuel Assembly System (AFAS).

High Resolution Gamma System (HRGS) detectors with maintenance-free reliable electrically cooled cryostats will be identified and characterized (Internal Activity #1). The possible shortage of $^{3}$He gas has initiated a study of alternate technologies for neutron detection to provide a backup solution (Internal Activity #2). The use of magnetic or similar sensors for proximity monitoring of movements of metallic containers through the facility process areas is studied (Internal Activity #3). These internal activities are mainly focused on testing and characterization of commercial devices and are conducted by the IAEA with internal human and financial resources.

*Key Objective 3. Design, test and implement an integrated data collection and evaluation software for J-MOX, using synergies with RRP Information System.*

The development and implementation of an integrated data collection and evaluation system for J-MOX (JADE) will follow the steps below:

- High level requirements (2009-2011);
- Requirements specifications (2012/2013);
- IT architecture design (2012/2013);
- Software development and testing (2013/2015);
- Software deployment and test at J-MOX (2015).

The high level user requirements were gathered in 2010/2011. The software development is not expected before 2012.

The umbrella tasks USA D 1802 and EC D 1779 have been accepted at the end of 2008 in order to provide future assistance for the design, development, procurement, testing and installation of the JADE system. Sub-tasks will be defined as needs arise.

The joint use part of this system (data collection, some database and software evaluation modules) will be coordinated through the J-MOX Joint Technical Committee similarly as for the safeguards NDA and C/S systems (refer to section of key objective 2).

*Key Objective 4. Establish and implement DIE/DIV procedures that assure that the facility is constructed and will operate as declared and that the safeguards approach remains adequate and robust. Carry out DIE/DIV activities from construction to MOX commissioning phases.*

The first draft of the DIV plan/procedures was drafted in 2010. DIE/DIV activities will continue during the construction and commissioning phases of the plant (up to 2016). Various technologies will be developed and applied to carry out the DIE/DIV activities to document the results and to maintain the continuity of knowledge where needed. The following steps have been identified so far:

- DIV plan for the lifetime of the J-MOX plant including the list of essential equipment (first half of 2012).
- Continuous DIE to assess the validity of safeguards systems to be implemented (ongoing).
- Detailed procedures for DIV during construction and commissioning phases (2012/2014).
- Development of tools to manage DI documentation and track the DIV activities (2012).

### Key achievement targets

The expected achievements for each key objective are presented in section 4. For the next biennium, the following are in particular expected:

- Develop and deliver Near Real Time Accountancy (NRTA) concept and tool for J-MOX (Key Objective 1): December 2013.
- Develop NDA systems with adequate detectors for gamma and neutron measurement (Key Objective 2): December 2013.
- Finalize testing of the Advanced Material Accountancy Glove Box system (AMGB) prototype: March 2012.
- Deploy AMGB: December 2013.
- Finalize Detailed Design of Rods Verification Systems: December 2012.
- Finalize requirements specification and IT architecture of the integrated data collection and evaluation system for J-MOX (JADE) system (Key Objective 3): July 2013.
- Finalize first draft of detailed Design Information Verification (DIV) procedures for the construction phase (Key Objective 4): July 2013.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

*5.1. Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| EC | A 1778 | Support for the Safeguards Systems at the JNFL MOX Fuel Fabrication Plant (J-MOX) (UK E12(e); US A280.01) | Umbrella Task. Target: Mid 2016 |
| UK | A 1887 | | Umbrella Task. Target: Mid 2016 |
| USA | A 1801 | | Umbrella Task. Target: Mid 2016 |
| EC | D 1779 | Support for the Data Collection and Evaluation System (JADE) at the JNFL MOX Fuel Fabrication Plant (J-MOX) (US D.176) | Umbrella Task. Target: Mid 2016 |
| USA | D 1802 | | Umbrella Task. Target: Mid 2016 |
| JPN | A 1721 | Support for Development of J-MOX SG Systems | Umbrella Task. Target: Mid 2016 |
| UK | D 1878 | Development of a Software Tool to Simulate the Nuclear Material Accountancy System for MOX Facilities (D2(h)) | Target: Mid 2013 |

*5.2. Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 08/OA2-001 | Support for the SG Systems at the JNFL MOX Fuel Fabrication Plant (J-MOX) | Outstanding with FRA (2008) |
| 08/OA2-002 | Support for the Data Collection and Evaluation System (JADE) at the JNFL MOX Fuel Fabrication Plant (J-MOX) | Outstanding with FRA and UK (2008) |

*5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | Assess High Resolution Gamma System (HRGS) detectors with maintenance-free reliable electrically cooled cryostats |

| Activity No. | Activity Title |
|---|---|
| Activity #2 | Study alternate technologies for neutron detection to provide a backup solution in case the shortage of 3He gas |
| Activity #3 | Study the use of magnetic or similar sensors for proximity monitoring of movements of metallic containers |

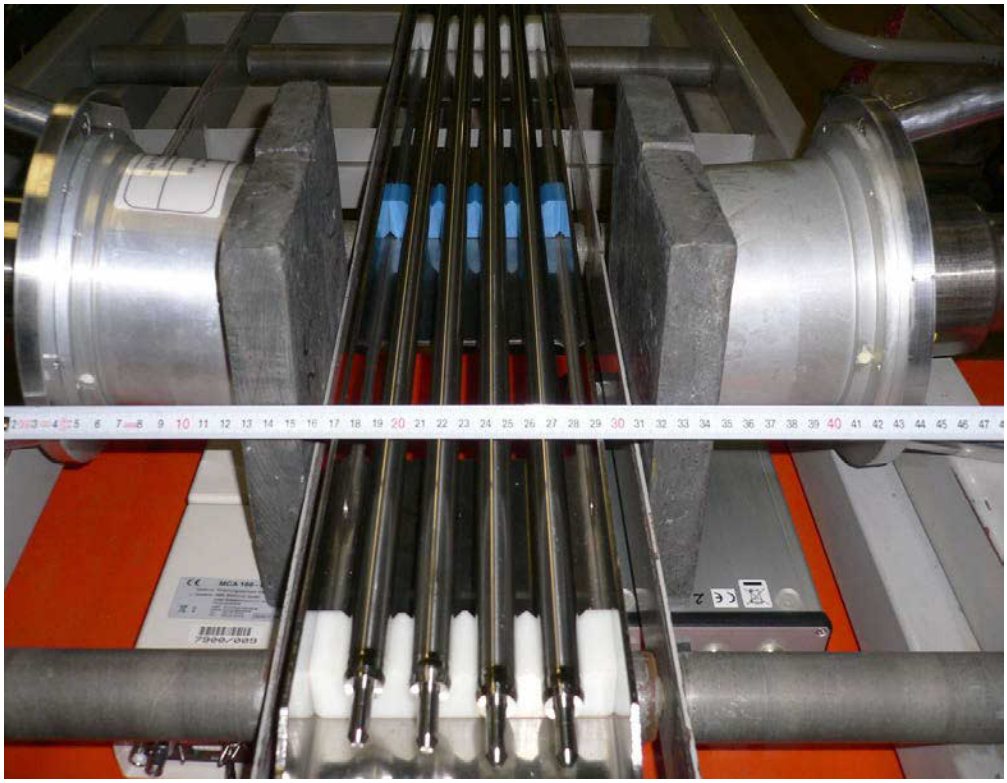


Figure 1: Testing of liquid Scintillators with MOX Fuel Rods.

Figure 2: Testing of AMGB Prototype during Factory Acceptance Test.

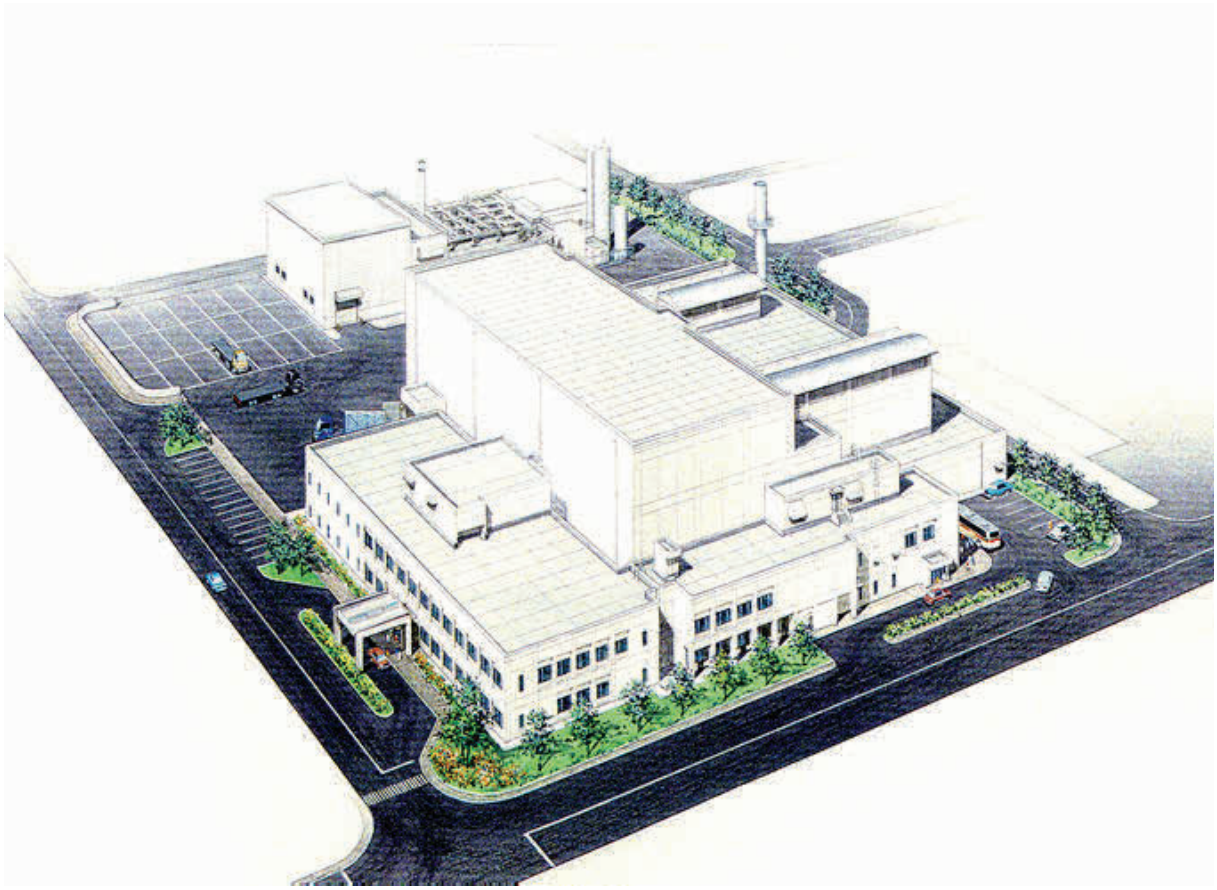


Figure 3: Bird's-eye view of the future J-MOX.

# SGOC-01

## Chernobyl

**Project Manager: Rastislav Hajdusek** **Division: SGOC**

### 1. Introduction

This document describes the plans within the Department of Safeguards for the period 2012–2013 for the development and implementation of safeguards systems for the decommissioning of the Chernobyl NPP and for the New Safe Confinement to be built around the existing sarcophagus ("Shelter") at Unit 4. It has been produced in accordance with the Department Long–Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular Strategy *1 – Building Support to the Non-proliferation Regime*, and *Strategy 2 – Coping with the Workload*.

### 2. Overview

The last unit of the Chernobyl Nuclear Power Plant in the Ukraine was shut down in December 2000. Decommissioning of the plant is expected to cover activities related to decontamination of buildings, soil and water, and to removal of spent nuclear fuel from the wet storage. The spent fuel will be conditioned, (i.e. cut, canned) at a special processing facility and will then be transferred to an interim dry storage facility. A spent fuel conditioning facility, as a part of the new dry spent fuel storage (IFS-2), is in an advanced state of construction. It is expected that the conditioning facility will be commissioned in 2013 at the earliest. The transfer of 22 000 spent fuel assemblies from units 1-3 is expected to commence thereafter.

Figure 1: IFS-2 Spent Fuel Conditioning Facility.

Figure 2: IFS-2 Dry Storage.

A New Safe Confinement will be built around the "Shelter" encasing the Chernobyl Unit 4, which was destroyed in the 1986 accident. The "Shelter" was built more than 25 years ago and its stability is not satisfactory; it contains about 200 tons of nuclear material in various forms including melted reactor core material. It is expected that the New Safe Confinement will be completed in 2015. After completion of the New Safe Confinement the "Shelter" structure will be dismantled and nuclear material will be removed (e.g. for characterization). The safeguards system that was installed during 2006 at the main access points of the currently existing "Shelter" needs to be upgraded and completed with the installations inside the reactor hall of Unit 4.

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

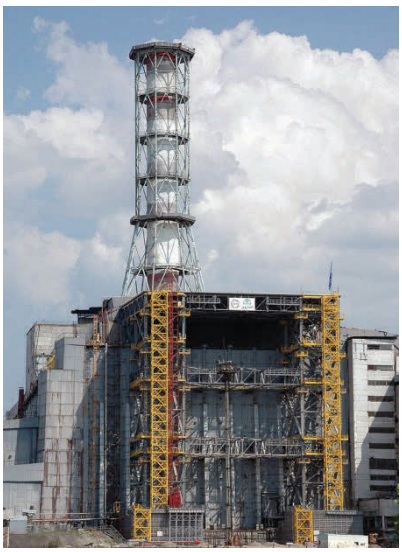


Figure 3: Shelter.

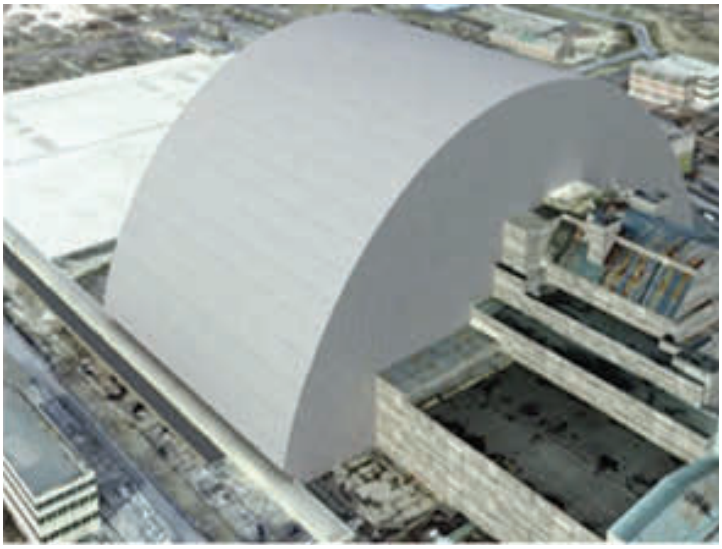


Figure 4: New Safe Confinement.

Work under Project SGOC-1 over the next two years will mainly consist of development and finalization of safeguards approaches, preparation for safeguards equipment installation and integration of data collection and remote monitoring systems.

In 2005 a safeguards approach regarding application of safeguards to the nuclear material in the Chernobyl Unit 4 "Shelter" was approved by DDG and partly implemented at Chernobyl. This safeguards approach needs to be implemented fully and a new safeguards approach needs to be prepared for the New Safe Confinement as soon as the design information is available.

Significant design development and safeguards implementation activities are expected in 2012–2013. In particular the project will make sure that the safeguards approach is fully implemented at "Shelter" before December 2012. Implementation of safeguards at the conditioning facility is also planned to be achieved before December 2012.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term direction for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Term R&D Plan, 2012–2023.

As a first step, the long-term direction of the current D&IS project was defined:

*Develop and implement effective and efficient safeguards systems at the Chernobyl site.*

In order to support the long-term direction activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Develop and finalize the safeguards approaches for the Chernobyl site.*

   This objective will target the development or revision of safeguards approaches at the conditioning plant, dry storage, and New Safe Confinement.

2. *Implement equipment and technologies supporting the verification and monitoring of nuclear material at the Chernobyl site.*

   This objective addresses the verification and monitoring of inventories, transfers to and from the Conditioning facility, conditioning of spent fuel and monitoring of irradiated material at the various facilities at the Chernobyl site.

3. *Integrate safeguards systems for collection of data and remote monitoring at the Chernobyl site.*

   This objective aims at the integration of safeguards systems for the collection of data including the secure transmission of information within and outside the Chernobyl site.

## 4. Activities

Many of the activities will be performed by Safeguards Department personnel. Assistance will be required from Member State Support Programmes mainly for expert review of design of hardware and software, development and testing of new systems (NDA, C/S) including authentication/protection of data, development of an integrated data acquisition and evaluation system and the development and testing of evaluation software modules.

*Key Objective 1. Develop and finalize the safeguards approaches for the Chernobyl site.*

- Under task USA E 1361 "Integrated Safeguards System for Chernobyl SF Conditioning Facility (Part 2/3 of Chernobyl Transfer and Conditioning Campaign)" (E.130.1) the safeguards approaches at the Conditioning facility and for the transfer between the Conditioning facility and the Dry Storage will be revised.
- A safeguards approach for New Safe Confinement will be prepared after the design is made available to the IAEA *(New Task Proposal #1) in coordination with project SGTS-03 Surveillance systems, SGTS-11 Unattended Measurement Techniques, SGTS-14 Remote Monitoring and Data Processing Systems).*

*Key Objective 2. Implement equipment and technologies supporting the verification and monitoring of nuclear material at the Chernobyl site.*

- Under the joint task JNT E USA, 1445 RUS "Safeguards System for Chernobyl Unit 4 "Shelter" " (C.111) development and authorization of equipment for monitoring of Spent Fuel in the South Spent Fuel Pond will be finalized. The equipment consists of C/S and NDA devices for the detection of movements of nuclear materials out of the area. According to this plan safeguards equipment will also be installed inside the Reactor hall no 4. These activities will be coordinated with the equipment related D&IS projects: *SGTS-01 NDA Techniques* and *SGTS-03 Surveillance Systems*.
- The following activities will be performed under task USA E 1361 "Integrated Safeguards System for Chernobyl SF Conditioning Facility (Part 2/3 of Chernobyl Transfer and Conditioning Campaign)" (E.130.1):
  - Equipment will be installed at the Conditioning facility. Field test measurement will be carried out before spent fuel conditioning starts (second half of 2013).
  - The safeguards equipment to be used during the transport of spent fuel (Mobile Monitor for Container Transfer – MMCT) will be upgraded. The system is currently used for confirmation of movements of spent fuel transports between different MBAs by a special transport wagon at the site. The MMCT needs to be fully upgraded in coordination with project *SGTS-11 Unattended*

*Measurement Techniques*. This equipment will be used later for confirmation of the spent fuel transports to the conditioning facility. Chernobyl NPP also plans to purchase and use one or two more transport wagons in 2011–2012. The wagons also have to be equipped with MMCT.

– Definition of equipment and technologies to be used for the verification and monitoring of nuclear material in the New Safe Confinement will start once the safeguards approach is finalized.

*Key Objective 3. Integrate safeguards systems for collection of data and remote monitoring at the Chernobyl site.*

- Integration of the safeguards data collection at the site is to be finalized. Partial site integration was accomplished in February 2009. Data collection during the transfer of spent fuel from the Conditioning facility to the Dry Storage facility (ISF-2) needs to be implemented, in coordination with project *SGTS-11 Unattended Measurements Techniques*. The possibility for remote monitoring will also be considered in coordination with the project *SGTS-14 Remote Monitoring and Data Processing Systems*. Remote monitoring is not active for ISF-2 (*New Task Proposal #2*).

### Key achievement targets

The project identified the major milestones for the 2012–2013 biennium as listed below. One should note that their achievement is subject to the adequate availability of Member State resources.

- Finalize safeguards implementation at the "Shelter" (Key Objective 2): December 2012.
- Implementation of safeguards at the Conditioning facility (Key Objective 2): July 2013.
- Development of safeguards approach at New Safe Confinement (Key Objective 1): December 2013.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

*5.1. Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| USA | E 1361 | Integrated Safeguard System for Chernobyl SF Conditioning Facility (Part 2/3 of Chernobyl Transfer and Conditioning Campaign) (E.130.1) | Completion date mid of 2013 |
| USA RUS | JNT E 1445 | Safeguards System for Chernobyl Unit 4 ("Shelter") (C.111) | Completion date end of 2012 |

*5.2. Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| New Task Proposal #1 | Integrated safeguards system for New safe Confinement | |
| New Task Proposal #2 | Data collection and remote monitoring for ISF-2 | Under consideration joint effort with SGTS-11 and SGTS-14) |

*5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

None.

# SGTS-01

## NDA Techniques

### Project Manager: Stefan Jung

### Division: SGTS

### 1. Introduction

This document describes the plans for developing and implementing Non Destructive Assay (NDA) methods and systems for the assessment and verification of nuclear material, including spent fuel and the products of reprocessing and pyroprocessing, within the Department of Safeguards for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building support to the non-proliferation regime, Strategy 3 – Safeguarding advanced and innovative nuclear fuel cycle* and *Strategy 4 – Taking on new mandates* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

The tasks under this project support the Department's efforts in improving present detection and verification capability in the instrumentation and measurement analysis area. This project integrates the tasks of previous project *SGTS-07 Improved Techniques and Instruments for Spent Fuel Verification and Monitoring*, which will be closed. Furthermore the project shares a number of objectives with SGTS projects such as *SGTS-08 Novel Technologies in Support of Safeguards Implementation, SGTS-11 Unattended Measurement Techniques SGTS-12 Verification Techniques for Large Scale Enrichment Plants* and *SGTS-15 Technologies for New IAEA Verification Mandates*.

The project addresses the development, evaluation, implementation, and enhancement of attended portable and facility-resident non-destructive assay (NDA) instrumentation used in a wide range of safeguards applications. Also in a wider context, gamma ray and neutron techniques as well as physical methods not traditionally used in safeguards are studied and developed.

The project focuses on measurement and verification of nuclear material, including spent fuel and the products of reprocessing and pyroprocessing. The IAEA also needs to verify the absence of undeclared fissile material generation at nuclear power stations and research reactors. This results in the need to perform non-destructive assay on selected items to certify that they do not contain any nuclear material.

Over the past years, significant progress has been achieved in the area of partial defect test on spent fuel. Completion of on-going activities will result in a diversified set of instruments able to cover the operational needs for partial defect tests on spent fuel. A modernization campaign of NDA equipment concerning the widely used hand-held spectrometer HM-5 and the Mini Multi Channel Analyser is ongoing. It has already resulted in working prototypes and will yield upgraded and compatible instruments based on the latest progress in digital electronics and detector technology. Also some implementation effort will be spent in the next biennium to accompany the introduction of these instruments, as well as the electrically cooled germanium detector systems introduced in the last biennium.

The end-users of the project that will benefit from the results of this D&IS programme are Operation Divisions carrying out safeguards verification activities but also technical staff using the improved methods and instruments. The safeguards training section is involved as well as the Declared and Statistical Information

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

Analysis Section when new methods are implemented, impacting statistical evaluation and planning of sampling.

In future, the Divisions of Operations will continue to submit special requests for the verification of fresh and irradiated nuclear material. The project will continue to address those requests mainly internally in order to fulfil the needs by adapting or customizing existing instruments. When necessary, specific development programmes will be initiated in partnership with MSSPs.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term direction for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023

As a first step, the long-term direction of the current D&IS project was defined:

***Develop and improve performance and detection capabilities of equipment/methods to verify, detect, check and monitor nuclear material (including irradiated material) and nuclear activities.***

In order to support this long-term direction, activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Improve detection capability and efficiency of NDA equipment and techniques for safeguards.*
2. *Enhance the capability of detecting undeclared materials and activities by NDA techniques.*
3. *Develop and implement technologies capable of performing partial defect tests on spent fuel assemblies.*
4. *Investigate technologies supporting direct reverification of spent fuel storage casks.*
5. *Develop instruments and methods supporting verification of material resulting from processing of irradiated material.*
6. *Contribute to the development of additional tools for new IAEA verification mandates.*
7. *Provide implementation support to Divisions of Operations.*

## 4. Activities

Funding for most of the described D&IS activities is foreseen to be provided by Member States Support Programmes (MSSPs) which continue to play a major role in achieving the stated project objectives.

*Key Objective 1. Improve detection capability and efficiency of NDA equipment and techniques for safeguards.*

- USA A 1607 Development of ISOC Self Modelling Capabilities

  The In Situ Object Counting System (ISOCS) makes use of numerically calibrated gamma spectrometry systems for quantitative gamma ray spectroscopy. It was introduced successfully for the assay of

uranium retained in waste and for hold up measurements in the last two biennia. With this ongoing task the method will be further developed and its usability will be improved.

- EC A 1507 COMPUCEA Upgrading

  COMPUCEA (Combined Procedure for Uranium Concentration and Enrichment Assay) is a transportable system and a method for accurate on-site analytical measurements of uranium elemental assay and enrichment during the physical inventory verification (PIV) in Low-Enriched Uranium (LEU) fuel fabrication plants. COMPUCEA was authorized for inspection use, category A, in 2011. Further improvement of the performance of the instrument and implementation in countries outside the EU will be pursued under this task. Additional activities managed under project *SGAS-03 Sampling Logistics, Analysis Support and NWAL Coordination* consist of:

  – Task JNT A 1877 BRZ "Standard Pellets for In-Field DA Calibration" aims to provide calibration standard materials for in-field methods such as COMPUCEA, to perform in-situ analysis of concentration and enrichment of U fuel pellets (completion date: end of 2012);

  – As part of the Regular Budget activities, SGTS in cooperation with SGAS and SGIM is in the process of establishing and evaluating COMPUCEA for in-the-field usage (*Activity #1)* under *SGAS-03*). The comprehensive master-plan for establishing COMPUCEA at the IAEA deals with the provision of reference materials (procurement, validation, storage, shipping), creation of instrument hardware and software as well as integration testing and authorizing as field use equipment, training and transfer of expertise to in-field teams, and finally field testing with associated vulnerability and cost/benefit-analysis. Specific areas of MSSP assistance will be characterized and ultimately formulated as new task proposal(s) in the relevant projects *SGTS-01, SGAS-01 Destructive Analysis of Nuclear Materials* and SGAS-03 (*New Task Proposal #1*).

- Improve methodology for core inventory verification in research reactors

  The implementation of IAEA safeguards at research reactor facilities includes the need to verify the reactor design information and amount of fissile material in the reactor core to guard against undeclared manipulations in the reactor fuel cycle. The currently used criticality method cannot provide full assurance that no undeclared activities could take place. The main challenges are the verification of large cores (more than 1SQ) and the verification of shut down reactors (*Activity #1*).

- USA, EC, FRA JNT A 1684 (Sustainability and Maintenance of Software for Pu-isotopics and U-enrichment (C.119)) will continue with the implementation of a database of spectra for performance testing of codes and the development of performance criteria and suitable test procedures.

- Modelling, Testing and Training

  The authorization of new equipment for routine use requires simulation and modelling as well as functional and qualification testing at different stages of the development process (prototype, pre-production model, final model) to assure conformance to the IAEA's requirements and manufacturer's specifications. The new equipment also requires, before implementation, that IAEA technicians are trained in commissioning and troubleshooting. In the case of NDA and UMS equipment a wide range of special nuclear material (SNM) samples is needed in order to simulate real measurement conditions both for functional tests and training. Two tasks will provide for appropriate facilities and capabilities:

  EC A 0860 (Qualification Testing of New Safeguards Equipment) will provide facilities and capabilities for testing equipment at the EC Joint Research Centre Ispra. In addition, umbrella task EC A 1362 (Modelling, Testing and Training for NDA and UMS Equipment) will cover modelling, simulation and training needs on a case by case basis.

- Within a mid-term perspective the development of a new version of the highly portable Cerenkov viewing device or upgrade of existing technology has to be considered. The Cerenkov Viewing Device ICVD is one of the most important tools in spent fuel verification activities. Continued factory support and availability of the instrument has been secured with the support of the Canadian

Support Programme. Succession planning should start in the next D&IS period relying on support of MSSPs (*New Task Proposal #1).*

- Technical Manuals and Procedures for Safeguards Instrumentation

  IAEA instrumentation documentation is essential to assure correct NDA measurements. Support in drafting this documentation is needed because the workload exceeds available SGTS resources. Tasks USA A 1842 and UK A 1729 will continue to provide for this need. The original task proposal (08/TAU-001) is outstanding with the Australian Support Programme.

*Key Objective 2. Enhance the capability of detecting undeclared materials and activities by NDA Techniques.*

Activities related to Key Objective 2 will continue currently active tasks and plans:

- Adapt hand-held devices originally designed for illicit trafficking monitoring tofulfil safeguards needs.

  In monitoring of illicit trafficking a series of hand-held devices are used, which could be useful for safeguards purposes, provided some changes are made. This is a continuous in-house effort, in close contact with the developers (*Activity #2*).

- A commercial hand-held Raman Spectrometer as identified by SGTS-08 will be further evaluated internally (*Activity #3*).

- Technical Support for the Prototype Portable Hand-Held LIBS System including adaptation of its library of spectra will be provided under task CAN A 1855.

- Extend portable XRF applicability to front end nuclear material/ore.

  Portable XRF is currently authorized for analysis of possible dual-use alloys. The potential for extending this technology to front end nuclear material/ore will be explored internally or though contracting (*Activity #4*).

- Continue to improve portable inspection kits for CA and inspections under integrated safeguards, including the miniaturization of next generation equipment. (Typically, packages of commercially available components are integrated in-house, tailored to typical recurrent inspection tasks; thus they become unique reusable tools.) Investigate new advanced tools capable of supporting inspectors in the field. Make available, upon request of Operations Divisions, specific tools. This is an in-house continuous effort (*Activity #5*).

*Key Objective 3. Develop and implement technologies capable of performing partial defect tests on spent fuel assemblies.*

Activities related to Key Objective 3 will concentrate on completing the currently active tasks:

- Task JNT A 1508 (Digital Cerenkov Viewing Device (DCVD) Additional Capabilities Performance Testing (CAN, SWE)) will continue with emphasis on the development of data interpretation tools supporting the quantitative evaluation of DCVD images in terms of partial defect test. At a later stage the DCVD could be further developed under the auspices of the D&IS project SGTS-11 to be used unattended.

- Task JNT A 1510 (Prototype Tomographic Spent-Fuel Detector System (EC, FIN, SWE)) The task originally conducted with HUN Support Programme active participation resulted in the development of a prototype Passive Gamma Emission Tomograph (PGET). The task continues with plans for testing using real fuel assemblies at JRC Ispra before testing the complete system at a nuclear power plant.

- USA A 1668 Spent Fuel Fissile Measurements Using Self-Induced Neutron Resonance Densitometry (SINRD) (A.273) is exploring the applicability of the Self-Induced Neutron Resonance Densitometry method to various safeguards applications, such as the verification of heavy metal (U, Th, Np, Pu, Th, Cm …) ingots from pyroprocessing or the partial defect test on spent fuel assemblies. Theoretical

work has been completed and the task is on standby mode until an implementation opportunity arises.

Upon successful completion of the above tasks, a cost-effective implementation plan will be defined at the Departmental level to meet IAEA requirements.

*Key Objective 4. Investigate technologies supporting direct reverification of spent fuel storage casks.*

- No instrument is available to restore continuity of knowledge on dry storage casks. The gamma scanning method developed by INL has matured enough to initiate a development task filling the gap between the existing instrument and a deployable instrument for inspection use (*Task Proposal 09/TAU-010*). The task is expected to result in equipment able on request and without any baseline measurements to restore continuity of knowledge on dry storage containers. The development would be undertaken internally (*Activity #6*) if the above referenced task proposal is not accepted.

*Key Objective 5. Develop instruments and methods supporting verification of material resulting from processing of irradiated material.*

- The Advanced Experimental Fuel Counter (AEFC) has been developed by LANL for the quantitative assay of spent fuel assemblies from research reactors. It embeds a combination of passive and active neutron counting in both total and coincidence mode. In addition, gross gamma counting is used to confirm the average burn up and burn up profile. Task proposal 11/TND-001 "Data acquisition and evaluation tools for the Advanced Experimental Fuel Counter (AEFC)" aims at supporting the deployment of the AEFC for inspection use with a user interface that requires a minimum of expertise.

*Key Objective 6. Contribute to the development of additional tools for new IAEA verification mandates.*

- Activities related to the identification and development of appropriate NDA techniques and equipment for new IAEA verification mandates and contributing to project SGTS-15 will be managed under the SGTS-01 project and performed by the TND/P&R NDA team, in close coordination with SGTS-15 project which will provide system analysis, define specific requirements and integrate results. These activities are further described within the SGTS-15 project plan.

*Key Objective 7. Provide implementation support to Divisions of Operations.*

- USA A 0931 "Implementation Support – Instruments and Techniques" is an umbrella task taking care on an ad hoc basis of development and implementation activities related to a specific immediate need of Divisions of Operations.
- BEL A 1086 "Calibration of Underwater Coincidence Counter (UWCC)": UWCC supports the verification of fresh MOX assemblies stored underwater. The current task is continued to provide a facility for calibrating existing and new UWCCs meant to be deployed in the field.
- Continue to design, calibrate and commission customized instruments for the verification of irradiated fuel (*Activity #7*) and possible support provided by the CZ SP under the task CZ A 1566 "Test Bed Facility for Spent Fuel Verification Systems.

### Key achievement targets

- Deliver hand-held radionuclide identification devices to operations (Key Objective 1): June 2012.
- Implement the Combined Procedure for Uranium Concentration and Enrichment Assay (COMPUCEA) in Member States outside the European Union (Key Objective 2): December 2012.
- Demonstrate extended fuel-type range capability for Digital Cerenkov Viewing Device (DCVD) quantitative partial defect test of spent fuel assemblies (Key Objective 3): December 2013.

- Demonstrate Passive Gamma Emission Tomograph (PGET) for partial defect test on spent fuel assemblies (Key Objective 3): June 2013.
- Demonstrate Passive Gamma Top Imager for direct re-verification of dry spent fuel storage casks (Key Objective 4): October 2013.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### 5.1. *Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| BEL | A 1086 | Calibration of Underwater Coincidence Counter | Ongoing |
| CAN | A 1855 | Technical Support for the Prototype Portable Hand-Held LIBS System (PHHL) | To be completed by 2013 |
| EC FRA USA | JNT A 1684 | Sustainability and Maintenance of Software for Pu-isotopics and U-enrichment (EC, ,FRA, USA) (USA A.274) | Ongoing |
| EC | A 0860 | Qualification Testing of New Safeguards Equipment | Ongoing |
| EC | A 1362 | Modelling Testing and Training for NDA and URM Equipment | Ongoing |
| EC | A 1507 | Compucea Upgrading | To be completed by mid 2012 |
| FRA | A 1438 | Evaluation of Geophysics Non-Destructive Methods | Task on hold |
| GER | A 1271 | Software for Hand Held Gamma Spectrometer (C.35) | To be completed in 2011 |
| GER | A 1791 | Digital Upgrade of Mini Multi-Channel Analyzer (MMCA) (C.40) | To be completed in 2011 |
| HUN | A 1667 | Development and Evaluation of a Multiplicity Spectrometer Prototype | Proposed for completion |
| UK | A 1729 | Technical Manuals and Procedures for Safeguards Instrumentation (UK E11; USA A.285) | Ongoing |
| USA | A 1842 | | Ongoing |
| USA | A 0931 | NDA Implementation Support – Instruments and Techniques (A.252) | Ongoing |
| USA | A 1607 | Development of ISOCS Self Modelling Capabilities (A.267) | To be completed in 2012 |
| CAN SWE | JNT A 1508 | DCVD Additional Capabilities Performance Testing (CAN, SWE) | To be completed by mid 2012 |
| CZ | A 1566 | Test Bed Facility for Spent Fuel Verification Systems | Ongoing |
| CZ | A 1646 | Impact of Retrieval of Spent Fuel on Radiation Traces Taken on Dry Spent Fuel Storages | Proposed for termination |
| EC IN SWE | JNT A 1510 | Prototype Tomographic Spent-Fuel Detector System (EC, FIN, HUN, SWE) | Completion by end 2012 |
| USA | A 1668 | Spent Fuel Fissile Measurements Using Self-Induced Neutron Resonance Densitometry (SINRD) (A.273) | On hold |

### 5.2. *Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 11/TND-001 | Data acquisition and evaluation tools for the Advanced Experimental Fuel Counter (AEFC) | Submitted to US (2011) |

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 08/TAU-001 | Technical Manuals and Procedures for SG Instrumentation | Outstanding with AUL (2008) |
| 09/TAU-010 | Restoration of Continuity of Knowledge of LWR Fuel Assemblies in Dry Storage Casks by Gamma Scanning from the Top of the Casks | Outstanding with the US (2009) |
| New Task Proposal #1 | New generation of highly portable Cerenkov viewing device (ICVD) | To be submitted to MSSPs in 2013 |

### *5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | Explore feasibility of alternative verification method applicable to research reactor core |
| Activity #2 | Adapt hand-held devices originally designed for illicit trafficking monitoring |
| Activity #3 | Evaluate a commercial Hand Held Raman Spectrometer for inspection use |
| Activity #4 | Explore applicability of XRF hand held tools to front-end fuel cycle applications |
| Activity #5 | Make available tools for specific tasks in toolboxes as appropriate and needed by operations |
| Activity #6 | In house development of a gamma scanner for dry spent fuel cask C/S anomaly resolutions if 09/TAU-010 doesn't get accepted by the USSP |
| Activity #7 | Internal customization of existing NDA systems for verification of irradiated material (ongoing activity) |

## Attachments

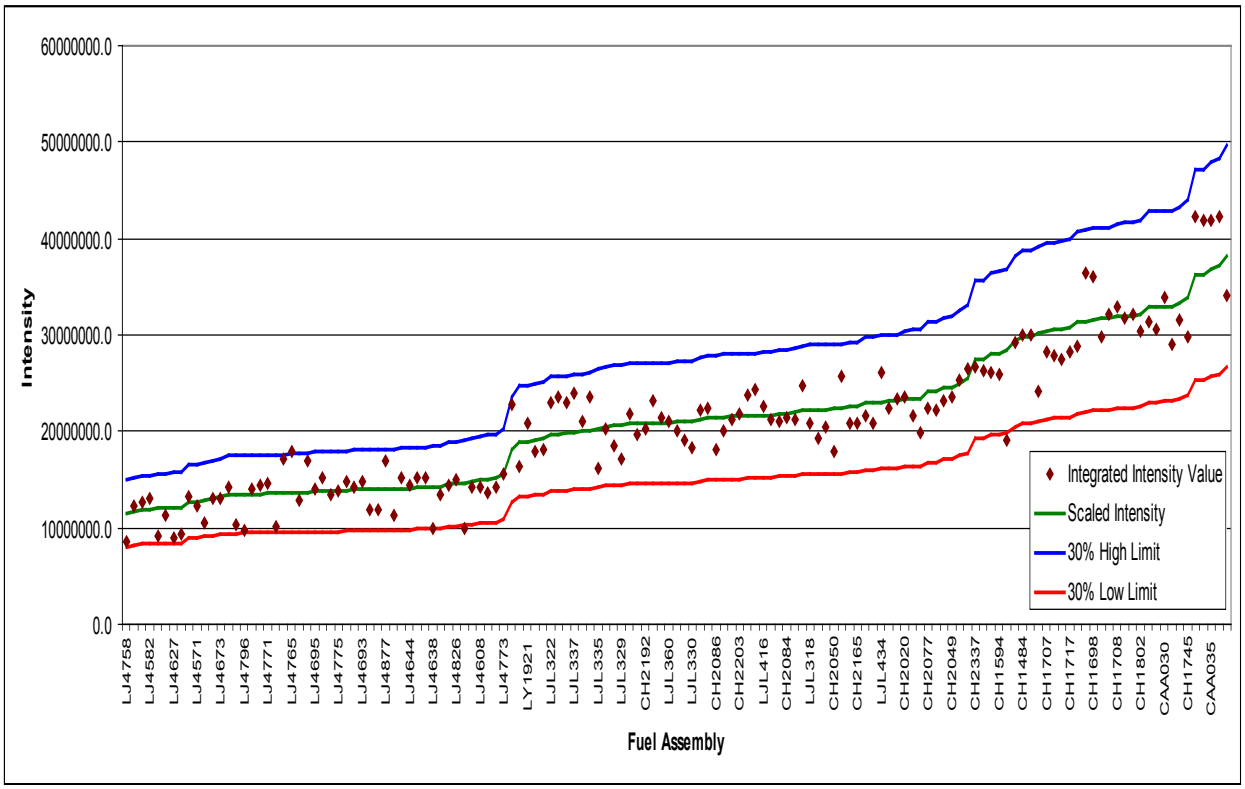



Figure 1: DCVD partial defect testing: quantitative evaluation algorithm developed and demonstrated in the last biennium; performance to be tested and method implemented and extended to a wide class of fuels.

# SGTS-02

## Improved Techniques and Instruments for Sealing and Containment Verification

**Project Manager: Bernard Wishard** **Division: SGTS**

### 1. Introduction

This document describes the plans for developing and implementing support for sealing and containment verification systems within the Department of Safeguards for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building Support for the Non-proliferation Regime, Strategy 2 – Coping with the Workload, Strategy 3 – Safeguards Advanced Reactors and Innovative Nuclear Fuel Cycles* and *Strategy 4 – Taking on new mandates* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

The scope of this project is to provide the Agency with sealing and containment verification technologies that can meet all of its needs for maintaining continuity of knowledge of nuclear material in containers, the IAEA's and facility's equipment, and to provide integrity and authenticity of instrument data used to draw conclusions.

This project supports in particular strategies, development and implementation of seals and containment verification instrumentation needed for new safeguards applications or for replacement of legacy equipment as well as for routine safeguards inspection activities. The project plays a vital role in ensuring integrity and authenticity of safeguards equipment and its data by assessing and providing solutions to mitigate identified vulnerabilities.

Consistent with strategic objectives for the equipment development this project is adapting commercial off-the-shelf equipment/technology through the use of the latest advancements in the developments of components from leading vendors in the market. A typical example of applied commercial technology is the potential application of Livewire® for verification of integrity of cables which is widely used in the commercial airline industry.

To ensure the robustness of sealing systems in the field and the authenticity of remotely obtained seals and containment verification data, independent vulnerability assessments are underway on the Laser Surface Authentication, the Laser Surface Mapping of Canisters (including casks), and the Remote Monitoring Sealing Array (RMSA).

Major recent accomplishments include the construction and commercialization of the next generation reader for the Cobra (type V) seal that allows the comparison of high-resolution images with a user friendly interface; a new adhesive seal ready for routine use; harmonization of security protocol for XCAM, UNAP and RMSA which is consistent with the best practices of the industry; and the completion of a successful test for a technique detecting intrusion of cables.

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

The major challenge faced by the project is standardization of the present set of sealing and containment devices, in order to minimize the amount of equipment, related maintenance and training requirements while continuing to improve the data security.

The project also coordinates its development and implementation support efforts with projects *SGTS-03 Surveillance Techniques, SGTS-08 Novel Technologies in Support of Safeguards Implementation, SGTS-11 Unattended Measurement Techniques, SGTS-14 Remote Monitoring and Data Processing Systems* and *SGTS-15 Technologies for New IAEA Verification Mandates*. In particular development of techniques and instruments for sealing and containment contributing to project SGTS-15 will be managed under the current SGTS-02 project and performed by the TSI/Seals team, in close coordination with SGTS-15 project which will provide system analysis, define specific requirements and integrate results. These activities are further described within the SGTS-15 project plan.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term directions for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023.

As a first step, the long-term direction of the current D&IS project was defined:

***Develop and provide implementation support for sealing systems and containment verification instruments, identify areas where improved techniques and capabilities are required, systematically plan for the next generation of seals, and investigate the applicability of new and evolving technologies.***

In order to support the long-term direction, activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Modernize and sustain sealing systems used in safeguards and increase their tamper resistance.*
2. *Develop and maintain sealing systems for facility specific application.*
3. *Improve and expand techniques, tools and procedures for containment verification.*
4. *Enhance system integration of sealing technologies with surveillance and non-destructive assay (NDA) systems and software.*
5. *Research, develop, and implement new and novel technologies that can be applied for secure sealing and containment verification systems.*
6. *Expand and improve capabilities to identify and mitigate the vulnerabilities of safeguards equipment and data derived from equipment.*
7. *Act as focal point to increase data security of SG equipment.*

## 4. Activities

*Key Objective 1. Modernize and sustain sealing systems used in safeguards and increase their tamper resistance.*

- UK E 1762 Laser Surface Authentication (LSA) Prototype Test and Evaluation

  Ingenia Technology Limited has developed the LSA system (LSAS) to extract an intrinsic material signature from both the copper and brass parts of the IAEA CAPS metal seal. The LSAS has been delivered and tested to meet IAEA specification for usability and accuracy.

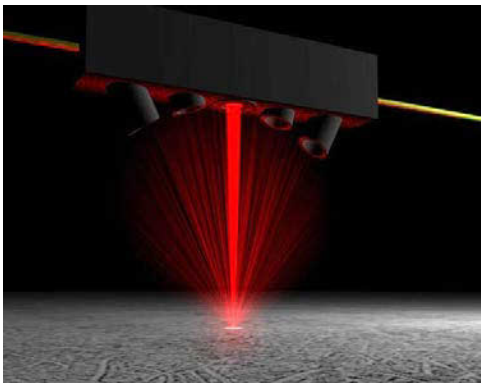


Figure 1: LSAS instrument verification technique.

  A Vulnerability Assessment (VA) is in process with the General Physics Institute and auxiliary support has been requested for a state level attack VA by the USSP (*Task Proposal 09/TSR-005*). The LSA can potentially be implemented to decrease the labour intensive nature of metal seal authentication.

- Designs for the replacement of the CAPS seal replacement with glass materials are near completion. Prototypes have been fabricated by the Agency using a rapid prototype printer with drawings. Visualization and analysis of these designs will continue using regular funds (*Activity #8*). Integration of unique markers inside the glass materials will allow in situ verification by the new COBRA seal reader, shown in figure 5.

- USA E 1532 Wire Verification Probe (E.144)/EC E 1898 Design Vulnerability Assessment (DVA) of Wire Integrity Verification Instrument (WIVI)

  The WIVI is intended to verify the integrity of metal seal wires. The design review of the wire verifier has not been completed. Therefore the DVA has been postponed.

- GER E 0994 Electronic Optical Sealing System (EOSS) Deployment (D.27)

  The EOSS sealing system is undergoing a firmware revision to add functionality and to update the inspection communication interface. New reader hardware is being designed to make the seal easier and more reliable to read in the field. Support is provided for EOSS implementation support (GER E 1890) aiming to completely replace the VACOSS sealing system.

- USA E 01771 Development of the Remotely Monitored Sealing Array

  The Remotely Monitored Sealing Array (RMSA) prototype delivery was fully accepted by the Agency. Work will continue to complete the final acceptance process, including: vulnerability assessment, radiation and environmental testing, and development of a program to allow the Remote Monitoring Unit to integrate seal data into the remote monitoring of the RMSA. State of health messages are collected daily from two separate systems deployed at the Agency, providing valuable performance data. Additional support for the display of seal status with the Hand Held Reader will be needed from Sandia National Laboratories.

- CAN E 1848 Vulnerability Assessment of the Remotely Monitored Sealing Array (RMSA)

The Vulnerability Assessment of the RMSA funded by the Canadian Support Programme has begun. Further environmental testing of the RMSA is being performed at the Research Institute (RISI) Moscow.

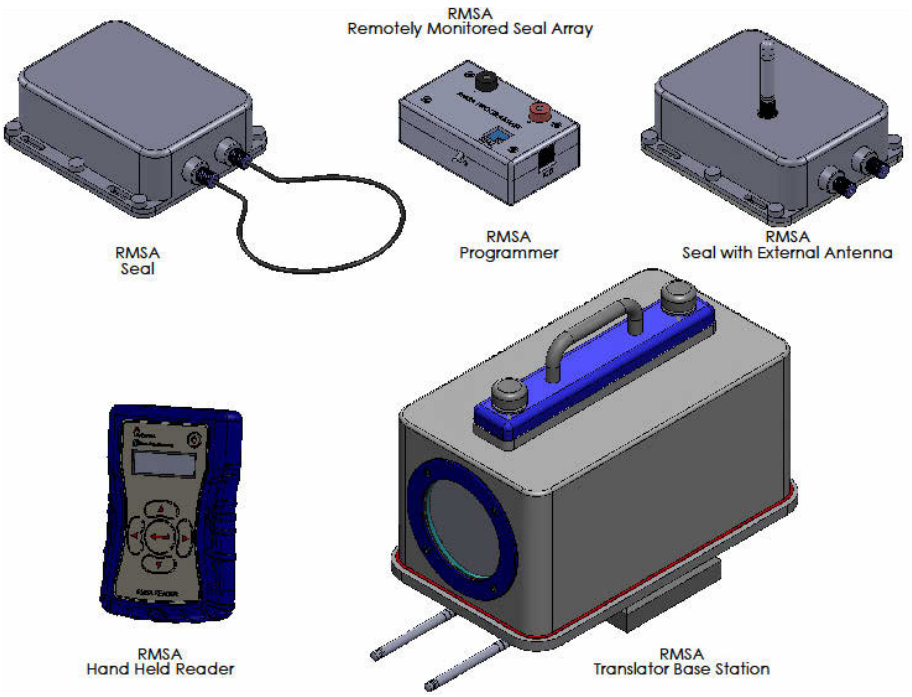



Figure 2: RMSA System Hardware.

- Upgraded COBRA seals/enhanced COBRA reader

  New improved COBRA seals (iCOBRA) have been in development for the past year (*Activity #9)*. The current COBRA reader has been in use for 10 years and exceeded all expectations for field life but is in need of replacement. A new COBRA reader has been specified, designed and delivered.

  The iCOBRA reader is the tool used for in-situ application and verification of iCOBRA seals. iCOBRA seals are applied and reference images stored by the iCOBRA system. Verification of the seal is later aided with visual tools of image comparison including side by side review and blink comparison. The integrity of the seal is determined by the inspector with the iCOBRA.

  This new reader will again allow the in-situ inspection of the iCOBRA seal with an analysis engine for display and verification of iCOBRA seals. Future enhancements may include verification of electronic seals and glass CAP Seal.


Figure 3: Modified iCOBRA seal with Reflective Particle Tags (RPT) and a verification image.

Figures 4 and 5: COBRA seal reader with iCOBRA and Glass seal prototype.

Figure 6: Prototypes of non-metallic CAPS-type seals.

- EC E 1849 Development of an Inexpensive Electronic Seal

  The COBRA seal is an integral part of dual sealing applications. Modern electronics allow for the development of an inexpensive active analogue of the Cobra. This active version would be a disposable battery operated device with simple hardware user interface incorporated into the seal or into a portable reader device, and may use short range wireless communication to the seal. The battery life must be 4 years minimum in the temperature range from -40 deg C to +85 deg C, and able to withstand outdoor applications. The price per seal should not exceed 160 euros. The JRC has accepted this task and has built an alpha prototype. A beta prototype will be available in 2012 for IAEA testing.

- EC E 1899 Remote Identification and Tracking System Demonstration

  The JRC Ispra continues to assess Radio-Frequency Identification Devices (RFID) technologies which could be used for safeguards. A demonstration of RFID technologies will contribute to the November 2011 Workshop on Sealing and Containment technologies.

- Improve C/S measures to secure SG sensitive documents, equipment and DA samples (Activity #1)

  Enhance secure transport containers for equipment and Inspectors working documents.

  Improve DA sample authentication, for example using unique heat-shrink wraps.

- Preserve institutional knowledge and enhance documentation via the SG portal (Activity #2)

  Move seals documentation and training materials to flexible platforms that allow continual updating and access to authorized personnel.

  Develop knowledge library of equipment, manuals, (special) techniques and (special) applications to keep updated knowledge of documentation for Seals Unit.

  Create a portal presence for the Seals Unit.

*Key Objective 2. Develop and maintain sealing systems for facility specific application.*

- CAN E 1364 Implementation Support for IRUSS Systems (pending with European Commission and US Support Programmes)

  This task continues to be important as ARC seals are in service at Darlington NPP, Canada. Although no specific plans for IRUSS support are pending, the Canadian Support Programme has been asked to provide consulting support to resolve sealing problems with the aging ARC system. This task will be required as a contingency until such time as the JCSS has replaced all the ARC seals.

- EC E 1559 Update of the Ultrasonic Sealing Bolt: Development of a system for underwater sealing of spent fuel at KANUPP, Pakistan.

  Sealing system for spent fuel pond at KANUPP based on JCSS is currently under deployment with the JCSS system.

- USA E 1700 Vulnerability Assessment of the Ultra-sonic Sealing Bolt (E.154)

  SANDIA performed the VA of the Ultra-sonic Sealing Bolt. The final report has been received by the IAEA. The task is proposed for completion.

- Develop sealing system that allows "Stand-off" verification (*New Task Proposal #1*). This task is important to decrease inspector activities for the verification of storage canisters.

- Support Arms Control Sealing Arrangements such as PMDA (*Activity #5*)

  Develop a two-part electronic seal that allows both attachment and detachment by Facility Operator on casks; without the need for surveillance, in coordination with project SGTS-15.

*Key objective 3. Improve and expand techniques, tools and procedures for containment verification.*

- EC E 1549 Laser Surface Mapping of Canister Closure Welds

  The Joint Research Centre, Ispra has completed the development of a containment verification system based on laser surface mapping technology. The next steps include the environmental tests, the irradiation test and a third party vulnerability assessment (*Task Proposal 10/TSR-003*).

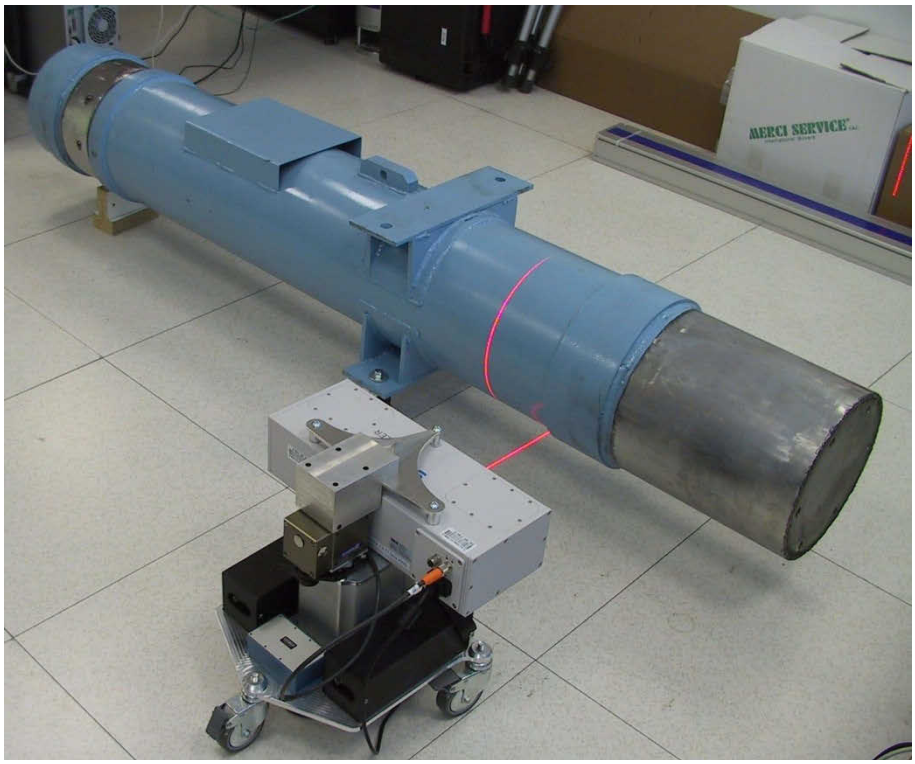



Figure 7: Laser mapping of a canister surface.

- Stand-off tracking of material containers (*Activity #7*)

  Develop techniques such as Radio-Frequency Identification Devices (RFID) for stand-off tracking of material containers such as UF6 cylinders and small quantity canisters.

*Key Objective 4. Enhance system integration of sealing technologies with surveillance and NDA systems and software.*

- Develop and implement common interfaces, triggers, authentication and encryption protocols that allow critical events (door opening and camera scene changes) to be securely communicated to all classes of unattended instruments (*Activity #10).*
- Adapt technologies that facilitate the joint-use of equipment with outside entities such as EURATOM, ABACC and facility operators, e.g. RMSA (*Activity #11).*

*Key Objective 5. Research, develop and implement novel technologies that can be applied for secure sealing and containment verification systems*

- USA E 1773 Reflective Particle Tags for Verification of Welds (E.162)

  The IAEA is awaiting the USSP proposal for finalization and delivery of the prototype. The prototype could be used for verifying the installation of bolts and casks.

- Study to determine if counterfeit-resistant markers can be placed inside containment materials

  A study will be initiated to determine material printing technology to assure non-counterfeit or replacements can be applied to metallic finishes. Anodize processes to strengthen material coatings can additionally imbed invisible markers within the anodic coating. Ink and printing materials have the possibility to make the counterfeiting process much more difficult. Printed designs that are stimulated by special lighting will show evidence of tampering to the unaided eye or camera. This study has been initiated internally (*Activity #12).* Support from the MSSP may be requested in the future.

*Key Objective 6. Expand and improve capabilities to identify and mitigate the vulnerabilities of safeguards equipment and data derived from equipment.*

- The proof-of-feasibility using LiveWire® for detecting changes in cabling was done in cooperation with project *SGTS-11 Unattended Measurement Techniques*. A LiveWire® module was connected in serial with a signal coming from a preamplifier. After some modifications of the LiveWire® module to acknowledge the bandwidth and characteristics of the preamplifier signal, the device was able to detect changes to the cabling (e.g. length and open-circuit at either end). Further studies will follow to assess the technology for applications for enhanced data security (*Activity #3*).
- Development of internal Vulnerability Review (VR) capabilities (*Activity #6*)

  The IAEA has developed using regular budget funds a laboratory for the initial review of vulnerabilities for safeguards equipment. The VR Lab has the capability to screen newly developed sealing systems as well as existing systems currently in service.

*Key Objective 7. Act as focal point to increase data security of SG equipment (Activity #4)*

- Move towards a single token for IAEA inspectors;
- Harmonize security requirements for new safeguards equipment;
- Develop (IT) Risk Assessment for Safeguards Equipment;
- Develop Forensic tools for safeguards equipment and related requirements;
- Specify requirements and initiate development for a fully authenticated weighing system which could be used for small canisters or scaled to UF6 cylinders.

### Key achievement targets

- Build and assess 1000 glass seal prototypes designed to replace the CAPS metal seal (Key Objective 1): June 2013.
- Develop and deliver the upgrade of the new iCobra reader so that it will verify the Electronic Optical Sealing System (EOSS), making this an all-in-one reader (Key Objective 1): September 2013.
- Complete Remote Monitoring Sealing Array (RMSA) Vulnerability Assessment and finalize RMSA commercialization (Key Objective 1): November 2013.
- Finalize Vulnerability Assessment and assess usefulness of Laser Surface Mapping for Containment Verification (LMCV) with dry storage canisters (Key Objective 3): December 2012.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

*5.1. Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| CAN | E 1364 | Implementation Support for IRUSS Systems | Support no longer needed, will be proposed for completion |
| CAN | E 1848 | Vulnerability Assessment of the Remotely Monitored Sealing Array (RMSA) | Vulnerability Assessment and Radiation testing programs are in process |
| EC | E 1549 | Laser Surface Mapping of Canister Closure Welds | Vulnerability Assessment is in process |
| EC | E 1559 | Update of the Ultrasonic Sealing Bolt | Development completed. Deployment of JCSS requires further support |
| EC | E 1849 | Development of a Low-cost Active Electronic Seal | JRC developing seal, awaiting other member state support |
| EC | E 1898 | Design Vulnerability Assessment of Wire Integrity Verification Instrument (WIVI) | On hold awaiting design modifications |
| EC | E 1899 | Remote Identification and Tracking System Demonstration | Will contribute to Nov 2011 workshop |
| GER | E 0994 | Electronic Optical Sealing System (EOSS) (D.27) | Ongoing. New firmware being tested |
| GER | E 1890 | EOSS Sealing Systems Implementation Support (D.36) | No tasks identified |
| UK | E 1762 | LSA Prototype Test and Evaluation (E10(j)) | Technical work has been performed successfully. Awaiting Vulnerability Assessment form GPI and USSP |
| USA | E 1532 | Wire Verification Probe (E.144) | Pending meeting to discuss design modifications |
| USA | E 1700 | Vulnerability Assessment of the Ultra-sonic Sealing Bolt (E.154) | Final report received by the IAEA. The task is proposed for completion |
| USA | E 1771 | Development of a Remotely Monitored Sealing Array (E.161) | Ongoing, Vulnerability Assessment and Radiation testing progressing. Remote Monitoring Unit integrating into RM data center |
| USA | E 1773 | Reflective Particle Tags for Verification of Welds (E.162) | Awaiting proposal to finalize |

*5.2. Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 09/TAU-007 | Remote Identification and Tracking System Demonstration | Superseded by Nov 2011 Workshop |
| 09/TSR-004 | Development of a Low-cost Active Electronic Seal | Outstanding with FRA, JPN, RUS, UK, USA. Accepted by EC |
| 09/TSR-005 | Vulnerability Assessment of the Laser Surface Authentication System (LSAS) | Outstanding with ISTC and USA (2010). Contracted to GPI Moscow |
| 10/TSR-003 | Vulnerability Assessment of the Laser Surface Mapping System for Containment Verification (LMCV) and the Laser Item Identification System (L2IS) Based on the 3D-LSA Technique | LMCV contracted to GPI Moscow. L2IS accepted by Canadian SP |
| New Task Proposal #1 | Develop a sealing system/technique that allow "stand-off" verification | To be submitted in 2012 to MSSPs |

*5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | Improve C/S measures to secure SG sensitive documents, equipment and DA samples |
| Activity #2 | Preserve institutional knowledge and enhance documentation via SG portal |
| Activity #3 | Protection of analogue signal cables using wide brand time-domain reflectometry such as Livewire |
| Activity #4 | Increase data security |
| Activity #5 | Support Arms Control Sealing Arrangements such as PMDA |
| Activity #6 | Development of internal Vulnerability Review (VR) capabilities |
| Activity #7 | Stand-off tracking of material containers |
| Activity #8 | Development of replacement for the CAPS metal seal with glass material |
| Activity #9 | Upgrade COBRA seals/readers |
| Activity #10 | Development of common interfaces, triggers, authentication and encryption protocols |
| Activity #11 | Coordinate with EURATOM and ABACC on joint use C/S equipment (e.g. RMSA |
| Activity #12 | Study the use of counterfeit-resistant markers |

# SGTS-03

## Surveillance Techniques

### Project Manager: Martin Moeslinger — Division: SGTS

### 1. Introduction

This document describes the plans for developing and implementing optical surveillance equipment within the Department of Safeguards for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building Support to the Non-proliferation Regime, Strategy 2 – Coping with the Workload* of the Long-Term Strategic Plan, 2012–2023 and *Strategy 4 – Taking on New Mandates*.

### 2. Overview

The scope of the project covers the development and implementation of optical surveillance equipment needed for new safeguards applications, for the replacement of legacy equipment and surveillance instruments for routine safeguards inspection activities. Optical surveillance equipment, lighting solutions and laser based verification instruments are being provided to all IAEA Operations Divisions for safeguards implementation.

Figure 1: Finished NGSS cameras mounted on a test rig.

The project is consistent with Strategies 1, 2 and 4 of the Departmental Long-Term Strategic Plan, 2012–2023; specifically the goal of increasing the efficiency in safeguards implementation by making full use of the appropriate equipment and techniques and enhancing cooperation with States and other Safeguards inspectorates. It is also consistent with Objective E of the IAEA Medium-Term Strategy 2012–2017; specifically the goal of strengthening the effectiveness and improving the efficiency of the Agency's safeguards and other verification activities.

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

The methods and technologies identified for the research and development activities covered under Project SGTS-03 are carefully selected to meet the challenges of emerging and future safeguards implementation regimes. A particular focus of the development and implementation support activities carried out under this project is on the development, standardization and modularization of advanced surveillance data analysis techniques to reduce the burden currently presented to SG inspectors and analysts. The project also coordinates its D&IS efforts with projects *SGTS-02 Techniques and Instruments for Sealing and Containment Verification, SGTS-08 Novel Technologies in Support of Safeguards Implementation, SGTS-11 Unattended Measurement Techniques, SGTS-14 Remote Monitoring and Data Processing Systems* and *SGTS-15 Technologies for New IAEA Verification Mandates*. In particular surveillance activities contributing to project SGTS-15 will be managed under the current SGTS-03 project and performed by the TUS/SURV team, in close coordination with the SGTS-15 project which will provide system analysis, define specific requirements and integrate results. These activities are further described within the SGTS-15 project plan. Developments carried out under SGTS-03 are coordinated with project *SGIS-02 Information Security* to ensure compliance with existing and future departmental information security standards.

The most recent achievements include the fielding of the NGSS camera replacing the aging DCM-14 based surveillance systems, the progress made in the field testing of the L2IS laser ID system and a successfully conducted vulnerability assessment of the 3DLR laser DIV tool. The major challenge ahead for a successful execution of project SGTS-03 remains the availability of adequate human and financial resources. The availability of further resources is also essential to fully benefit from costly prior developments carried out under SGTS-03, like the NGSS.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term directions for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023

As a first step, the long-term direction of the current D&IS project was defined:

***Provide advanced surveillance equipment and technologies to improve and optimize departmental operations and capabilities to effectively carry out the IAEA's safeguards mission.***

In order to support the long-term direction, activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Develop, test, authorize and implement advanced surveillance equipment.*

   As a result of the development and implementation support activities conducted during the last years, implementation of the Next Generation Surveillance System (NGSS) is now effective. However, the IAEA still needs to extend its capability to connect to legacy and/or operator owned cameras and to provide NGSS based solutions for integrated sealing systems usable by operators themselves.

2. *Enhance surveillance data processing and review tools to reduce the burden on SG inspectors and analysis.*

   With the implementation of advanced surveillance cameras capable of generating high resolution colour images at a fast rate a strong need to further improve surveillance data processing arises. D&IS activities

to automatically and reliably extract safeguard relevant information from acquired surveillance data will be carried out. The development goal is the implementation of an efficient data post-processing tool coherent with a departmentally standardized sensor data review platform.

3. *Develop and implement 3D imaging that would allow improved inspector vision and enhanced pattern recognition.*

4. *Enhance surveillance capabilities by further developing non-video based systems (laser, radar, etc.) for both imaging and design/containment verification application.*

5. *Expand current capabilities by extending surveillance beyond the visible light spectrum.*

## 4. Activities

Funding for most of the described D&IS activities is foreseen to be provided by Member States Support Programmes (MSSP) which continue to play a major role in achieving the stated project objectives.

*Key Objective 1. Develop, test, authorize and implement advanced surveillance equipment.*

- JNT E 1437 Next Generation Camera Module and Server-Based Surveillance Systems (XCAM Development GER D.35) (USA E.137):

  The development of the NGSS camera has been completed with the acceptance of the related deliverables in June 2011. The acceptance tests on the NGSS server and surveillance review software are ongoing and scheduled to be completed in September 2011. Field tests of the NGSS have started with the goal of full authorization for SG use by the end of 2012.

- EC E 1830 Vulnerability Assessment of the Next Generation Surveillance System (NGSS)

  The vulnerability assessment of the NGSS camera has been successfully completed with the final VA report expected by October 2011.

- Develop a modular front-end for the NGSS camera which supports the connection of legacy CCTV camera heads. Consider the integration of advanced wire integrity verification and tamper indication technology (*New Task proposal #1*).

- Obtain factory support for the NGSS core camera to assist an efficient and timely implementation (*New Task proposal #2*).

- Develop an NGSS camera based electronic sealing system to replace the obsolete VMOS. VMOS was designed to allow the application or removal of IAEA electronic seals by a facility operator without the physical presence of SG inspectors (*New Task proposal #3*). This activity will be coordinated with project SGTS-02.

- Design and validate a new, universal underwater housing for NGSS based surveillance cameras (*Internal Activity #1*)

  A new underwater camera housing will be developed for the application of surveillance in spent fuel ponds. The new design will accommodate the NGSS camera module, taking into account requirements expressed from other inspectorates (EURATOM, ABACC) to ensure applicability in joint equipment use situations.

- USA E 1108 - Manufacturer Support for DIS Systems

  In order to support the efficient and timely implementation of SG surveillance two factory support engineers were provided to assist in the equipment testing and the provision of unique expertise. A review of the required resources and workload to be covered by the SGTS Surveillance Team within the next two years confirms the ongoing need for this level of factory support specifically related to the fielding of NGSS.

- Finalize documentation for Surveillance Equipment (completion of manuals and procedures) (*New Task proposal #7*)

  Additional support will be requested to assist in the preparation, completion or update of documentation for surveillance equipment. This includes SG specific reference manuals, checklist procedures and performance forms for systems based on the DCM-14 as well as 3DLR, L2IS and HILL and NGSS.

*Key Objective 2. Enhance surveillance data processing and review tools to reduce the burden on SG inspectors and analysis.*

- USA E 1249 - Upgrading of GARS Review Software and Software Factory Support. The task will be extended to cover the new GARS version used for NGSS.
- FRA E 01818 - Evaluating the Enhancement of Surveillance Using Intelligent Camera Technology (CALADIOM® based)

  Within this task an "artificial retina" technology (CALADIOM®) is investigated for applicability within current and future SG surveillance solutions. CALADIOM® is based on intelligent dynamic pattern recognition and behavioral analysis of objects of interest. The data analysis is performed at the optical sensor level and has the potential to dramatically reduce the amount of data generated by cameras. Reducing the amount of data and the resource requirements associated in further data processing and review is seen as one of the major upcoming challenges for the next decade. Possibilities to use the non-visible part of the light spectrum will also be investigated. Activities planned during the biennium include the continuation of technology field testing supported by task CZ A 1883 and the assessment of its applicability in post-processing surveillance data before review.
- Develop a modular surveillance review software tool, coherent with a new comprehensive departmental sensor data review platform (*New Task proposal #4*).
- Evaluate alternate and commercially available pattern recognition and object tracking technologies to select the best possible solution for SG surveillance data processing/filtering (*New Task proposal #5*).

*Key Objective 3. Develop and implement 3D imaging that would allow improved inspector vision and enhanced pattern recognition.*

- EC E 1636 - Software Engineering Support for 3D Camera Development

  Task EC E 1636 is foreseen to demonstrate the fusion of a solid state laser array based 3D camera with the NGSS camera. The three-dimensional, spatial information obtained by the 3D camera augments images acquired with the NGSS camera to yield superior protection against image falsification. It is planned to ask Member State Support Programmes for additional assistance in case hardware or software device support is identified as being required from the NGSS side.

*Key Objective 4. Enhance surveillance capabilities by further developing non-video based systems (laser, radar, etc.) for both imaging and design/containment verification application.*

- EC E 1425 - 3D Laser Range Finder for Design Verification in RRP (3DLR)

  The 3D Laser Range Finder device (3DLR) was developed in cooperation with the EC Joint Research Centre Ispra and under significant contribution by the EC Support Programme. Further improvements of the 3DLR software will be required. Possibilities to integrate 3DLR with an Outdoor Verification System (OVS) based on the same technology are investigated with the goal of establishing a comprehensive design and containment verification tool (3DLC). The 3DLR laser scanner head will be updated by the latest commercially available version to reduce the size and weight of the instrument and thus greatly improve the ease of use by SG inspectors.
- CAN E 1833 - Vulnerability Assessment for 3D - Laser Range Finder

  The vulnerability assessment of the 3DLR laser DIV tool was successfully completed by mid 2011. Related suggestions are implemented under task EC E 1425.

- EC E 1696 - Laser Item Identification System (L2IS)

  The Laser Item Identification System (L2IS) is developed to allow attended and unattended unique identification of nuclear-material-bearing containers, in particular UF6 cylinders like the ones being used in the Rokkasho Enrichment Plant (Japan) and other facilities handling nuclear material in bulk quantities. Activities under this task included the development of a new laser scanner (unit 3) for PIV usage. As a result of the field testing several performance improvements have been made. The task is expected to be completed towards the end of 2012.

- Develop and test Surveillance techniques to be used inside Reactor Hall 4 of the Chernobyl NPP (*Internal Activity #2*)

  In support of the implementation of SG measures at the Chernobyl NPP several technologies are investigated in coordination with project *SGOC-01 Chernobyl* to provide suitable means for surveillance monitoring inside the destroyed reactor hall of unit 4.

*Key Objectives 5. Expand current capabilities by extending surveillance beyond the visible light spectrum.*

- Assess available alternative image acquisition technologies (*New Task proposal #6*)

  To support SG surveillance under conditions adverse to traditional optical systems operating in the visible light spectrum, alternate imaging technologies based on radar and acoustics will be investigated and evaluated. The primary target applications will be the underwater surveillance under poor visibility.

### Key achievement targets

- Develop and deliver an analogue (CCTV) interface for the NGSS camera in order to use special radiation hardened and/or operator owned cameras (Key Objective 1): December 2012.
- Develop and deliver an underwater housing for the NGSS camera (Key Objective 1): September 2012.
- Develop and deliver an NGSS camera based electronic sealing system to replace the obsolete VMOS. VMOS was designed to allow the application or removal of IAEA electronic seals by a facility operator without the physical presence of SG inspectors (Key Objective 1): March 2013.
- Develop and deliver a 3D Camera to augment standard 2D surveillance with spatial information in order to better protect against image falsification (Key Objective 3): October 2012.
- Evaluate CALADIOM® Camera Technology to confirm its potential for a significant reduction of the amount of surveillance data presented to SG inspectors for review. The goal is a reduction in the time spent for data analysis and review and the review quality improvement (Key Objective 2): March 2013.
- Develop and evaluate a modular surveillance review software tool in order to allow a more efficient integration with other SG sensors, to sustain the surveillance data review platform and to ensure compliance with emerging information security requirements (Key Objective 2): June 2013.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### *5.1. Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| CAN | E 1833 | Vulnerability Assessment for 3D - Laser Range Finder | Dec 2011 |
| CZ | A 1883 | Smart Sensor for Enhanced Surveillance (2SES) Field Test | May 2012 |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| EC | E 1425 | 3D Laser Range Finder for Design Verification | Dec 2012 |
| EC | E 1636 | Software Engineering Support for 3D Camera Development | Mar 2012 |
| EC | E 1696 | L2IS: Laser Item Identification System | Dec 2012 |
| EC | E 1830 | Vulnerability Assessment of the Next Generation Surveillance System (NGSS) | Q4/2011 |
| FRA | E 1818 | Evaluating the Enhancement of Surveillance Using Intelligent Camera Technology (CALADIOM based) | June 2012 |
| GER | E 1341 | Remote Monitoring and Unattended Digital Surveillance Systems (D.34) | Task proposed for completion |
| GER USA | JNT E 1437 | Next Generation Camera Module and Server-Based Surveillance Systems (XCAM Development GER D.35) (USA E.137) | Q4/2011 |
| USA | E 1108 | Manufacturer Support for DIS Systems (E.133) | ongoing |
| USA | E 1249 | Upgrading of GARS Review Software and Software Factory Support (E.119) | ongoing |

### *5.2. Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| New Task Proposal #1 | Development of an analog (CCTV) interface for the NGSS camera | To be proposed to GERSP in Q4/2011 |
| New Task Proposal #2 | NGSS camera factory support contract | To be proposed to GERSP in Q4/2011 |
| New Task Proposal #3 | Next generation VMOS system development (based on the NGSS camera) | To be proposed to GERSP, USSP, ECSP, et. Al. in Q1/2012 |
| New Task Proposal #4 | Development of an advanced, modular surveillance review tool | To be proposed to GERSP, USSP, ECSP, RUSSP, et. Al. in Q2/2012 |
| New Task Proposal #5 | Evaluation of advanced surveillance image processing technologies | To be proposed to all MSSPs in Q1/2012 |
| New Task Proposal #6 | Assessment of radar and acoustics based imaging as an alternative to optical surveillance in difficult environments | To be proposed to all MSSPs in Q1/2012 |
| New Task Proposal #7 | Documentation support for SG Surveillance Equipment | To be proposed to all MSSPs in Q4/2011 |

### *5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | Development of an underwater housing for the NGSS camera |
| Activity #2 | Surveillance equipment development for Chernobyl NPP Unit 4 |

## Attachments

Figure 2: 24-channel NGSS system under test.


Figure 3: 3DLR laser scanner used by SG inspector.

# SGTS-08

## Novel Technologies in Support of Safeguards Implementation

**Project Manager: Julian Whichello** **Division: SGTS**

### 1. Introduction

This document describes the plans for identifying, developing and evaluating novel techniques and instruments that are intended to support emerging and future safeguards implementation needs, within the Department of Safeguards, for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building support to the non-proliferation regime, Strategy 2 – Coping with the workload, Strategy 3 – Safeguarding advanced and innovative nuclear fuel cycle* and *Strategy 4 – Taking on new mandates* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

Project SGTS-08 is one means by which the IAEA invests in its future by identifying and evaluating methods and technologies that will be needed to meet the challenges of emerging and future safeguards implementation regimes. The Project was established initially to identify and evaluate a broader range of methods and instruments that had not been previously considered for safeguards applications, as well as providing a systematic mechanism to analyse gaps in the inspectorate's technical support capabilities, particularly in the area of (early) detection of undeclared nuclear activities, materials, and facilities. With recent changes resulting from the Departmental reorganization and the promulgation of a future safeguards vision stemming from the Departmental Long-Term R&D Plan, activities and tasks within the Project have been modified accordingly.

For example, *early* detection, as called for in the IAEA's long-term strategic objectives, will also require the identification of undeclared activities, materials and facilities well before the appearance of separated uranium and/or plutonium. Achieving this aim will require the inspectorate to pursue techniques that can identify materials (i.e. items, compounds, elements, and isotopes existing in a wide range of physical states) that are used to develop and establish those nuclear fuel cycle (NFC) processes that have the capability to produce separated uranium, plutonium and other safeguards-sensitive substances and items.

Previous activities within the Project included a safeguards technology gap analysis based on the identification of unique and safeguards-useful 'indicators (I)', which identify the presence of a particular nuclear fuel cycle (NFC) process, and 'signatures (S)', which emanate from that process when it is in operation. Needs were assessed against open-source technical and scientific information covering existing, in-development, and novel technologies[3], along with respective capabilities for detecting the identified I&S parameters. Through internal and Member State resources, the Project will expand its ability to review open source technical and scientific literature, compiling and archiving methods and technologies of potential safeguards use.

The Project will also continue to strengthen interfaces with other IAEA efforts that identify emerging and long-term safeguards implementation needs and develop future safeguards approaches, including needs identified in State-level technical objectives, novel technologies required in support of safeguards implementation at

1 GOV/2010/66 dated 26 November 2010.

2 STR-370.

3 Novel technologies, instruments and methodologies are those that have not been applied previously in support of safeguards implementation.

geological repositories, future safeguards approaches for new (e.g. GenIV) reactor concepts, new types of uranium enrichment methods, and technologies required in support of other types of treaty verification.

Several promising technologies, potentially addressing safeguards implementation needs, have been identified under Project SGTS-08. These include atmospheric gas sampling techniques, analysis of the verification of declared NFC activities, laser spectrometry for the rapid in-situ analysis of unknown substances - thus reducing the time required to analyze environmental samples, optically stimulated luminescence to identify locations that may have been used for previous activities related to the storage and use of nuclear materials, micro-seismic monitoring, and underground navigation and communication systems in support of on-site inspection activities at geological repositories. Instruments based on these technologies are presently being either evaluated or developed for evaluation through support programme tasks with Member States. A prototype hand-held laser induced breakdown spectrometer (PHHL) was delivered to the IAEA in December 2009. The instrument is currently undergoing evaluation and field-testing. In the longer term, detectors based on other novel methods are under consideration. These include: proposed novel detection methods, which may provide effective power and burn-up monitors for the next generation of nuclear reactors; nuclear magnetic resonance, which may provide alternatives to nuclear and non-nuclear material identification and flow monitoring; and the possible detection and analysis of signature emanations from NFC processes. The Project will continue to maintain a 'watching brief' on developments in antineutrino detectors undertaken independently by various research groups.

The Project's continuing evaluation of atmospheric noble gas sampling and analysis for the detection of clandestine reprocessing will culminate in concepts for notional on-site and near-site detection and monitoring systems. These will be the subject of further evaluation, including the creation of notional inspection implementation strategies that include atmospheric noble gas sampling and analysis and estimations of purchase and implementation costs.

The aforementioned tasks were initiated as an outcome of intra-departmental discussions and as a result of the NFC I&S work and the gap analysis approach. Progression of the above tasks from conceptual phase status to their respective development and implementation phases, through partnership with appropriately equipped functional units within the Department, will allow the Project's modest resources to address other priority needs (e.g. geological repositories, less intrusive monitoring methods, next generation nuclear reactors, early detection of clandestine facilities, fissile material cut-off, monitoring strategic arms reduction treaties, etc.). Depending on the technology involved, additional expertise, necessary to undertake these novel areas will be drawn from available internal staff and Member State experts, under the Project's umbrella tasks, supplemented by requests to Member States for consultants, cost-free experts (CFEs) and junior professional officers (JPOs).

To achieve its objective within the current levels of available regular budget funding and resources, the Project will continue to rely almost entirely on Member States' support to provide technical guidance, services, facilities, funds and expertise. Project SGTS-08 continues to develop relationships for the exchange of science and technology through the establishment of 17 umbrella tasks with Member States and one with the EC. The plan for Project SGTS-08 will also complete the carry-over of tasks from the previous biennium while acknowledging recent Departmental changes and the recent moves to establishing a safeguards system that is more objectives-based and information-driven. For example, work underway from 2007 – 2011 to establish a systematic approach to the identification of needed safeguards capabilities through conducting gap analyses based on the identification of safeguards-useful indicators and signatures associated with strategic parts of the nuclear fuel cycle was transferred to the Division of Concepts and Planning (SGCP) for further development and implementation.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term direction for R&D in supporting the

implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023.

As a first step, the long-term direction of the current D&IS project was defined:

***Continue to build a systematic mechanism to identify emerging and future safeguards needs, particularly those in regard to early detection of undeclared activities, materials and facilities; identify and analyze gaps in the inspectorate's technical capabilities; identify effective and efficient technology solutions to those needs; and, where required, establish tasks to develop and to evaluate proposed solutions against Safeguards implementation requirements.***

In order to support this long-term direction, the following general key objectives and activities will continue, be completed or will be initiated during the 2012-2013 biennium:

1. *Finalize outstanding conceptual prototype development and evaluation tasks.*

   Project SGTS-08 was established in 2006, and was mandated initially to review over 60 MSSP-suggested novel technologies that respective Member States believed may have benefits for safeguards implementation. From that review, 15 technologies were seen both to address some specific need and to be novel. The 15 technologies were presented to an intra-Departmental committee for acceptance and for prioritization, with the five highest ranked tasks to be initiated first. Of those five tasks: one was found eventually to be un-fundable[4] and was replaced by another task from the priority list[5]; two were completed[6,7], one was initiated, but impeded by unexpected delays[8]; one was placed on hold pending the outcome of another task[9].

   Project SGTS-08 is assisting other safeguards activities, including undertaking identification and evaluation of potentially beneficial methods and technologies, including safeguards applications utilizing novel detection methods and the addressing of special needs associated with the implementation of safeguards at geological repositories.

2. *Analyse and evaluate novel technologies that have been proposed to meet specific safeguards needs.*

3. *Survey novel technologies and conduct market research and reviews of science and technology publications in novel technological areas.*

4 $UF_6$ Monitor Based on Semiconductor Sensor Technology.

5 Mobile Lidar for Monitoring Gaseous Pollutants.

6 Laser Induced Breakdown Spectroscopy (LIBS).

7 Simulation of Atmospheric Noble Gas Concentrations to Assess Sampling Procedures for the Detection of Clandestine Reprocessing.

8 Optically Stimulated Luminescence in Forensics.

9 Equipment for Sampling and Concentrating Atmospheric Noble Gases for the Measurement of Krypton and Xenon.

## 4. Activities

As mentioned above, funding for most of the Project's planned activities will need to be provided by non-regular budgetary sources. Member States Support Programmes (MSSP) will continue to play a major role in achieving the Project's objectives. There are currently no D&IS tasks within Project SGTS-08 that are supported with regular budget funds. Only the most basic resources and funding for convening expert and end-user workshops currently originate from regular budgetary sources. Therefore, the Project will continue to rely almost entirely on support from Member States for the provision of technical expertise, funding and resources. Cooperation with Member States and the MSSP system will remain paramount to the project's ability to meet Department expectations for the identification of novel methods and instruments in support of safeguards.

Within available resources, and as a consequence of a recent Departmental reorganization, the Project will focus its activities in the 2012-2013 biennium on: selection, evaluation and filtering of novel technologies applicable for safeguards. It will also work in close coordination with experts from other technical D&IS projects to take promising concepts to the next stage of development and evaluation. Further development and implementation of identified technologies will be managed and performed by other technically and resource capable functional units within the Department. For example, the hand-held laser induced breakdown spectrometer (PHHL) was transferred to the Non-destructive Assay Team for further evaluation and development. Likewise, the work covering the identification of safeguards-useful indicators and signatures of the nuclear fuel cycle was transferred to the Concepts and Planning Division.

With the reorganized Project and its associated resources, the future work envisaged for Project SGTS-08 will comprise fewer development tasks (including the development of conceptual prototypes). Commensurate with available resources, the Project will aim at increasing IAEA knowledge about potentially beneficial novel methods and technologies in support of safeguards implementation.

*Key Objective 1. Finalize outstanding conceptual prototype development and evaluation tasks.*

Of the remaining tasks from the initial Departmental solicitation, review and prioritization, the following will be completed, transferred, terminated or continued in the 2012-2013 biennium:

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| Noble gas sampling and monitoring in support of SG implementation (GER A 1643) | Completed in 2011 | Currently undergoing internal Departmental review. NTT is awaiting feedback from potential end-users in SGAS and SGCP. If supported, follow-on task(s) will be prepared for the 2012-2013 biennium (*New Task Proposals #1 and 2* are described in section 5.2. below) |
| LIBS for environmental swipe pre-screening (GER A 1835) | Transferred | Task transferred to, and continuing under SGAS |
| Evaluation of *FirstDefender* RM (see figure 1, below) | Transferred | Task transferred to, and continuing under SGTND/PRNDA |
| Optically stimulated luminescence (CAN A 1627) | On-hold | Awaiting Canadian Support Programme to inform the IAEA if it is able to deliver the device for Agency laboratory and field evaluation |
| Equipment for sampling and concentrating atmospheric noble gases for the measurement of krypton and xenon (FRA A 1707) | To be terminated | The atmospheric sampling equipment is no longer available. However, knowledge will be shared through the existing umbrella task the French MSSP, FRA A 1641 |
| Identification and evaluation of novel technologies in support of SG implementation at geological repositories | Continuing | Requests to be sent to MSSPs, under respective novel technologies umbrella tasks to provide assistance |


Figure 1: Handheld Raman System (HHRM) based on the commercially-available *FirstDefender RM.* The system uses Raman Spectroscopy to matched target material with library scans in its memory. It can store over 7,000 material scans in its library. The system as supplied can identify a wide range of light-coloured and non-fluorescent compounds.

*Key Objective 2. Analyse and evaluate novel technologies that have been proposed to meet specific safeguards needs.*

Specifically, the Project will carry out the following on an on-going basis:

- Promote research and development (R&D) for departmentally needed methods and instruments, principally through the MSSP system, and through other standing bodies (e.g. the recently established ESARDA Novel Approaches – Novel Technologies Working Group) as required.
- As necessary, organize and convene seminars and workshops that will gather end-users, topic experts and other stakeholders to discuss novel methods and technologies.
- As required, participate in Departmental initiatives to develop ideas and roadmaps for the development and implementation of novel methods and technologies.
- Identify and evaluate methods and technologies that can detect undeclared activities, and the misuse of facilities and materials early.
- With other Departmental Projects, support the development of safeguards verification tools for field activities (e.g. more functionally useful and 'user-friendly' instruments, more features in smaller packages, more automated functions, etc.).
- Enhance capability to get in-field real time results of nuclear material samples using both novel destructive and non-destructive techniques (e.g. using laser induced breakdown spectrometry (LIBS) to speed up the processing of environmental swipe samples taken in the field by pre-screening swipes to identify high-value deposits).
- Further identify detection techniques specific to advanced sensitive nuclear activity signatures (e.g. laser-based and other in-field sampling and measurement instruments).
- With assistance of Member States under their respective umbrella tasks in support of the Project, develop concepts for stand-off capabilities that can be used to detect nuclear activities remotely (e.g. detection of noble gases as indicators of undeclared reprocessing; the use of emanations to detection for a wide range of safeguards relevant activities).
- Provide recommendations to the Division and/or the Department on the purchase, adaptation and evaluation of novel safeguards measures and tools.

*Key Objective 3. Survey novel technologies and conduct market research and reviews of science and technology publications in novel technological areas.*

Specifically, the Project will carry out the following on an on-going basis:

- Develop and establish a mechanism to systematically monitor science and technology developments with the goal of identifying appropriate novel technologies that improve existing safeguards measures and tools needs.
- Monitor worldwide R&D for methods and technologies that can potentially meet emerging and future safeguards implementation needs. Specifically:
  - Devote at least 20% of Team resources to routine information gathering from scientific, technical, open sources, trade journals, research institutes, academia and sister verification organizations (e.g. EURATOM, CTBTO, OPCW, etc.).
  - As far as possible, utilize MSSP resources to provide additional data gathering and analytic resources and information on novel detection and measurements techniques.
- Create and maintain a novel methods and technologies database from MSSP contributions, open-sources, national laboratories, academia and private industry.

### Key achievement targets

- Complete the following carry-over of tasks from the previous biennium:
  - Contingent upon the provision of the optically stimulated luminescence equipment from Canada, devise a suitable test plan, undertake required training and carry out laboratory and field evaluation of the instrument. A report will be made on the outcome (Key Objective 1): April 2012.
  - With end-user support, and direction, propose and undertake follow up task(s) to GER A 1643 regarding noble gas sampling and monitoring (Key Objective 1): June 2012.
- Identify, evaluate and report on novel technologies meeting IAEA needs in support of safeguards implementation at geological repositories (Key Objective 1): December 2012.
- Identify new hand-held instruments, in order to support Complementary Access inspections. Search through existing manufacturers' listings for hand-held instruments that are predominately commercially available and that can detect the ancillary signs of undeclared nuclear activity (Key Objective 2): December 2012.
- Test, and qualify at least one new, commercial instrument per year that can directly support the Complementary Access inspection by detecting or identifying a particular indicator for undeclared activities (Key Objective 2): December 2012/December 2013.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### *5.1. Current Active and Stand-by Member State Support Programme Tasks*

Over the 2012-2013 biennium, the majority of MSSP tasks under Project SGTS-08 will be umbrella tasks, which will be used principally for the following continuing general activities:

- To undertake small and/or short-duration tasks.
- To facilitate technical & scientific information exchanges.
- To assist the Project with compiling technical requirements for particular safeguards needs.
- To assist the Project with expert reviews of technical proposals.

- To facilitate the provision of experts for short periods.
- To assist the Project with product evaluations and field tests.

Umbrella task activities are reported in detail in the Departmental Support Programme Information and Communication System (SPRICS).

As required, the Project may also initiate tasks that will be used to investigate specific prototype methods and technology concepts.

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| ARG | A 1637 | MSSP Umbrella Task: Support for Novel Technologies | Task will be used as required to facilitate the general umbrella task activities defined above.<br>Current task completion date is December 2012. |
| AUL | A 1856 | | Task will be used as required to facilitate the general umbrella task activities defined above.<br>Current task completion date is July 2012. |
| BEL | A 1615 | | Task will be used as required to facilitate the general umbrella task activities defined above.<br>Current task completion date is December 2011. |
| BRZ | A 1601 | | Task will be used as required to facilitate the general umbrella task activities defined above.<br>Task completion date was December 2010. A request will be made at the next MSSP meeting to extend this task to December 2013. |
| CAN | A 1622 | | Task will be used as required to facilitate the general umbrella task activities defined above.<br>Current task completion date is March 2013. |
| EC | A 1634 | | Task will be used as required to facilitate the general umbrella task activities defined above.<br>Current task completion date is December 2012. |
| ESP | A 1826 | | Task will be used as required to facilitate the general umbrella task activities defined above.<br>Current task completion date is December 2012. |
| FIN | A 1628 | | Task will be used to facilitate further exchanges of technical information and in support of developing novel technology concepts for safeguards implementation at geological repositories.<br>Current task completion date is December 2011. |
| FRA | A 1641 | | Task will be used as required to facilitate the general umbrella task activities defined above.<br>Current task completion date is December 2011. |
| GER | A 1633 | | Task will be used as required to facilitate the general umbrella task activities defined above.<br>Current task completion date is December 2012. |
| HUN | A 1597 | | Task will be used as required to facilitate the general umbrella task activities defined above.<br>Current task completion date is December 2011. |
| JPN | A 1798 | | Task will be used as required to facilitate the general umbrella task activities defined above, and to facilitate exchanges of information in regard to the safeguards usefulness of krypton-85 sampling and analysis.<br>Current task completion date is January 2012. |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| NET | A 1850 | | Task will be used as required to facilitate the general umbrella task activities defined above.<br>Current task completion date is May 2012. |
| ROK | A 1894 | | Task will be used as required to facilitate the general umbrella task activities defined above.<br>Current task completion date is December 2011. |
| RUS | A 1621 | | Task will be used as required to facilitate the general umbrella task activities defined above.<br>A request will be made at the next MSSP meeting to extend this task to December 2013. |
| SWE | A 1671 | | In addition to the general activities common to all Project SGTS-08 umbrella tasks, SWE A 1671 may also be used to investigate the possibility of enhancing the Swedish Automatic Unit for Noble gas Acquisition SAUNA to measure krypton-85 and in support of developing novel technical concepts in support of geological safeguards implementation.<br>Request Sweden to extend this task into 2012/13. |
| UK | A 1599 | | Task will be used as required to facilitate the general umbrella task activities defined above.<br>Current task completion date is December 2011. Request the UK to extend this task into 2012/13 so that exploratory discussions on novel technologies can be arranged. |
| USA | A 1616 | | Task will be used as required to facilitate the general umbrella task activities defined above, including assistance in in the following specific topic areas:<br>Noble gas sample analysis using atom trap trace analysis (ATTA), and its adaptability for Safeguards needs.<br>Novel technologies in support of safeguards implementation at geological repositories.<br>Request the USA to extend this task into 2012-2013. |
| CAN | A 1627 | Optically Stimulated Luminescence in Forensics | On standby, awaiting the Canadian Support Programme's delivery of a prototype device IAEA evaluation. |
| FRA | A 1707 | Equipment for Sampling and Concentrating Atmospheric Noble Gases for the Measurement of Krypton and Xenon | On hold, awaiting feedback from the completed task GER A 1643. Termination of this task FRA A 1707 has been suggested to the French MSSP, and to continue technical exchanges with experienced French experts under the FRA A 1641 umbrella task arrangement. |

### *5.2. Proposed and Planned Member State Support Programme Tasks*

Over the period of the 2012-2013 biennium, Member States currently subscribing to the Project through the umbrella task mechanism will continue to contribute, particularly with technical & scientific information exchanges. Member States in the IAEA Support Programme system, but not currently participating in the Project through the umbrella task mechanism, will continue to be encouraged to join, by acceptance of the 06/TDO-007 task proposal.

Following Departmental review and approval, two new task proposals will be submitted for Member States' consideration in regard to the overall aim of demonstrating specific concepts for the use of noble gas sampling and monitoring in support of safeguards implementation. This work stems from the IAEA's September 2005 *Technical Meeting on Noble Gas Monitoring Sampling and Analysis for Safeguards Applications*, which recommended *inter alia* the establishment of tasks to further investigate the technique in a phased approach to provide needed data to better understand the technique's to safeguards.

Completed task GER A 1643 was established to cover Phase I, which utilized computer simulation models of safeguards scenarios. The final report of GER A 1643 Phase I was delivered to the IAEA in April 2011. The report demonstrated the applicability of krypton-85 sampling and analysis for the early detection of unreported reprocessing activities. Based on the positive outcome of Phase I, progression to Phase II has been proposed. Phase II will comprise a demonstration and of noble gas sampling and analysis using available technologies for detecting atmospheric krypton-85.

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 06/TDO-007 | MSSP Umbrella Task: Support for Novel Technologies | Continue encouraging the Czech Republic and the P.R. China to support novel technologies by establishing an umbrella task with the Project. |
| New Task Proposal #1 | Demonstration and Evaluation of Available Technologies for Detecting Atmospheric Krypton-85 | The task will provide the IAEA with a final report on the performed demonstration exercise, including provision of the required technical and procedural infrastructure, the on-going cost to operate the sampling and analysis equipment, and comparing it as a benchmark with other novel sampling and analysis technologies. |
| New Task Proposal #2 | Simulations of Krypton-85 Releases for On-Site Sampling | The task will devise procedures for establishing sampling locations for on-site atmospheric noble gas monitoring that have been proposed for verification of reprocessing activities. An important goal of this task will be a determination of capabilities to distinguish between local and remote sources when sampling on-site. |

### *5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

None foreseen.

# SGTS-11

## Unattended Measurement Techniques

### Project Manager: Thierry Pochet — Division: SGTS

### 1. Introduction

This document describes the plans for developing and implementing Unattended Measurement Techniques within the Department of Safeguards for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building Support for the Non-proliferation Regime, Strategy 2 – Coping with the Workload, Strategy 3 – Safeguards Advanced Reactors and Innovative Nuclear Fuel Cycles,* and *Strategy 4 – Taking on new mandates* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

The motivation for most of the activities planned under the present project is provided in the Long-Term Strategic Plan, 2012–2023, *Strategy 2 – Coping with the Workload*. Relevant excerpts include: *"The world is witnessing a renewed, global interest in nuclear energy...this will bring many additional nuclear activities and facilities under safeguards...the expanding workload implies that the Department needs to re-examine how it implements safeguards."* One of the primary outcomes of this re-examination is that in the future, unattended measurement systems will be expected to perform many of the tasks that safeguards inspectors currently perform in the field. Furthermore, those unattended systems will be expected to operate remotely in ways that embrace modern data security practices, and allow the Inspectorate to accurately and efficiently incorporate data from unattended measurements into the State evaluation process.

To meet the unattended measurement challenges of the future, it is necessary to develop a robust plan for D&IS that spans the full life cycle of development – beginning from initial concepts, proceeding to prototype instrument testing, and culminating in the engineering of robust, reliable instruments ready to be deployed in facilities around the world. The long-term direction of the SGTS-11 project and the associated key objectives for the 2012–2013 biennium have been defined to address this entire development lifecycle – see Figure 1 (with limited emphasis on the routine implementation issues that are considered to be outside the scope of SGTS D&IS projects).

The SGTS-11 key objectives will address some of the outstanding issues and challenges related to unattended measurement systems (UMS), for example: reliability of components and integrated systems; efficient and user-friendly analysis software for unattended measurements that seamlessly integrates into an over-arching collect and review software; adaptation of non-destructive assay (NDA) and analytical methods to unattended operation; collaboration within SGTS and with Operations Divisions to define concepts for unattended measurement systems that address emerging applications (e.g. disarmament, MOX fuel facilities, new reactor types and fuel repositories).

A number of the SGTS-11 key objectives are shared between SGTS projects. The most prominent project connections are with *SGTS-01 NDA Techniques, SGTS-12 Verification Techniques for Large Scale Enrichment Plants, SGTS-13 Universal NDA Data Acquisition Platform (UNAP), SGTS-14 Remote Monitoring and Data Processing Systems*, and *SGTS-15 Technologies for New IAEA Verification Mandates*. The prominent interface points between

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

the projects, as they are currently envisioned, are described in this document; other connections will be identified through the course of project execution.

The end-users that will benefit from these D&IS activities are the Operations Divisions performing safeguards verification activities and SGTS, which is responsible for the design, construction, installation and maintenance of new UMS. The primary outcomes of SGTS-11 will be the enhancement and expansion of the SGTS technology base, and the streamlining of the process for designing, building, installing and maintaining UMS. The former will help meet current and emerging verification challenges in a resource-constrained environment, while the latter will reduce costs, particularly labour costs, for the deployment and maintenance of UMS. Improvements in data reduction and analysis software will reduce the time and effort that safeguards inspectors must devote to understanding and utilizing UMS data streams, and thereby reduce costs associated with training and troubleshooting. The series of tasks and sub-tasks that have been defined to meet these objectives will be accomplished through a combination of internal resources and Member State Support Programmes.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term directions for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Term R&D Plan, 2012–2013. In particular, the Long-Term Directions for R&D which are relevant to the SGTS-11 project and the Departmental Strategies from which they are derived are identified here:

- Enhance safeguards equipment capabilities and techniques (*Strategy 1 – Building Support for the Non-proliferation Regime; Strategy 2 – Coping With the Workload*);
- Make optimum use of unattended monitoring and secure remote transmission (*Strategy 2 – Coping With the Workload*);
- Improve technical capability to detect misuse of enrichment and reprocessing facilities (*Strategy 1 – Building Support for the Non-proliferation Regime*);
- Identify, adapt and deploy appropriate new and/or novel technologies to improve existing, and to develop new, safeguards measures and tools (*Strategy 1 – Building Support for the Non-proliferation Regime; Strategy 2 – Coping With the Workload; Strategy 3 – Safeguards Advanced Reactors and Innovative Nuclear Fuel Cycles*).

Consequently, the long-term direction of the current D&IS project was defined:

***Provide optimized unattended measurement techniques that enhance present safeguards equipment capabilities and techniques for the detection and monitoring of declared and undeclared nuclear material and activities.***

In order to support this long-term direction, activities have to be initiated, continued and/or finalized during the biennium and can be structured under the following key objectives:

1. *Improve reliability, standardization and maintainability.*

   In unattended measurement systems, the detectors/sensors are often located in harsh environments with limited accessibility (e.g. reactor vaults, hot cells), making it difficult and costly to calibrate, repair and replace both detectors/sensors and co-located electronics components. At the data acquisition end

of the system, longer intervals between inspector visits, ever-increasing use of remote monitoring and the desire for joint-use instrumentation (e.g. data sharing between the Operator and the IAEA) require improvements in data security and remote transmission hardware and methods. These unattended applications present significantly different requirements than the attended NDA applications for which many commercially available components were designed. To meet this challenge, the development of pulse-processing electronics and data acquisition modules designed to the specific requirements of unattended measurements will continue. Important project connections include *SGTS-13 Universal NDA Data Acquisition Platform*.

2. *Adapt NDA and analytical methods to unattended, remotely monitored operation.*

As the IAEA is asked to monitor more facilities without a commensurate increase in Inspectorate resources, many of the quantitative NDA and analytical measurements that are currently done via human intervention must be adapted to an unattended, remotely monitored mode. A notable theme in this process is the enhancement of UMS to be more quantitative in function and reporting. High-priority applications include unattended spent fuel verification, online enrichment monitoring, unattended $UF_6$ cylinder verification and tracking, unattended MOX fuel-rod verification and unattended technologies for disarmament verification. This activity will require expanded technical expertise within the UMS team (including support from MSSPs) and strong coupling to other SGTS projects since there is considerable overlap in the technical domains spanned by these projects. Important project connections include projects *SGTS-01 NDA Techniques, SGTS-12 Verification Techniques for Large Scale Enrichment Plants, SGTS-15 Additional tools for Disarmament Verification, SGOC-01 Chernobyl* and *SGOA-02 Safeguards System for JNFL MOX Fuel Fabrication Plant (J-MOX*).

3. *Expand and enhance data reduction and interpretation software.*

Analysis software is the essential bridge between raw instrument data that only a few analysts fully understand, and verification conclusions made by safeguards inspectors. A recognized shortcoming with some UMS is the fidelity and completeness of the analysis and reporting performed by data interpretation software. For example, the detectors, pulse-processing electronics and data acquisition hardware for the VIFM system have a strong track record, but the VIFM analysis and reporting software has limited flexibility for new reactor types or variants on existing reactors, and is not integrated at the facility level. Expanding and enhancing the VIFM software would aid and accelerate the Inspector's ability to draw safeguards conclusions. Also, there is opportunity to extract more information from UMS instrument so as to provide analysts and inspectors with a more complete picture of facility activities. To address such challenges, the instrumentation and analysis expertise in TUS needs to be closely coupled to software development expertise at the Agency in a way that is sustainable and efficient. It is expected that this software development expertise will be provided under *SGTS-14 Remote Monitoring and Data Processing*.

4. *Monitor and evaluate new sensors and methods.*

The UMS Unit will continue to stay abreast of advancements in relevant fields and as appropriate, evaluate new technologies and measurement methods. High-priority investigations in 2012-2013 include the evaluation of a fiber-scintillator-based spent-fuel silo verification tool, and a study of the viability of automated environmental sampling and analysis for the detection of undeclared activities in declared facilities. Other, lower-level exploration may include He-3 replacements, alternative room-temperature semiconductors, alternative scintillators, active interrogation (both neutron and high-energy photon), and fast coincidence methods. In order to meet this objective, it is important that TUS staff have the opportunity to attend relevant technical conferences, publish, and participate in working groups and evaluation teams. Important project connections include *SGTS-08 Novel Technologies in Support of Safeguards Implementation*.

## 4. Activities

Many of the activities will be performed by Safeguards Department personnel. Assistance will be required from Member State Support Programmes mainly for activities under Key Objectives 2 (Adapt NDA and analytical methods to unattended, remotely monitored operation) and 4 (Evaluate new sensors and methods).

*Key Objective 1. Improve reliability, standardization and maintainability.*

- Front-end Electronics for Unattended Measurement (FEUM): Field experience has shown that front-end electronics (i.e. preamplifier, shaping amplifier and discriminator stages) are often the weak link in unattended measurement systems, in terms of reliability and ease of maintenance. Measurements and analysis performed by Safeguards Department personnel in 2011 supported Technical Specifications for the procurement of FEUM prototypes. Testing and evaluation of those prototypes will be completed in 2012 and pending positive outcomes, production and trial deployments will commence in 2013. FEUM development should be supported by regular budget funds and resources (*Activity #2*). In case prototype testing is found unsatisfactory and significant development is foreseen to develop a device that fully complies with Safeguards requirements, a new D&IS task request will be submitted in 2012 to the MSSP (*New Task Proposal #4*).
- Next Generation ADAM[3] Module (NGAM): In the previous biennium, a number of NGAM units were received and evaluated by TUS staff. A number of issues and desired improvements were identified, and iteration with the company BOT engineering (CAN E 1499) will continue in 2012. Long-term testing and test deployments of NGAM is scheduled for 2012 and 2013, and will be completed in parallel with UNAP adoption and evaluation.
- New Mobile Unit for Radiation Detection (i-MUND): This new Unit is meant to replace the existing MUND Unit (Mobile Unit for Neutron Detection) with modern and more robust components in order to improve the reliability and the power consumption of the device and to include gamma-ray detection capabilities. The integration, improvement, and standardization of the i-MUND front-end electronics and data logger began in 2010 and by late 2011, the first prototype was provided by the vendor. At the end of 2012, the prototypes will have been tested and evaluated for field deployment. As appropriate, the paths of FEUM and i-MUND will be merged, with a continuing eye toward standardization. i-MUND electronics development is supported by regular budget funds and resources (*Activity #1*). Extra budgetary funds may be utilized for procurement of completed units.
- Consultation for Improvement, Evaluation and Testing of Solution Monitoring Software (SMS): The aim of the task is to provide assistance and support to SGOA2 in regard to the SMS used at the Rokkasho Reprocessing Plant (RRP). This includes the development, validation and tuning of reference signatures, testing of software updates, diagnosing and proposing corrections for identified issues. According to the latest status update (2011-03-11), the task is extended until end of 2012. After 2012, depending on the availability of additional relevant facility data (pending the start of the RRP commercial operation), the task may be put on stand-by, subject to re-activation once more data become available. This work is supported by extra-budgetary fund under the task EC A 1661.
- During the 2012–2013 biennium, a significant number of Unattended Monitoring Systems will be due for major hardware and software upgrade (especially at the Rokkasho Reprocessing Plant (RRP) and Chernobyl NPP) as ageing components must be replaced with modern and standardized devices, which will further improve system reliability and maintainability. As many of the UMS are based on LANL (Los Alamos National Laboratory) technology, technical support from LANL might be required through the existing tasks USA E 1274 (URM System Standardization and Support) and, for the UMS systems installed at Rokkasho, USA A 1351 (Support for Development of the Safeguards Systems at RRP). Associated documentation for the UMS upgrade at Chernobyl is being carried out through the task USA E 1701.

[3] ADAM: Stand-Alone Autonomous Data Acquisition Module.

- Miscellaneous tool development: A collection of relatively limited development efforts are needed to populate the UMS toolbox for effective and efficient calibration, maintenance and reliability engineering for unattended measurement components. High-priority developments include power management strategies (building upon previous successes in CAN E 1530), a charge pulse injector for field calibration of front-end electronics, and a signal branching module for current-mode ion chambers (to facilitate redundancy). Field prototypes of these devices are expected by the end of 2013. This work will be supported by regular budget funds and resources (*Activity #3*).

*Key Objective 2. Adapt NDA and analytical methods to unattended, remotely monitored operation.*

- Unattended Cerenkov Viewing Device (UCVD): Safeguards objectives for Scandinavian fuel encapsulation plants (prior to permanent emplacement of spent fuel in geological repositories) include partial defect measurements on spent fuel assemblies. Proposed instrumentation approaches include a combination of neutron counting (for active length and full-volume interrogation) with an unattended CVD instrument for detection of missing or altered pins. This effort will be managed in collaboration with *SGTS-01 NDA Techniques*, building on that project's experience with quantitative digital CVD approaches. In 2012–2013, a concept for an integrated UCVD will be developed and an MSSP task proposal will be issued to support development of quantitative image recognition and analysis approaches appropriate for unattended operation (*New Task Proposal #2*).
- Unattended gamma-ray spectroscopy for MOX fuel fabrication facilities: Safeguards objectives for JMOX include verification of MOX fuel rod characteristics such as active length and Pu content. Unattended gamma-ray spectroscopy methods and instruments are being developed and will leverage, to the extent possible, concurrent development of gamma-spectroscopy modules and techniques from previous and ongoing UMS activities. This work is supported by regular budget funds and resources (*Activity #4*) and will be managed in collaboration with the J-MOX project.
- Solution Monitoring Measurement System (SMMS): The SMMS evaluation software (TRP-TAMS (Tank Monitoring System)), originally developed under the completed task UK A 1653, was updated and tested in 2011. During the 2012–2013 biennium SMMS activities include the completion of the documentation of the Software that is currently at the final stage of its development. This work will be supported by task EC E 1814.
- On-Line Enrichment Monitor (OLEM): OLEM is intended to provide continuous, quantitative measurement of the in-process feed, product and tail gas at centrifuge enrichment plants, and will support the objectives of timely detection of facility misuse for HEU production, higher-than declared production, and undeclared LEU production. UK A 1868 will support field testing at Urenco Capenhurst and the USSP expressed the intention to support the development of a field prototype via a future USSP task (*Task Proposal 10/TAU-004*). Regular budget supports proof-of-principle analysis by Safeguards Department staff. Testing of the field prototype will be completed in 2013, and will inform decisions about the expected performance and role of OLEM in future enrichment plant safeguards approaches.
- Unattended Cylinder Verification System (UCVS): UCVS is intended to provide continuous, quantitative measurement of the feed, product and tail cylinders entering and leaving an enrichment facility. It supports the objectives of timely detection of facility misuse for higher-than declared production and undeclared LEU production. EC A 1687 (completed in 2010) and USA A 1760 (to be completed in 2011) provided a survey of candidate technologies for cylinder verification. In 2012-2013, a concept for an integrated UCVS will be developed and an MSSP task proposal will be issued to support development of a field prototype and subsequent testing (*New Task proposal #3*).
- Additional Tools for Disarmament Verification: UMS activities contributing to project SGTS-15 will be managed under the SGTS-11 and performed by the TUS/UMS team, in close coordination with SGTS-15 project which will provide system analysis, define specific requirements and integrate results. These activities are further described in the SGTS-15 project plan.

*Key Objective 3. Expand and enhance data reduction and interpretation software.*

- Input to functional requirements and technical specification for integrated collect and review software: The SGTS-14 project will lead the development of a new integrated collect and review infrastructure, but SGTS-11 and TUS instrument and analysis experience will support this activity (*Activity #5*). Evaluation of the collect and review software (RADAR, CRISP) currently used by Euratom inspectors and potential incorporation of some of its functionalities into our new software platform should be considered as part of this task. This work will be supported by regular budget funds and resources and will be managed in collaboration with *SGTS-14*.
- Development of instrument-specific analysis and interpretation modules for UMS: High-priority efforts in this area include the improvement of Core Discharge Monitor (CDM) algorithms, integration of VIFM data streams (i.e. CDM, Bundle Counter and Spent Fuel Transfer Monitor (SFTM) data at the facility level), medium-resolution gamma-ray spectroscopy collection and analysis methods, and development of specific algorithms to analyze reactor power data provided by GRPM (Grand based Reactor Power Measurement) systems. This work will be supported by regular budget funds and resources (*Activity #6*) and will be managed in collaboration with the SGTS-14 project.

*Key Objective 4. Monitor and evaluate new sensors and methods.*

- Survey and evaluation of automated environmental sampling methods: The viability of unattended environmental sampling for the detection of undeclared activities in declared facilities will be assessed. Topics of interest will include both the techniques for collection (e.g. particulate or noble gases) and for subsequent online analysis (e.g. user laser spectroscopy methods). Of primary concern is how unattended methods compare and contrast with current environmental sampling in terms of effectiveness and sensitivity. Unattended environmental sampling at centrifuge enrichment plants is the high-priority application, as successful development of an appropriate technology would support more timely detection of HEU production and significantly reduce the burden of collection and analysis of swipe samples at a growing number of enrichment plants. In 2012, an MSSP task proposal will be issued for a survey of current techniques appropriate for unattended sampling analysis at enrichment plants. Pending positive results of this survey, a path toward the testing and evaluation of available technologies will be defined in 2013 (*New Task proposal #1*).
- Evaluation and field testing of a Silo Entry Gamma Monitor (SEGM) for multi-silo scenarios: In the previous biennium, a SEGM variant based on fiber scintillators was conceptualized, designed and laboratory prototypes were procured. In 2012, the laboratory prototypes will be evaluated and pending success in that phase, field prototypes will be fabricated and tested. This work will be supported by regular budget funds and resources (*Activity #7*).
- Continued characterization and evaluation of liquid scintillators and associated electronics and comparison to baseline technologies (e.g. He-3 and B-lined) for unattended measurement applications that include gross neutron counting and fast neutron coincidence counting. Preliminary measurements and evaluation of the technique under various mixed gamma-ray and neutron fields will be completed by the end of 2012. In case of encouraging results, the technique will be further developed for implementation in a facility for field testing (2014). This work will be supported by regular budget funds and resources (*Activity #8*).

### Key achievement targets

- Authorize upgrades in electronics (improved Mobile Unit for Neutron Detection) and data acquisition modules (Next Generation ADAM Module (NGAM) and Universal Data Acquisition Platform (UNAP)) (Key Objective 1): June 2013.
- Deploy standardized front-end electronics for Unattended Monitoring Systems after completing performance and environmental testing (Key Objective 1): December 2013.

- Complete field evaluation of On-Line Enrichment Monitor and Unattended Cylinder Verification System for enrichment plant safeguards (Key Objective 2): December 2013.
- Authorize enhanced, integrated Irradiated Fuel Monitor Analysis software including the completion of Core Discharge Monitor (CDM) algorithms revision and the integration of CDM and Bundle Counter reporting at the facility level in order to facilitate data analysis (Key Objective 3): June 2013.
- Complete evaluation of advanced sensors and methods and authorize the upgrade of the multi-Silo Entrance Gate Monitor (Key Objective 4): June 2013.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### *5.1. Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| CAN | E 1499 | Development of the Next Generation ADAM Module | To be completed in June 2012 |
| CAN | E 1530 | VIFM Implementation Support | On-going task |
| EC | A 1661 | Consultation for Improvement, Evaluation and Testing of Solution Monitoring Software (SMS) | To be completed in December 2012 |
| EC | E 1814 | Solution Monitoring System (SMMS) Hardware Upgrade | To be completed in December 2012 |
| GER | A 1269 | Digital Unattended MCA (DIUM) (C.36) | On stand-by |
| UK | A 1868 | On-Line Enrichment Monitor (OLEM) (E12 (d)) | To be completed in December 2013 |
| USA | A 1238 | Development of Integrated Review Software for UMS (A241) | To be completed in December 2011 |
| USA | A 1351 | Support for Development of the Safeguards System at Rokkasho Reprocessing Plant (RRP) (A.247) | On-going task |
| USA | E 1274 | URM Systems Standardization and Support (E.122) | On-going task |
| USA | E 1701 | Unattended Monitoring System (UMS) Documentation Support (E.155) | To be completed in July 2012 |

### *5.2. Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 10/TAU-004 | On-Line Enrichment Monitor (OLEM) | Outstanding with EC and USA (2010) |
| New Task Proposal #1 | Viability of Unattended Environmental Sampling at Enrichment Plants | To be submitted in January 2012<br>MSSP(s): USA, UK |
| New Task Proposal #2 | Unattended Cerenkov Viewing Device | To be submitted in January 2012<br>MSSP(s): TBD |
| New Task Proposal #3 | Unattended Cylinder Verification System | To be submitted in June 2013<br>MSSP(s): USA, EC, UK |
| New Task Proposal #4 | Front-end Electronics for Unattended Measurement (FEUM) | To be submitted in January 2012 in case no off-the-shelf solution is found acceptable.<br>MSSP(s): TBD |

*5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | MUND electronics upgrade |
| Activity #2 | Front-end Electronics for unattended measurements (FEUM) |
| Activity #3 | UMS calibration and characterization tools |
| Activity #4 | Unattended gamma-ray spectroscopy hardware and methods |
| Activity #5 | Functional requirements and technical specifications for integrated Collect and Review software |
| Activity #6 | VIFM software upgrade and integration |
| Activity #7 | Multi-silo SEGM development |
| Activity #8 | Evaluation of liquid scintillators and comparison to baseline technologies (e.g. He-3) that include gross neutron counting and fast neutron coincidence counting |

## Attachments

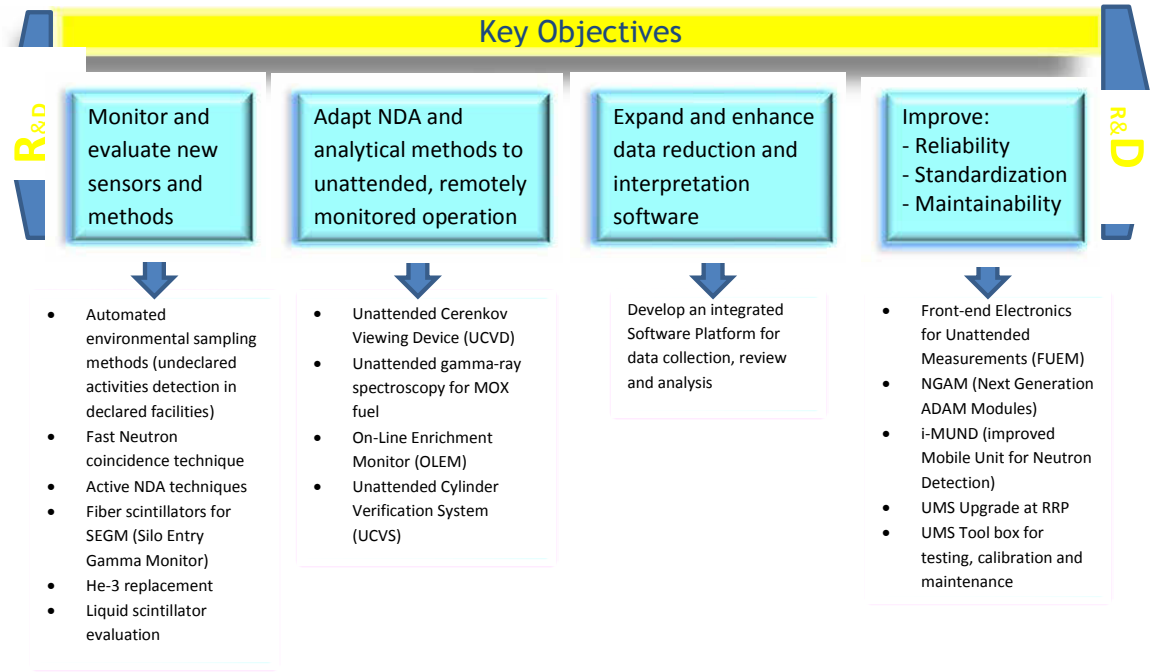



Figure 1: SGTS-11 Key Objectives for the biennium 2012-13.

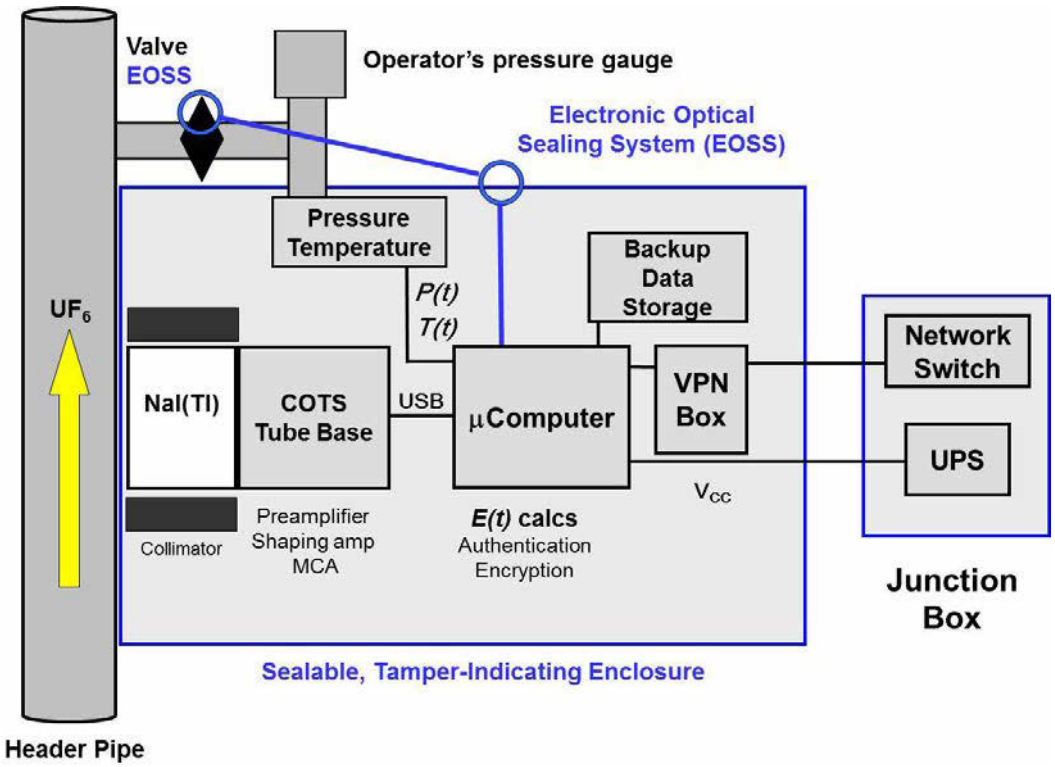



Figure 2: Conceptual overview for an Online Enrichment Monitor that combines a medium-resolution gamma-ray spectrometer with gas pressure information to provide continuous monitoring of in-process material at enrichment plants.

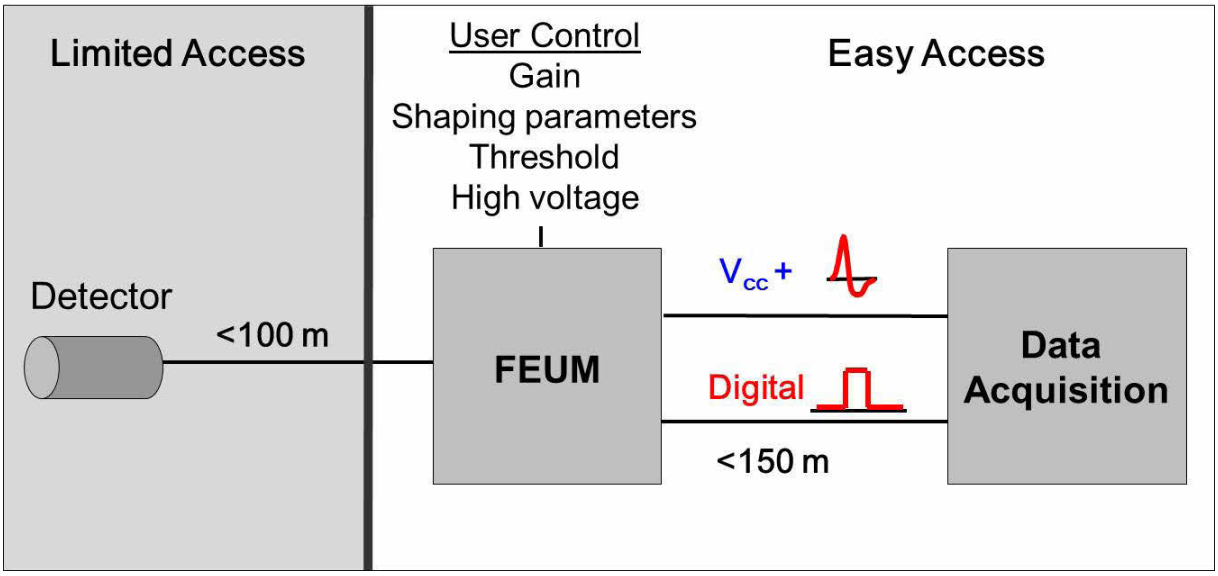



Figure 3: Schematic overview of FEUM as a part of an unattended measurement system with detectors located in areas of limited access. Development objectives for FEUM include standardization, improved reliability and the ability to locate FEUM considerable distances away from detectors in areas of limited access.

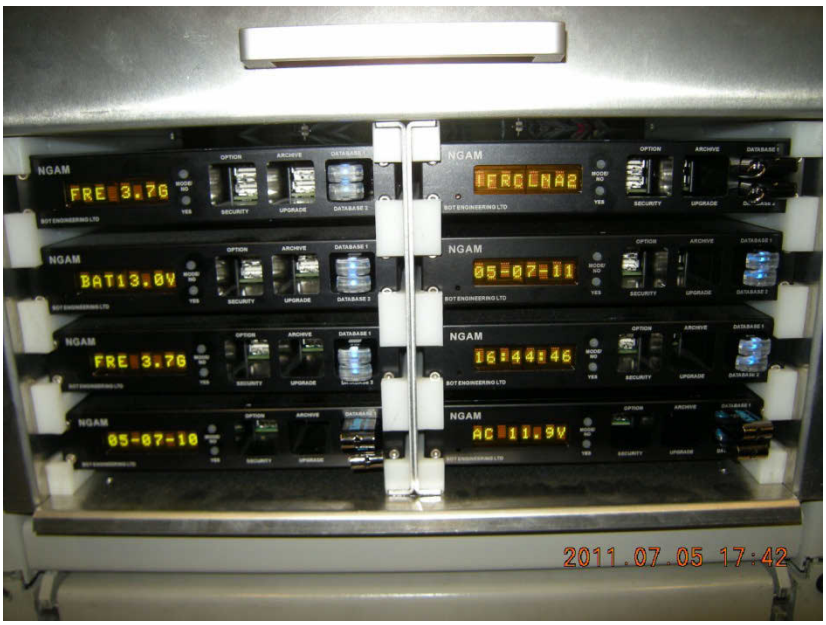



Figure 4: The NGAM (Next Generation ADAM) module is a 8 channel SCA data acquisition module. It is backward compatible with all VIFM system detectors. Data is stored redundantly on two discrete drives. It is a TCP-IP compliant device that connects to collect computer via an Ethernet (internet/intranet) connection. The NGAM also features an embedded web-browser application that allows data archive and system diagnostics via a PC (i.e. without need of connection to a collect computer or additional software).

# SGTS-12

## Techniques and Equipment for Safeguards at Gas Centrifuge Enrichment Plants

**Project Manager: Alain Lebrun** **Division: SGTS**

### 1. Introduction

This document describes the plans for developing and implementing verification techniques applicable to large enrichment plants for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1].

This project supports the generic *Strategy 1 – Building Support for the Non-Proliferation Regime* through "improving technical capabilities using science and technology innovation" and *Strategy 2 – Coping with the Workload* by "seeking efficiency gains in SG implementation while making use of the appropriate equipment and techniques". The "Enhancing detection of misuse of enrichment and reprocessing technologies through improving, and using, technical knowledge and technology innovation" is also an explicit long-term direction of the Long-Term Strategic Plan, 2012–2023[2].

### 2. Overview

This D&IS project was established in 2007 in order to modernize the existing tools applicable to safeguards verification at enrichment plants and to explore alternative technologies and new concepts of use of IAEA equipment in combination with shared data from operator systems. Technologies developed under this project may also be used elsewhere including small pilot enrichment plants. The project aims at formulating instrumentation solutions to strengthen IAEA safeguards while reducing the inspection effort at large Gas Centrifuge Enrichment Plants (GCEPs). As recommended by the model safeguards approach, detection and deterrence of excess production scenario needs to be addressed. The technological developments are designed consistently with approaches developed under the D&IS project *SGCP-03 Safeguards Approaches*. They are conducted within the related technical areas such as the D&IS project *SGTS-01 Non Destructive Assay Techniques, SGTS-03 Surveillance Techniques* and *SGTS-11 Unattended Measurements Techniques*. Longer term developments on more speculative technologies will still be carried out under the project *SGTS-08 Novel Technologies in Support of Safeguards Implementation*.

The modernization of existing instrumentation –mainly attended Non Destructive Assay systems – is completed.

Conceptual design steps of unattended system are also completed and IAEA monitoring systems development has been initiated under the proper technical area (SGTS-11).

The project is now focusing on data sharing from operator systems and more prospective attended assay such as transportable mass spectrometry or laser spectrometry.

While in 2007 the D&IS project was a technological response to the "Model Safeguards Approach for Gas Centrifuge Enrichment Plants" developed in 2006, the outcome of the project since contributed significantly to the elaboration of the Conceptual Safeguards Approach for large GCEP presented by SGOB as a basis for implementing IAEA safeguards at the US facility in Eunice (New Mexico). It is also consistent with the implementation of sharing data from operator systems at the George Besse II plant in France.

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

Currently, verification of the material balance still remain highly dependent on manned inspections with almost no role played by unattended systems while the large plants are highly automated with operator systems capturing flow data from all across the plant.

The D&IS plan is therefore three fold:

- Modernizing existing tools supporting routine inspections that will continue to be the basis of IAEA safeguards in many existing facilities;
- Developing advanced tools supporting more effective announced and unannounced inspections;
- Elaborating concepts of use of operator systems in a secured and cost-effective manner in order to reduce the inspection effort while enhancing IAEA Safeguards efficiency.

Two large GCEPs in States with Voluntary Offer Agreements (VOAs) are under construction and if designated for IAEA safeguards will represent the unique opportunity to gain experience with new innovative approaches and associated technologies. This will require a medium term amendment of this plan with D&IS activities and tasks specifically targeted to these plants.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term direction for R&D in supporting the implementation of the Departmental strategies.

As a first step, the long-term direction of the current D&IS project was defined:

***Conceptualize and demonstrate feasibility of a new approach in the use of instrumentation at enrichment plants. In essence, the main long term proposal reverses the continuous operator data capture versus inspection paradigm to maintain safeguards conclusion credibility while securing cost effectiveness. The proposed direction is to capture data from operator systems and continuously secure it in IAEA systems on a systematic basis thus ensuring 100% coverage of the verification. Both announced and unannounced inspections appropriately defined taking into account relevant state factors would be used to obtain a satisfactory level of confidence that the shared data are genuine and authentic.***

The modernization of existing instrumentation, mainly attended Non Destructive Assay systems, is completed.

In order to support the long-term direction, activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Demonstrate the feasibility of cost-effective and secured sharing of data from operators weighing systems.*

2. *Develop monitors for continuous accurate assay of the enrichment in high pressure take off piping.*

3. *3.Develop the techniques for attended NDA on UF6 material allowing on-site bias defect analysis.*

4. *4.Establish the feasibility of unattended measurement stations where all cylinders in and out of the facility would be identified and quantitatively assayed.*

5. *5.Select and develop the NDA components of such measurement station or alternative solution to quantitatively assay the nature and quantity of uranium in cylinders stored at the facility, or being connected to the process.*

6. *6.Select and develop the techniques to uniquely identify the cylinders supporting their tracking at facilities including those attached to the process.*

## 4. Activities

Field testing is a critical step in the development of instrumentation. The task FRA A 1882 is offering a test bed option for the technologies and method being developed under the project.

*Key Objective 1. Demonstrate the feasibility of cost-effective and secured sharing data from operators weighing systems.*

- Operators of enrichment facilities use two types of weighing systems: 1) high precision scales where all cylinders are weighed for accountancy purposes, 2) process load cells for safety and process control purposes. Sharing data from both weighing systems would allow the IAEA to efficiently verify the material balance with a reduced inspection effort. Innovative data authentication, weighing data analysis methodology and associated software are being developed with MSSP support (Task JNT A 1879 FRA, EC "Evaluation of Data Collected From Operator Systems at Enrichment Plants") with particular attention to the sensitiveness of the shared data. This MSSP task is focusing on the data sharing system currently being implemented at the George Besse II plant in France. The related D&IS activities include:
  - Evaluate the concept of data authentication by analysis of the data coherence across the plant;
  - Develop the data evaluation packages able to verify continuously the mass balance at all times;
  - Assess the vulnerability of such a data sharing approach.

  The task JNT A 1879 has highest priority and its first results are intended be implemented to support real inspections in 2012.

*Key Objective 2. Develop monitors for continuous accurate assay of the enrichment in high pressure take off piping.*

- In conjunction with sharing the data from the process load cells, accurate enrichment monitoring on product and tails high pressure take off piping will support the continuous verification of the U-235 mass balance in addition to the material mass balance. Development proposals responding to the IAEA user requirement for an On Line Enrichment Monitor have been evaluated and actual development will be carried out under the D&IS project *SGTS-11 Unattended Measurement Techniques* as soon as approved by the USSP.

*Key Objective 3. Develop the techniques for attended NDA on UF6 material allowing on-site bias defect analysis.*

- Bias defect analyses are usually carried out by means of destructive analysis (plus accurate weighing) which imply sample taking, shipment to the laboratories and carrying out costly DA procedures. Therefore the number of bias defect analysis is limited and delivery time of the analysis result is quite long. The availability of NDA techniques applicable on site and supporting bias defect analysis will allow the IAEA to perform more bias defect analysis, thus consolidating the verification of the material balance and flow estimate within the enrichment plants. The related D&IS activities are:
  - Complete or initiate tasks to improve the NDA technique based on tuneable laser spectrometry. Proof of principle was obtained in 2007. Improvements developed since in particular with testing of new laser components developed under task GER A 1658 pave the way to a deployable instrument to be developed with MSSP assistance. However, intellectual property and technical issues prevented engaging a successful development of a deployable instrument. Emergence of

new laser technology (quantum cascade laser (QCL)) is offering renewed opportunities that will be pursued internally with possible contribution of contractors (*Activity #1*);

– Evaluate suitability and performances of transportable mass spectrometers based on innovative technologies such as ion trap or time of flight mass spectrometry (*Activity #2*).

*Key Objective 4. Establish the feasibility of unattended measurement stations where all cylinders in and out of the facility would be identified and quantitatively assayed.*

- Under the IAEA Conceptual Approach for GCEP safeguards, the unattended measurement station associating cylinder identification and NDA to a shared accountancy scale is only optional. Thus the medium priority is assigned to these activities. The measurement station concept assumes that all cylinders go in and out of the facility via a unique route where unattended equipment would assay them. No target facility has been identified yet for the implementation, therefore the activity remain limited to follow up on experiments and developments conducted in various R&D structures such as DOE PPNL on a cylinder portal monitor and DOE SRNL on authenticated accountancy scale. The work conducted under task EC E 1696 "L2IS: Laser Item Identification System" managed under project *SGTS-03 Surveillance techniques* is also part of this building block approach.

*Key Objective 5. Select and develop the NDA components of such measurement stations or alternative solution to quantitatively assay the nature and quantity of uranium in cylinders stored at the facility, or being connected to the process.*

- Two MSSP tasks are currently active under the European Commission and US Support Programmes (EC A 1687 and USA A 1760, "State of the Art of NDA Techniques Applicable to $UF_6$ Cylinders") to reassess the feasibility and performances of NDA techniques applicable to UF6 cylinders and prone to unattended operation. The second phase of the work will be completed by end of 2012.

*Key Objective 6. Select and develop the techniques to uniquely identify the cylinders supporting their tracking at facilities including those attached to the process.*

- Under the IAEA Conceptual Approach for GCEP safeguards, the identification of UF6 cylinders is optional. Furthermore, the international meeting on enrichment organized in Chester in December 2009 with operators, regulators, inspectorates and R&D entities concluded that a global identification system should be an undertaking by the community of operators rather than from inspectorates. Therefore, the IAEA continues monitoring the maturation of identification/tracking technologies in support of possible safeguards use under project *SGTS-02 Techniques and Instruments for Sealing and Containment Verification*.

### Key achievement targets

Detailed milestones expected to be achieved under each key objective are presented above. The highest priority is assigned to the following:

- Evaluation of Data Collected From Operator Systems at Enrichment Plants (Key Objective 1):
  First results of the evaluation of the concept of data authentication by analysis of data coherence across the plant and of the development of data evaluation packages able to verify continuously the mass balance at all times will be implemented in support of inspections in 2012: December 2012.
- Update assessment of the technical feasibility of on-site bias defect analysis on $UF_6$ samples by laser absorption spectrometry or transportable mass spectrometry (Key Objective 3): June 2013.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### *5.1. Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| EC<br>FRA | JNT A 1879 | Evaluation of Data Collected From Operator Systems at Enrichment Plants | To be completed in 2013 |
| EC | A 1687 | State of the Art of NDA Techniques Applicable to UF6 Cylinders (USA A.279) | Phase II to be completed in 2012 |
| USA | A 1760 | | Phase II to be completed in 2012 |
| FRA | A 1882 | Test Bed Facility of Instrument and Methods for Verification at Gas Centrifuge Enrichment Plants | Ongoing |
| GER | A 1658 | Development of Tunable Diode Laser for UF6 Gas Enrichment Measurements (C.39) | On stand-by |

### *5.2. Proposed and Planned Member State Support Programme Tasks*

Unless the Urenco US facility gets designated for IAEA safeguards, no MSSP tasks are planned to be initiated in the next biennium.

### *5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | Monitor and assess the suitability of QCLs for in situ laser spectrometry for UF6 bias defect analysis |
| Activity #2 | Evaluate transportable mass spectrometry for on-site bias defect |

# SGTS-13

## Universal NDA Data Acquisition Platform (UNAP)

**Project Manager: Mark Pickrell** **Division: SGTS**

### 1. Introduction

This document describes the plans for developing and implementing the Universal NDA Data Acquisition Platform, (UNAP) within the Department of Safeguards for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building Support to the Non-Proliferation Regime, Strategy 2 – Coping with the Workload, Strategy 3 – Safeguarding Advanced Reactors and Innovative Fuel Cycles*, and *Strategy 4 – Taking on New Mandates* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

The UNAP supports *Strategy 1 – Building Support to the Non-Proliferation Regime and Strategy 2 – Coping with the Workload* by simplifying and reducing the necessary hardware for safeguards measurements. It supports *Strategy 3 – Safeguarding Advanced Reactors and Innovative Fuel Cycles* and *Strategy 4 – Taking on New Mandates* by providing data acquisition inputs not presently available in our present inventory, which allows new instruments and measurements to be developed within the existing data acquisition topology.

The UNAP is being developed to enhance and optimize NDA equipment for attended and unattended nuclear material verification and monitoring. It is designed to acquire and process all types of NDA data (e.g. gamma, neutron counting, power monitoring, etc.) in both attended and unattended mode using a single common platform. The UNAP is being built to MILSPEC standards, which will provide standardization, robustness, and reliability. UNAP will operate with streamlined and user-friendly software and will become the backbone of upgraded and future NDA equipment. The majority of future NDA systems (with the exception of hand-held systems) will be built using the UNAP, so that data acquisition will be done to a single hardware and software platform. The UNAP has the ability to transmit data remotely using TCP/IP protocols over Ethernet and improves data protection using digital security following the asymmetric key (PKI-Public Key Architecture) protocols for authentication and encryption. The PKI architecture also provides a technological basis for joint use of equipment. Future NDA equipment will be based on UNAP as the backbone operating with streamlined and user-friendly software. This standardisation effort will also simplify the supply chain. Cooperation with projects *SGTS-01 NDA Techniques, SGTS-11 Unattended Measurement Techniques, SGOA-02 Safeguards System for JNFL MOX Fuel Fabrication Plant (J-MOX)* and *SGTS-15 Technologies for New IAEA Verification Mandates* is on-going.

A comprehensive, detailed set of specifications for the UNAP has been completed. Actual circuit level design of the UNAP and the development of the processor board have been completed. The software level design of the UNAP also began in 2010 and is ongoing. Prototypes of both the processor and data acquisition modules are currently undergoing extensive testing. The design of an industrial-quality engineered system and the production of the UNAP were contracted in 2010. That design is also complete and the final design review is scheduled for September 2011. Full scale manufacturing of these pre-production prototypes begins in October of 2011, with delivery anticipated in the first quarter, 2012.

The UNAP project will be completed during this biennium provided that the field tests will be successfully.

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term direction for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023.

As a first step, the direction[3] of the current D&IS project was defined:

***Provide a standardized, secure and highly reliable universal NDA data acquisition platform for future NDA systems (except of hand held systems) supporting the verification and monitoring of nuclear material.***

In order to support this direction, activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Develop the full set of specification for the UNAP system in consultation with NDA instrumentation experts from all principal developers and vendors (Initial Key Objective, already completed in 2009).*

   This objective addressed the technical specifications for UNAP to meet user requirements. The specifications aim for a modern NDA data acquisition platform with standardized, robust and highly reliable components (MIL spec) that will also reduce maintenance and operating costs. UNAP shall provide the ability to interface in addition to NDA data to every type of industrial measurement (e.g. temperature, pressure, vibration, force, etc.) with the intent to expand the classical NDA data acquisition application to general process monitoring and automation as well.

2. *Design and build a prototype of the UNAP system with operating software.*

   According to the specification (see 3.1.), design and build a prototype of the UNAP system with operating software.

3. *Test UNAP prototype to demonstrate specified functionalities and to select the final version for production.*

Extensive field testing of UNAP is required to demonstrate that user requirements are met and UNAP can be qualified for safeguards inspection use (approval for Category A).

## 4 Activities

The UNAP development is being funded by the United States support program. In addition, the IAEA has used internal funds for the processor board engineering development. Finally, other Member States have offered assistance to the UNAP project. In particular, both the Japanese and European Union Support Programs have offered to support the extensive field testing of the UNAP and the USSP and European Union Support Programs also supported the conference to develop the detailed specifications.

[3] The project SGTS-13 itself has no long term direction beyond the biennium, only a short-term one until completion of the project, scheduled before the end of 2013.

*Key Objective 1. Develop the full set of specification for the UNAP system in consultation with NDA instrumentation experts from all principal developers and vendors.*

This objective is complete.

*Key Objective 2. Design and build a prototype of the UNAP system with operating software.*

- Design the input circuitry for the UNAP to include:
  - The Universal Data Acquisition (UDA) board. This board is being funded by the USSP and has been completed by the Los Alamos National Laboratory under task USA E 1715. Several board prototypes have been under test. The board design includes a schematic, Gerber printed circuit layout, and VHDL definition of the three Actel FPGA chips.
  - The Direct Current Input (DCI) board. This board is being funded by the USSP and has been completed by the Los Alamos National Lab oratory under task USA E 1715. Several board prototypes have been under test. This board is a near copy of the GRAND III design. It has the ability to measure fempto-amp levels of direct currents so it can be used to measure the outputs of several detectors without the need of a pre-amplifier.
  - The main processor board. This board design has been funded by the IAEA using internal funds. Actis computer was selected by competitive bidding to design and build this board. This board has a robust, high level processor running a full Linux kernel. The software for the UNAP is being developed on this board.
  - Power supply, battery backup, front panel, rear panel and mother boards. These boards are being funded by the USSP under task USA E 1715 and have been completed by Canberra Nuclear, Inc. Canberra was selected by competitive bid through the ISPO office at Brookhaven National Laboratory. These boards are mostly completed. All will be completed by the Final Design Review in September 2011. One of the design features of the UNAP for reliability and robustness is that there is no internal wiring; all internal connections are done with the flexible motherboard.
- Design of the full prototype to include the enclosure:
  - This design converts the schematics to an industrial quality system. This design will be complete as of the final design review in September 2011. It has been completed by Canberra Nuclear, Inc., and was funded by the USSP under task USA E 1715.
  - Construction of the first 12 pre-production prototypes is underway and the UNAP manufacturer, Canberra has procured all long lead time components. This task is part of the overall industrial design task supported by the USSP under task USA E 1715. The anticipated delivery of the first 12 prototypes is first quarter 2012.

*Key Objective 3. Test UNAP prototype to demonstrate specified functionalities and to select the final version for production.*

Extensive testing of the UNAP under a wide variety of field conditions:

- The 12 prototypes will be distributed among various users to test the system under as broad a range of conditions as can be envisioned. Testing conditions will be defined by the IAEA following the qualification procedure for SG equipment, exploring various operational regimes. UNAP testing will be performed using internal resources (*Activity #1*), as well as MSSP support provided under tasks EC E 1732 and JPN E 1720, and will include vulnerability assessment (*Activity #2*).

### Key achievement targets

- Deliver 12 pre-production UNAP prototypes for evaluation and testing (Key Objective 2): March 2012.

- Complete UNAP full field testing and authorize UNAP for safeguards use (Key Objective 3): March 2013.
- Project completed: March 2013.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### 5.1. *Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| EC | E 1732 | Development of a Universal Non-destructive Assay Data Acquisition Platform (UNAP) (USA E.157) | Prototypes to be delivered in Q1 2012. |
| JPN | E 1720 | | Testing to be completed in Q1 2013. |
| USA | E 1715 | | |

### 5.2. *Proposed and Planned Member State Support Programme Tasks*

None

### 5.3. *Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | Testing and certification to Cat A authorization. To completed Q1 2013 |
| Activity #2 | Conduct a third-party vulnerability study |

## Attachments

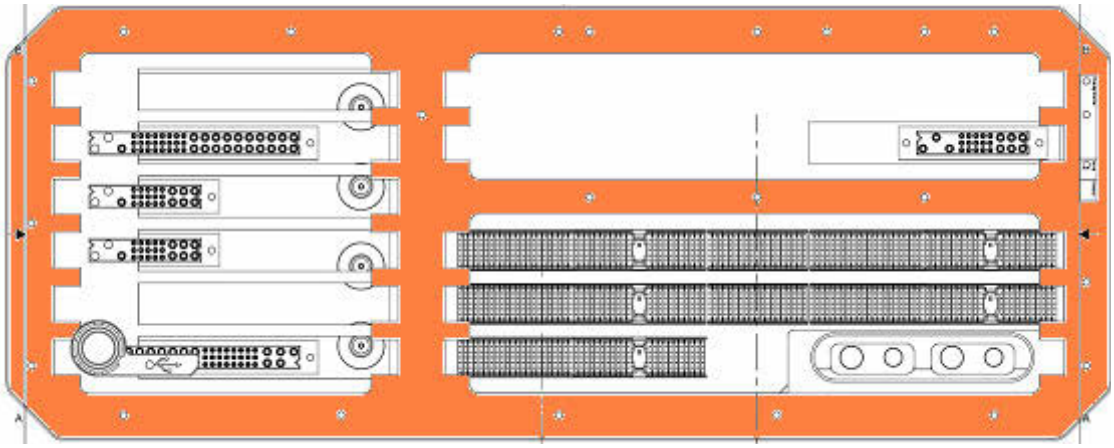


Figure 1: Cutaway view of UNAP showing extruded aluminum enclosure in orange and all internal circuit boards.

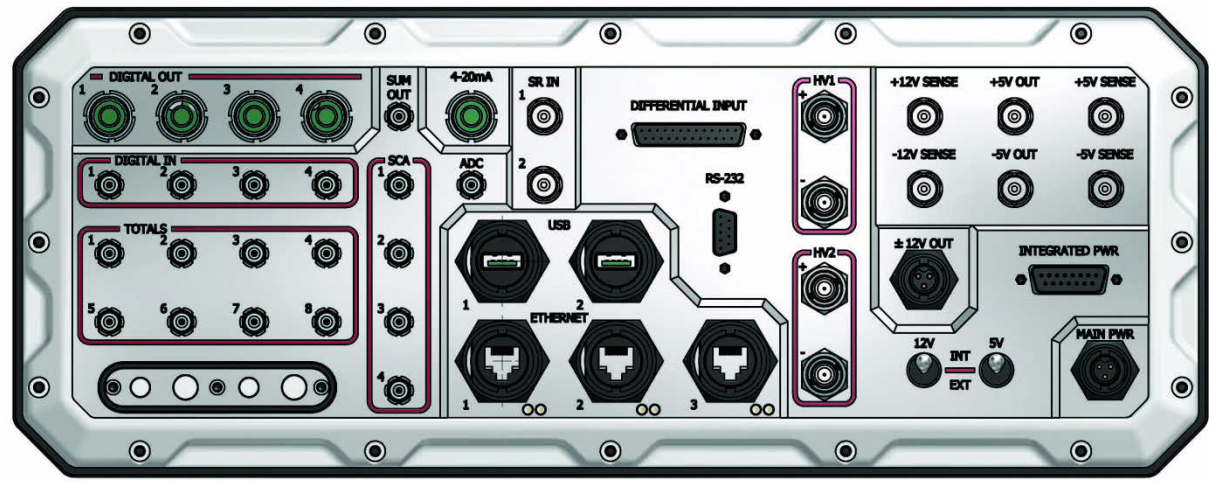



Figure 2: Back view of UNAP showing all connectors.

Figure 3: Artist rendering of UNAP.

# SGTS-14

## Remote Monitoring and Data Processing Systems

**Project Manager: Jim Regula** **Division: SGTS**

### 1. Introduction

This document describes the plans for developing and implementing remote monitoring and data processing systems within the Department of Safeguards for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 1 – Building Support for the Non-Proliferation Regime and Strategy 2 – Coping with the Workload* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

The project SGTS-14 addresses the Department's needs in the area of remote monitoring (RM) and data processing development and implementation, either for new safeguards applications or for the sustainability and maintenance of existing equipment. The focus of this project is therefore on development of equipment, software, and technological approaches for RM applications, RM infrastructure and general data processing.

Remote monitoring has expanded greatly in the last ten years. As of August 2011, there are 263 systems connected remotely: 152 surveillance and 111 unattended monitoring systems. This includes 583 cameras, over 150 electronic seals, all totalling over 3.5 GigaBytes of data per day being transferred to offices in Vienna, Tokyo, and Toronto. During the 2012-2013, the Remote Monitoring team will continue to develop the infrastructure, tools and methods for data transmission, data security, data integrity check and State of Health (SoH) monitoring. The number of systems connected remotely is expected to increase 10-15% per year, new system types will be connected, and new methods of transfer will be implemented.

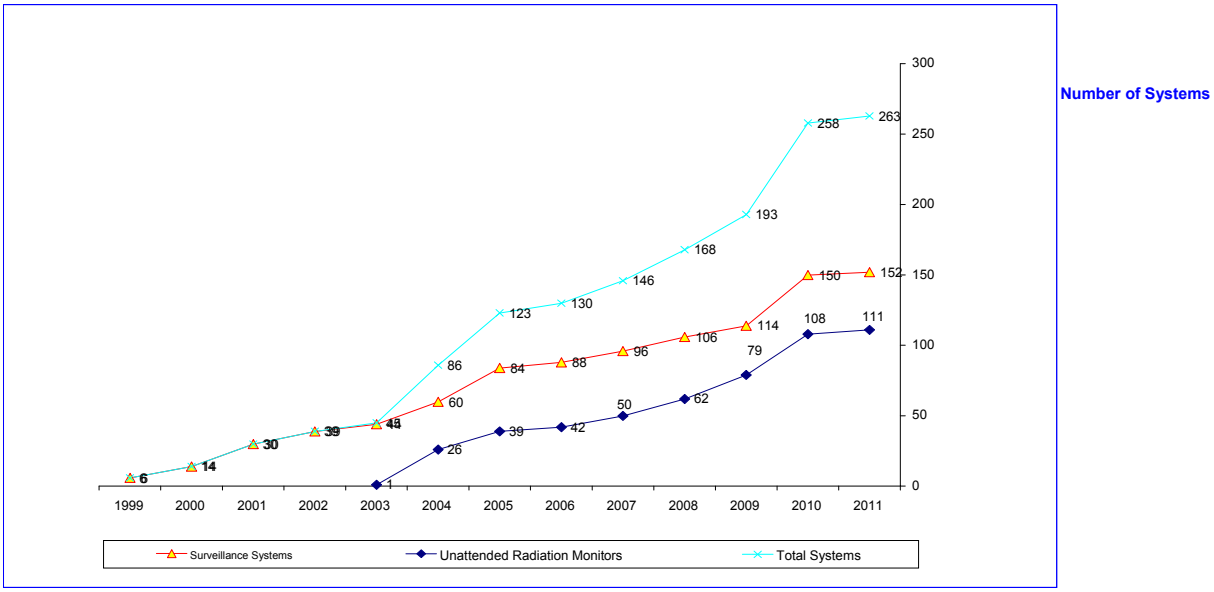



Figure 1: Remote Monitoring Systems, 1999-2011.

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

The end users who will benefit from these D&IS activities are all the Operations Divisions performing safeguards verification activities and SGTS technicians who are responsible for specific equipment connected in the field.

Recent RM achievements include: the establishment of the Safeguards RM Satellite Network covering all of Europe and central Asia (with full global expansion possible); upgrades of slower less reliable dial-up connections with broadband, including the use of wireless Wi-Fi, GSM, and 3G services with standard Virtual Private Network (VPN) security; establishment of a secure link with ABACC for data sharing; installation of an area review office in Wolsong, Republic of Korea; contributions to NGSS security; the implementation of EOSS seals in RM-mode; and numerous improvements to SoH processing of all remote systems. Along with these accomplishments come challenges: continuing communication upgrades, improving network monitoring, extending shared systems with EURATOM & ABACC, and implementing more advanced software projects. Of course, expansion of any new RM technology depends on the Member States acceptance of RM as a whole.

Figure 2: RM Satellite Network antenna on A-Tower IAEA, Vienna.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term direction for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023.

As a first step, the long-term direction of the current D&IS project was defined:

***Expand and upgrade RM software and hardware infrastructure to include new equipment, near real-time data processing, and advanced inspector communications world-wide.***

In order to support the long-term direction, activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Develop and implement improved technologies for network monitoring of the RM infrastructure.*

   Network monitoring is the use of a system that constantly monitors a computer network for slow or failing components and that notifies the network administrator (via email, pager or other alarms). Current technology must be upgraded to a State of the Art network monitoring system capable of detecting outages with more accuracy and recording such events to ensure service level agreements with providers.

2. *Develop advanced communications for future inspector needs.*

   The Remote Monitoring team has developed data communication solutions around the world. In the future, it should test & implement custom communications for inspectors based on new approaches, e.g. Complementary Access (CA).

3. *Ensure data security and integrity through entire RM process.*

   This objective includes periodic security analysis of RM infrastructure. This would include vulnerability assessments (VA) or solutions based on security consultant recommendations. This work would be done in conjunction with the project *SGIS-02 Information Security*.

4. *Obtain specific Member State trust in RM security and promote the use of RM.*

   One of the biggest obstacles to RM in certain geographic areas, is the lack of trust by the facility or Member State for the transmission of data off-site. Although there are currently 22 countries that allow RM transfer (some for over ten years), there are still a few that only allow data to be hand-carried off-site, which in fact is less secure than RM.

5. *Develop enhanced software tools, especially for data acquisition, storage and post-transfer analysis.*

   The RM project has been enlarged this biennium to include the area of data acquisition, storage and processing. This is intended to expand the software responsibilities of the RM project, not only for actual application development, but as a focal point to software development in SGTS.

## 4. Activities

Many of the activities will be performed by Safeguards Department personnel. Assistance will be required from Member State Support Programmes mainly for Key Objectives 1, 3 and 4.

*Key Objective 1. Develop and implement improved technologies for network monitoring of the RM infrastructure.*

- Upgrade the network monitoring system to a State of the Art network monitoring system capable of detecting outages with more accuracy and recording such events to ensure service level agreements with providers. This includes intrusion detection capabilities with traffic measurement and optimization.
- Develop a more comprehensive evaluation of all RM system logs (ex syslogs). This includes computer system management and security auditing as well as generalized informational, analysis, and debugging messages.
- Pursue the concept of near real-time transfer of RM data.
- Implementation of Virtual Private Networking for Remote Monitoring at Wolsong Facilities (Task ROK E 1529) is continuing because of further expansion of the facility.

To initiate some or all of the above concepts into the RM infrastructure, the *New Task Proposal #1* will be submitted to the MSSPs in 2012 (activity to be completed by 2013).

In addition, development of remote monitoring and data processing systems contributing to project *SGTS-15 Technologies for New IAEA Verification Mandates* will be managed under the current SGTS-14 project and performed by the TSI/RM team, in close coordination with SGTS-15 project which will provide system analysis, define specific requirements and integrate results. These activities are further described within the SGTS-15 project plan.

*Key Objective 2. Develop advanced communications for future inspector needs.*

- Complementary Access (CA) and other more non-traditional Safeguards approaches will become more common in the next biennium. The RM team will support these activities with more flexible communication solutions. For example, handheld devices at the facility with wireless VPN connections back to Vienna, capable of immediate measurement upload or download of needed data (ex. imagery data). Further, inspectors could also use such handheld to pull data directly from SG equipment at facilities via wireless technologies for instant review.

  In-house work has begun on these ideas (*Activity #1*), in coordination with project *SGIS-02 Information Security*. VPN tunnels have been established using the current handheld device. Plans have been made to connect future devices with operating systems that have a larger market share. Support from Member States is yet to be determined (to be completed in 2013).

*Key Objective 3. Ensure data security and integrity through entire RM process.*

- The activities under this objective will focus on the implementation of recommendations from security analysis of RM infrastructure by outside consultants (Task USA E 1735 completed in 2010), vulnerability assessments (VA) made on critical new field components, and product enhancements (including software upgrades) to extend system life security. VAs need to be independently performed on a regular basis (every 1-2 years). Support Programme assistance is expected with these tasks (*New Task Proposal #2*).

*Key Objective 4. Obtain specific Member State trust in RM security and promote the use of RM.*

Assistance has been requested from Support Programmes to sponsor activities (ex. pilot tests or VAs) to demonstrate the security and benefits of RM:

- The following tasks BRZ E 1875 and GER E 1859 were both started in 2010 and are continuing to make progress towards the goal of Member State confidence through the recommendation of approved security hardware and/or pilot tests. 09/TSR-006 was temporarily postponed by the Argentinean support program.

*Key Objective 5 Develop enhanced software tools, especially for data acquisition, storage and post-transfer analysis.*

Activities under this Key Objective can include many areas of work:

- Write requirements for data design of new equipment,
- Hands-on development, testing & approval of software security techniques for data from new equipment in development,
- Work with manufacturers to develop close to real-time SoH information processing on their specific hardware,
- Integrate UNAP and any newly developed instruments into the RM infrastructure, and
- Identify the appropriate path of development for an integrated data acquisition, storage and "All in One" review application.

These activities will be initiated by Safeguards Department personnel (*Activity #2*), in coordination with Safeguards Divisions and projects SGTS-02, SGTS-03, SGTS-11 and SGTS-13. Support from the MSSP may be requested. (*New Task Proposal #3*, to be determined).

### Key achievement targets

- Upgrade the current network monitoring system for RM to include the capability to detect critical outages due to provider failures and to quantify these outages for service level agreements (Key Objective 1): December 2013.
- Develop advanced communications for future inspector needs, which includes VPN clients for mobile handheld devices and wireless access to SGTS equipment during inspections (Key Objective 2): December 2013.
- Perform Vulnerability Assessment of the RM infrastructure and implement recommendations to assure long-term network security (Key Objective 3): December 2012.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### 5.1. *Current Active and Stand-by Member State Support Programme Tasks*

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| BRZ | E 1875 | Testing & Acceptance of Remote Monitoring Network Security for Facility Implementation | Continuing (desired completion date: 2012) |
| GER | E 1859 | | Continuing (desired completion date: 2012) |
| ROK | E 1529 | Implementation of Virtual Private Networking for Remote Monitoring at Wolsong Facilities | Continuing because of expansion into newly built units |

### 5.2. *Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| 09/TSR-006 | Testing & Acceptance of Remote Monitoring Network Security for Facility Implementation | Outstanding with ARG (2009) |
| New Task Proposal #1 | Assistance in Network Monitoring solutions for RM infrastructure | To be submitted in 2012 |
| New Task Proposal #2 | Assistance in security and vulnerability assessment on RM infrastructure | To be submitted in 2012 |

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| New Task Proposal #3 | Assistance in development of enhanced software tools | To be determined |

*5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

| Activity No. | Activity Title |
|---|---|
| Activity #1 | Develop more flexible communication tools to support CA |
| Activity #2 | Development of enhanced software tools |

# SGTS-15

## Technologies for New IAEA Verification Mandates

**Project Manager: Kenneth Baird** **Division: SGTS**

### 1. Introduction

This document describes the plans for developing and implementing technical tools within the Department of Safeguards needed for IAEA readiness to contribute to verification of disarmament initiatives for the period 2012–2013. It has been produced in accordance with the Departmental Long-Term Strategic Plan, 2012–2023, the IAEA Medium-Term Strategy, 2012–2017[1], and the Long-Term R&D Plan, 2012–2023[2].

This project supports in particular *Strategy 4 – Taking on new mandates* of the Long-Term Strategic Plan, 2012–2023.

### 2. Overview

This project is being initiated to develop the technical tools needed for future foreseen verification mandates that the IAEA will eventually implement. In particular, in accordance with the formal request received from the authorities of USA and the Russian Federation, during the biennium 2010-2011, the Department of Safeguards actively participated in the elaboration of the Russia-US-IAEA agreement defining verification measures to be performed by the IAEA under the U.S.-Russia Plutonium Management and Disposition Agreement (PMDA) ("Agreement between the Government of the United States of America, and the Government of the Russian Federation, concerning the Management and Disposition of Plutonium Designated as no longer required for Defense Purposes and Related Cooperation").

The current project focuses upon technical implementation, and is closely tied to the approaches being considered under the project *SGCP-03 Safeguards Approaches.* These verification activities, by their very nature, will have different objectives compared to existing safeguards agreements. Basic safeguards concepts such as "significant quantities", "timeliness", "diversion" may not be relevant. Other verification criteria may be applicable, such as maximum amounts of minor plutonium isotopes or, minimum burn up levels for disposition verification.

Initially, the project will focus on development and implementation needs relevant to the verification measures to be performed under the PMDA, but may expand over time to include technical aspects of other arrangements. The project outcome is expected to be systems and measurement techniques that are ready for implementation. Furthermore, the Division of Technical and Scientific Services will participate together with Divisions of Operations and the Division of Concepts and Planning in their efforts towards developing Subsidiary Arrangements and verification approaches.

This project is consistent with Strategy 4 of the Departmental Long-Term Strategic Plan, 2012–2023; specifically the goal of maintaining IAEA readiness to contribute to the verification of dismantled nuclear weapons programs. It is also consistent with Objective E of the IAEA Medium-Term Strategy 2012–2017; specifically the goal of strengthening the effectiveness and improving the efficiency of the Agency's safeguards and other verification activities.

The first planned implementation for the tools developed in this project will be in 2016, consistent with the PMDA timeframe. Thus within the next two biennium cycles the technical tools needed will have to move from a development phase into an implementation phase where systems or measurement techniques are ready

[1] GOV/2010/66 dated 26 November 2010.

[2] STR-370.

for robust deployment. For the 2012-2013 biennium, most of the key objectives listed below cannot be fully achieved. However, all anticipated investigations/developments must be initiated in the current biennium in order to meet the final implementation deadline.

## 3. Long-Term Direction(s) and Key Objectives

The objective of this document is to define and describe the D&IS project activities planned for implementation during the 2012–2013 biennium, in order to achieve the long-term directions for R&D in supporting the implementation of the Departmental strategies. The structural elements of this project plan are derived from the Long-Tem R&D Plan, 2012–2023.

As a first step, the long-term direction of the current D&IS project was defined:

***Make ready for implementation instruments and measurement techniques needed to support new IAEA verification mandates.***

In order to support this long-term direction, the activities listed below will focus on the immediate need of supporting the implementation of the PMDA by establishing readiness of appropriate technologies to fulfil the PMDA requirements. Those activities have to be initiated, continued or finalized during the biennium and can be structured under the following key objectives:

1. *Identify and develop technologies capable of maintaining Continuity of Knowledge (CoK) of "Designated plutonium" (i.e. Plutonium designated for disposal) as it passes through the lifecycle.*

2. *Develop and validate NDA tools supporting the verification of "Designated plutonium" and "Designated fuel" in particular with regards to PMDA requirement on accounting of minor plutonium isotopes.*

3. *Develop and validate power monitoring techniques applicable to fast neutron and light water reactors.*

4. *Develop and implement a methodology to validate core calculations relevant to the burn up verification.*

5. *Explore "substitution pathways" that are relevant to the PMDA.*

6. *Establish appropriate reporting tools to manage state declarations and inspection results that would meet requirements of verifications associated with disarmament initiatives in general and PMDA in particular.*

## 4. Activities

Funding for most of the described D&IS activities is foreseen to be provided by Member States Support Programmes (MSSPs) and other sources of extra budgetary funds.

*Key Objective 1. Identify and develop technologies capable of maintaining CoK of "Designated plutonium" as it passes through the lifecycle.*

- Develop Measurement, Monitoring, Containment and Surveillance Systems that are extremely robust (e.g. through the use of high-redundant components) and thus require infrequent planned maintenance and data-retrieval activities (perhaps only once/year). Technologies will specifically address the identified lifecycle stages:

- From "Designated plutonium" (Pu in powder form) to "Designated Fuel" (Fuel Assemblies) at fuel fabrication facilities.
- From "Designated Fuel" as it passes from fuel fabrication facilities to reactors.
- From "Designated Fuel" at the reactors as it is stored and 'burned' to agreed-upon levels, and
- From "Spent Designated Fuel" as it is removed from nuclear reactors and is placed into storage conditions for some agreed-upon periods.

- Explore techniques for the restoration of CoK in case of necessity.

  These issues will be addressed jointly with the projects *SGTS-02 Improved Techniques and Instruments for Sealing and Containment Verification, SGTS-03 Surveillance Techniques, SGTS-11 Unattended Measurement Techniques* and *SGTS-14 Remote Monitoring and Data Processing Systems.* These activities are currently being addressed internally, but task proposals may be submitted in the future.

*Key Objective 2. Develop and validate NDA tools supporting the verification of "Designated plutonium" and "Designated fuel" in particular with regards to PMDA requirement on accounting of minor plutonium isotopes.*

- Accounting for "Designated Pu" as it is turned into MOX fresh fuel, and accurate monitoring of the Pu-238 and Pu-240 accrual in the "Designated Pu" and "Designated Fuel". This issue will be addressed under the projects *SGTS-01 NDA Techniques* and *SGTS-11 Unattended Monitoring Techniques*. This activity is currently being addressed internally, but task proposals may be submitted in the future.

*Key Objective 3. Develop and validate power monitoring techniques applicable to fast neutron and light water power reactors.*

- The validation of reactor power monitoring techniques for implementation in large Fast Neutron Reactors (FNRs) and Pressurized light water reactor (PWRs). This issue will be addressed jointly with the D&IS project *SGTS-11 Unattended Monitoring Techniques*. This activity is currently being addressed internally, but task proposals may be submitted in the future.

*Key Objective 4. Develop and implement a methodology to validate core calculations relevant to the burn up verification.*

- Identify reactor core simulation packages suitable for burn up calculations on fast neutron reactors and on light water reactors. This will be accomplished through engaging with MSSPs to get code packages and benchmarking calculation (*New Task Proposal #1*). Internally to the IAEA the Department of Nuclear Energy will be solicited to provide support and advice. This issue will be addressed jointly with the project *SGTS-01 NDA Techniques.*
- Explore feasibility and develop measurement techniques suitable for burn up verification measurement in support of the validation effort of the calculated burn ups and consistently with PMDA provisions. This issue will be addressed jointly with the project *SGTS-01 NDA Techniques.* This activity is currently being addressed internally, but task proposals may be submitted in the future.

*Key Objective 5. Explore "substitution pathways" that are relevant to the PMDA.*

- Analyse possible pathways such as substitution of designated plutonium, designated fuel and designated spent fuel resulting into non conformity to the PMDA and propose relevant defence in depth measures. This issue will be addressed jointly with the project SGCP-03 Safeguards Approaches (Key Objective 6) and relevant Divisions of Operations. This activity is currently being addressed internally.

*Key Objective 6. Establish appropriate reporting tools to manage State declarations and inspection results that would meet requirements of verifications associated with disarmament initiatives in general and PMDA in particular.*

- Review applicability of existing reporting tools and assess the necessity for modification/replacement to adapt to disarmament verification activities in general and PMDA in particular. This issue will be addressed jointly with the project *SGCP-03 Safeguards Approaches* (Key Objective 6) and relevant Divisions of Operations. This activity is currently being addressed internally.

### Key achievement targets

- Validate the feasibility of the Pu minor isotopes measurement methods (Key Objective 2): December 2012.
- Validate the burn-up calculation method supporting the PMDA burn up criteria verification (Key Objective 4): March 2013.
- Identify and characterize possible substitution pathways relevant to the PMDA (Key Objective 5): December 2012.

## 5. Summary of Active and Proposed Member State Support Programme Tasks

### *5.1. Current Active and Stand-by Member State Support Programme Tasks*

None: this is a new D&IS project.

### *5.2. Proposed and Planned Member State Support Programme Tasks*

| Task Proposal ID. | Task Title | Comments |
|---|---|---|
| New Task Proposal #1 | Assistance on the use and provision of Core simulation packages | To be submitted to MSSPs in 2012 |

### *5.3. Current Active and Planned D&IS Activities Supported through Regular Budget*

None: Internal activities related to PMDA will be carried out under extra budgetary resources.

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