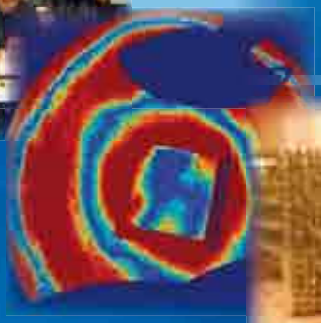
# Research and Development Programme for Nuclear Verification 2008–2009



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# Foreword

As part of its Quality Management System, the Agency continuously enhances the effectiveness and efficiency of the safeguards system. However, the nuclear non-proliferation regime continues to face a broad set of challenges. It is essential that safeguards continue to be able to respond to these challenges in an effective and timely manner in order to assure ourselves and our Member States and the international community that the Agency, as the international nuclear verification organization, is 'staying ahead of the game'.

The Research and Development (R&D) Programme for Nuclear Verification has been and remains pivotal in this regard. Of particular importance in our current environment are: the ability to keep abreast of state-of-the-art technology; maintaining and enhancing capabilities in information acquisition, analysis and evaluation; and ensuring that our staff are well trained. With the global reach of our responsibilities, and the continuous need to sift through vast amounts of information, we need to be sure that we prioritize our limited resources to the best advantage.

The Agency has reflected anticipated challenges in its R&D Programme for 2008–2009. It was developed using the expertise of the entire Department and reflects the Departmental strategy to maintain and further develop an effective and efficient verification system in order to maintain the Agency's ability to draw independent, impartial and timely safeguards conclusions. The current mechanisms for managing the Member State Support Programmes, including through the preparation and implementation of the R&D Programme, are more efficient than ever and allow the Agency to concentrate resources on its most important needs.

In its 2007 resolution on strengthening the effectiveness and improving the efficiency of the safeguards system, the General Conference called "on all Member States to give their full and continuing support to the Agency in order to ensure that the Agency is able to meet its safeguards responsibilities" and requested that "Member States cooperate among themselves to provide appropriate assistance to facilitate exchange of equipment, material and scientific and technological information for the implementation of additional protocols." The Agency remains dependent on Member States and the technology holders to continue to provide technology and expertise that could not otherwise be obtained. Increased cooperation of Members States is critical to achieving the goals of the R&D Programme, particularly in relation to access to novel technologies, analytical capabilities, as well as acquisition and analysis on trade in sensitive nuclear technology, in order to enable the Agency to effectively respond to emerging challenges.

As a platform for cooperation, the R&D Programme expresses clearly and transparently the needs of the Agency for the coming biennium, thus allowing Member States to respond appropriately. I look forward to the continued support of all concerned in achieving these important objectives and milestones.

Olli J. Heinonen
Deputy Director General
Head of the Department of Safeguards

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# Introduction to the R&D Programme 2008–2009

The purpose of the Biennial Research and Development Programme is to assist the Agency meet its near term challenges and improve the practice of implementing its verification activities in a manner which is relevant, credible, efficient, and encourages innovation and excellence.

The R&D Programme aims to improve and sustain the practice and methods utilized by the Agency, rather than pursue advancement in the basic scientific information that might serve as a foundation for part of a specific project. This application based programme builds upon the basic scientific information and discoveries made available to the Department from its Member States. In response to external developments, input from Member States and all its stakeholders, the Agency has prepared its R&D Programme for the biennial period 2008–2009 to refine its strategic focus areas and better situate priority activities in the context of the Department's total work portfolio. Consistent with its original intent, the R&D Programme will remain a working document that the Agency will use to solicit the transfer of technology, funds and expertise that are provided through the Member State Support Programmes (MSSPs).

In compiling the document the Agency has worked over a five month period to identify, review and coordinate the management of all of its near term R&D activities. The resources required to implement the R&D Programme come from the Agency 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 Support Programme mechanism. A major objective of the document is to allow MSSPs to plan their voluntary contributions to the programme.

The R&D Programme addresses both research, development and implementation activities. The Department's research is exploratory work that is carried out in an area to better understand the implications for safeguards applications. Development uses the information produced by the research phase either through internal or external efforts and carries it forward so it can be used by the Department of Safeguards, including those in the Operations and Support Divisions that prepare safeguards approaches, support the State Evaluation process and implement the myriad of safeguards verification activities. Implementation activities address the operational needs of the Department that require the expertise available from MSSPs including the support offered to sustain equipment through manufacturer's support and to the Department's Training and Quality Management programmes. All safeguards research, development and implementation activities funded by MSSPs and R&D from the Agency's regular budget are intended to be included in this programme. This programme helps to transparently share the scope and diversity of the Department's activities leading to an understanding of where assistance is needed. It also serves as a tool to aid our stakeholders and decision makers plan the use of available resources.

The R&D Programme's research, development and implementation activities endeavour to realize:

1. Continuous Improvement - those efforts addressing improvements to the efficiency and effectiveness of the Department's processes, equipment/systems (e.g. IT), tools, concepts and analytical work. The Department's Quality Management Programme is included as it serves as a formal mechanism to drive improvement.

2. Sustainability and Technology Extension – efforts are focused to sustain core capabilities and technologies. They include the development, modification or replacement of obsolete equipment, systems and technologies. Training programme implementation is included to sustain equipment and advance the knowledge, skills and abilities of the Department's staff. Manufacturer's support of existing equipment systems is included if funded by MSSPs.

3. New Capabilities – the programme seeks to champion research, studies and demonstrations to address emerging new needs. Efforts include the evaluation of Member State technology proposals that address safeguards applications and explore the practical applications of new, novel technologies and analytical capabilities. The programme's goal here is to strive to advance the State of the Art in nuclear

safeguards technologies.

The R&D programme planning process has addressed measures that are intended to achieve a vision for the respective project area needs while being mindful that the efforts are specific, quantifiable and achievable. Information on projects that are proposed, underway and an inventory of project concepts that have not yet been exploited is included. All these projects have been considered in terms of goals and key activities expressed in the Department of Safeguards Strategic Objectives for 2006–2011, to further "strengthen the effectiveness and improve the efficiency of the safeguards system." The R&D Programme is structured in a manner to express the needs of the Agency for the coming biennium and transparently, thus allowing Member States to respond appropriately.

The programme has been produced and will be managed using the Department's existing project management procedures (described below) with project managers appointed to manage the projects through the individual project plans that are described in the main body of this document.

### R&D Programme Development and Approval

The R&D Programme for 2008–2009 contains 23 projects. These are found on the List of R&D Projects and Project Managers. Each project has been described by the respective project manager in a project plan reflecting the Department's objectives and operational requirements. Projects and their managers are appointed by the respective Division Director. These project plans have been approved by the respective Division Director and Department-wide committees: the Equipment Coordination Committee (ECC), the Information Processing and Technology Committee (IPTC), the Research and Development Committee (RDC), the Analytical Services Committee (ASC), the Quality Managers' Meeting (QMM) as well as the Management Coordination Committee (MCM). The approved project plans were then made available to the Standing Advisory Group on Safeguards Implementation (SAGSI).

Once approved by the Department, the plans were compiled by the Department's Support Programmes Coordination Unit (SPC) into the R&D Programme.

### Programme and Project Management

The execution of the programme is performed through a number of activities planned in the 23 R&D project plans compiled in this document. Each project is assigned a project manager responsible through their line management to implement the project on behalf of the Department. For activities involving MSSPs the work is performed through a number of tasks managed by Agency task officers with assistance from the respective MSSP technical point of contact.

The projects cover all areas requiring research and development activities. They also describe the implementation activities that require support from MSSPs. Of the 23 projects nine are managed by the Division of Technical Support, three by the Division of Concepts and Planning, seven by the Division of Information Management, two by the Division of Operations A, one by Operations B and one by the Division of Operations C.

### Project Structure

Each project is described in terms of:

- background information in order to place the project in overall context within the Department of Safeguards
- objectives
- activities (including MSSP tasks) related to each objective
- active MSSP tasks

- proposed new MSSP tasks
- if applicable, current and proposed activities supported by the regular budget

The 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 writing the project plans. Up to date information can be found in the Support Programmes Information and Communication System (SPRICS).

### Significant Changes for 2008–2009

The distributions of responsibilities, and therefore certain projects, have been aligned with the new organizational structure established in the Department of Safeguards in 2007. This fine-tuning of the Department's structure was implemented to optimize the use of resources and to support the Department's strategic objectives in the new environment of fusing traditional safeguards and new measures inherent to strengthened and integrated safeguards. New project designations and their associations with a responsible Division and Approving Committee can be reviewed on the list of R&D Projects and Project Managers.

New challenges for the Department of Safeguards have resulted in the establishment of three new R&D projects that represent new areas of R&D.

- SGTS-12 Techniques and Equipment for Safeguards at Gas Centrifuge Enrichment Plants,
- SGTS-13 Universal NDA Data Acquisition Platform (UNAP)
- SGOB-01 R&D for Safeguarding Pebble Bed Reactors and Supporting Facilities

A review by the SGIM management team concluded that former projects focused on IT Infrastructure (SGIM-05) and the Agency's Safeguards Information System (SGIM-01) would best be served if merged together under renamed project SGIM-01, Integrated Safeguards Environment.

A review by the SGCP management team concluded that former project SGCP-01, Integrated Safeguards and its current and planned activities are now best managed within project SGCP-03, Safeguards Approaches.

### Reporting and Review

Biennially, project managers submit reports on their projects to the appropriate Departmental committees. Once approved, these reports are compiled by SPC and sent to MSSPs. Also, as is customary, task officers continue to submit task status reports to MSSPs at the review meetings. Application Reports are submitted to the respective Support Programme when a task is completed to summarize the task objectives and highlight the impact the activity had on Agency safeguards.

### The Future

The Department of Safeguards continues to rely on the resources of MSSPs to provide the necessary technology, funds and expertise.

With respect to the management of the R&D Programme the Department intends to continue its systematic review of procedures. In the past the Department has improved the task approval process, the planning process, project management and the task application reports.

Currently, the Agency is conducting a detailed assessment of the nature and scope of the Agency's needs over the coming decade or so, together with the resources required to deliver it. This assessment referred to as 20/20 will assist the Agency plan and prepare for its future challenges. In conjunction with the 20/20 vision, the Department of Safeguards is developing a new methodology to facilitate long-term strategic planning

to ensure its programme and R&D activities are able to anticipate and address the verification challenges developing as a result of evolving new safeguards challenges. This initiative will result in a 'long-term' research and development plan that will serve to guide the implementation of the short-term (biennial) Research and Development Programmes.

The Department has taken steps towards further improvement of the management of R&D activities. The new web-based collaboration and document management system, SPRICS 2.0, soon to be implemented in 2008, will be capable of holding all Support Programme data and will provide new opportunities for collaboration between all parties involved in executing the Department's R&D Programme. The system will:

- Enhance communication among all parties involved in R&D activities by providing them with direct access to all information.
- Place all information related to R&D tasks and projects in one place.
- Facilitate managing the projects and tasks including planning and reporting.
- Speed up the whole process from task initiation to its implementation through efficient information transmission and retrieval in an auditable manner.
- Improve accuracy of data and documents by reducing manual paperwork.
- Increase the transparency of R&D activities.
- Improve the efficiency of all parties involved in R&D activities.

### Administration of Member State Support Programme Tasks

Included within the activities of each project are existing and proposed new MSSP tasks. These tasks will be administered through SPC and MSSP coordinators. The administration is achieved by correspondence, formal task proposals, task outlines and reports on the use of task results.

The appointed MSSP coordinator is the Agency's main point of contact with the Member State concerning R&D projects. The SPC Unit, working with the MSSP coordinators, holds annual and semi-annual meetings with individual Member States 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.

### Member State Support Programmes

A list of all Member State Support Programmes is shown on the following page.

## 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 2008–2009 R&D Projects and Project Managers

| Project ID | Project Title | Project Manager | Responsible Division | Approving Committee | P&B 2008–2009 |
|---|---|---|---|---|---|
| SGCP-03 | Safeguards Approaches | Akos Petoe | SGCP/CCA | RDC | 4.1.2.4 |
| SGCP-101 | Quality Management | John Patten | SGCP/CPD | QMM | 4.1.2.5 |
| SGCP-102 | Training | Haroldo Barroso | SGCP/CTR | MCM | 4.1.2.7 |
| SGTS-01 | NDA Techniques | Roland Carchon | SGTS/TAU | ECC | 4.1.2.1 |
| SGTS-02 | Improved Techniques and Instruments for Sealing and Containment Verification | George Weeks | SGTS/TSR | ECC | 4.1.2.1 |
| SGTS-03 | Next Generation Surveillance Systems | Martin Moeslinger | SGTS/TSR | ECC | 4.1.2.1 |
| SGTS-06 | Destructive Analysis of Nuclear Materials for Safeguards | Roger Lafolie | SGTS/TTS | ASC | 4.1.1.9 |
| SGTS-07 | Improved Techniques and Instruments for Spent Fuel Verification and Monitoring | Alain Lebrun | SGTS/TAU | ECC | 4.1.2.1 |
| SGTS-08 | Novel Techniques and Instruments for Detection of Undeclared Nuclear Facilities, Material and Activities | Julian Whichello | SGTS/TTS | ECC | 4.1.2.15 |
| SGTS-11 | Unattended and Remote Monitoring Systems | Cesare Liguori | SGTS/TAU | ECC | 4.1.2.1 |
| SGTS-12 | Techniques and Equipment for Safeguards at Gas Centrifuge Enrichment Plants | Alain Lebrun | SGTS/TAU | ECC | 4.1.2.1 |
| SGTS-13 | Universal NDA Data Acquisition Platform (UNAP) | Mark Pickrell | SGTS/TAU | ECC | 4.1.2.1 |
| SGIM-01 | Integrated Safeguards Environment | Remzi Kirkgoeze | SGIM/IAP | IPTC | 4.1.2.13 |
| SGIM-02 | Commercial Satellite Imagery | Karen Steinmaus | SGIM/ICA | IPTC | 4.1.2.12 |
| SGIM-03 | Information from Open Sources | John Lepingwell | SGIM/ICA | IPTC | 4.1.2.12 |
| SGIM-06 | Enhanced Information Analysis Architecture | John Hilliard | SGIM/IAP | IPTC | 4.1.2.12 |
| SGIM-07 | Environmental Sampling for Safeguards | William Fuhr | SGIM/IDS | ASC | 4.1.2.6 |
| SGIM-08 | R&D for Statistical Analysis | Manuel Marinas de Miguel | SGIM/IDS | IPTC | 4.1.2.6 |
| SGIM-09 | Understanding Nuclear Trade Mechanisms | Matti Tarvainen | SGIM/ICA | IPTC | 4.1.2.16 |
| SGOA-01 | Safeguards System for Rokkasho Reprocessing Plant (RRP) | Christophe Creusot | SGOA/OA2 | ECC | 4.1.1.2 |
| SGOA-02 | Safeguards System for JNFL MOX Fuel Fabrication Plant (J-MOX) | Christophe Creusot | SGOA/OA2 | ECC | 4.1.2.9 |
| SGOB-01 | R & D for Safeguarding Pebble Bed Reactors and Supporting Facilities | Glen Horton | SGOB/OB2 | ECC | 4.1.1.2 |
| SGOC-01 | Chernobyl | Goeran Af Ekenstam | SGOC/OC2 | ECC | 4.1.2.10 |

ASC Analytical Services Committee
ECC Equipment Coordination Committee
IPTC Information Processing and Technology Committee
QMM Quality Managers' Meeting
RDC Research and Development Committee
MCM Management Coordination Committee

# Projects

# SGCP-03

## Safeguards Approaches

### Project Manager: Akos Petoe

### Division: SGCP

### 1. Background

This document describes the 2008–2009 plans within the Department of Safeguards for improving existing safeguards approaches and for developing safeguards approaches, including integrated safeguards approaches, for new facility types and facilities undergoing decommissioning. The project will particularly address issues relevant to facilities handling un-irradiated direct use nuclear material, uranium enrichment facilities and R&D installations, spent fuel conditioning facilities and geological repositories. Work is planned to address the proliferation resistance of fuel cycles and advanced facilities. This two-year plan will contribute to improving Departmental knowledge and ability to implement effective and efficient safeguards to facilities, which will be operated in the coming decade or even beyond.

▲ Decommissioning Activities

The SGCP-03 project plan incorporates activities that were included previously under R&D Project SGCP-01, Integrated Safeguards. The Integrated Safeguards R&D Project was initiated in 1998 to provide support to the Department in the development of the conceptual framework for integrated safeguards. The conceptual framework was completed in 2001 and reported to the Board of Governors in March 2002 (GOV/2002/8). Work has continued on the further development of elements of the conceptual framework in the light of experience gained in implementation, further evaluation and available technology. Valuable contributions to the development and testing of integrated safeguards concepts, guidelines and approaches have been provided by Member States throughout this time period under the SGCP-01 R&D Project.

The incorporation of the Integrated Safeguards Project within the broader Safeguards Approaches Project reflects the completion of the conceptual work for integrated safeguards and a transition to routine implementation. As of mid-2007, more than 80 States have additional protocols in force, more than 20 State level integrated safeguards approaches have been developed and approved and integrated safeguards are being implemented in 17 States. These numbers are expected to increase rapidly over the 2008–2009 planning period. While elements of the conceptual framework will continue to evolve, further development and refinement of specific integrated safeguards guidelines and approaches can be accommodated under the SGCP-03 R&D Project.

The current project plan has been prepared consistent with the Department of Safeguards Strategic Objectives for 2006–2011. Most project activities will be performed by Agency staff members. Substantial assistance is needed from Member State Support Programmes through their involvement in tasks relevant to the project.

### 2. Objectives

The objectives of this project are principally derived from the following goals and related key activities of the Department of Safeguards Strategic Objectives 2006–2011:

- Enhance detection capabilities through the development of new or improved safeguards approaches and techniques:
    - Develop, implement and revise, as appropriate, safeguards approaches for new safeguards situations (e.g. integrated safeguards), facility types and operating conditions, taking into account

experiences, conceptual and technological developments and on-going needs for effectiveness and cost

- Implement safeguards in an effective and efficient manner in States with safeguards agreements in force, including those with additional protocols:

    - Intensify cooperation between the Agency and Member States to strengthen arrangements for safeguards implementation, including support the development/improvement of State Systems of Accounting for and Control of Nuclear Material (SSACs) capabilities where appropriate and other relevant infrastructure with the view of ensuring more efficient and effective safeguards.

***The aim of this project is to continuously optimize the effectiveness of safeguards implementation through the refinement of existing safeguards and integrated safeguards approaches, and to develop new approaches as required for new facility types and facilities undergoing decommissioning.***

The specific objectives are:

*Revise and develop the technical background of safeguards applications with a focus on integrated safeguards including:*

*2.1. Revise the Physical Model*

The Physical Model is a set of 12 volumes that serve as a technical resource for Agency personnel involved in safeguards activities. The implementation of strengthened safeguards and a State level approach requires enhanced analysis of technical issues relating to nuclear facilities and processes. That has led to recognition of the need to improve and expand on the original versions of the Physical Model volumes.

*2.2. Improve the proliferation resistance of facilities and fuel cycles*

The Agency "International Project on Innovative Nuclear Reactors and Fuel Cycles" (INPRO) was established under DDG-NE in response to the invitation of the 44th General Conference for "all interested States to combine their efforts under the aegis of the Agency in considering the issues of the nuclear fuel cycle, in particular by examining innovative and proliferation-resistant nuclear technology". The Department of Safeguards provides the expertise and guidance for developing a Proliferation Resistance Assessment Methodology for Innovative Nuclear Fuel Cycles, for developing guidelines for the application of the methodology, and assisting in testing the methodology to evaluate reactor/fuel cycle proposals.

The U.S. Department of Energy's Office of Nuclear Energy, Science and Technology has engaged governments, industry, and the research community worldwide in a wide ranging discussion on the development of next generation nuclear energy systems known as "Generation IV". The Technology Goals for Generation IV nuclear energy systems highlight proliferation resistance and physical protection as one of the goal areas along with sustainability, safety and reliability, and economics. The Department of Safeguards is participating in the Proliferation Resistance and Physical Protection Working Group established by the Generation IV International Forum (GIF), with the aim to develop an implementation guide for the application of the proliferation resistance assessment methodology developed in the framework of GEN IV and to implement case studies to test the methodology.

*Develop and test safeguards and integrated safeguards approaches for certain facility types including:*

*2.3. Storage facilities with un-irradiated direct use material*

Model integrated safeguards approaches have been approved and are in use for the most common types of facilities, such as light-water reactors, on-load reactors, research reactors and low-enriched uranium (LEU) fuel fabrication plants. For other facility types, integrated safeguards approaches need to be developed, tested and approved. In the period 2008–2009, priority will be given to the storage facilities with un-irradiated direct-use materials.

*2.4. Enrichment facilities*

The Agency has developed an improved model safeguards approach for gas centrifuge enrichment plants (GCEPs) which was approved for implementation in 2006. One implementation option of the approach (unannounced interim inspections in conjunction with the provision of process information to the Agency through a 'mailbox' system) was field tested successfully at a large commercial GCEP in 2007. The next priority will be the development of a model integrated safeguards approach for GCEPs. In addition, facility-specific approaches will need to be developed and implemented based on the models as appropriate. Elements of the approach, including equipment components developed under SGTS-012, may require further field testing.

*2.5. Enrichment R&D installations*

A number of countries are conducting research and development on isotope separation techniques applicable to uranium enrichment, including gas centrifuge, laser-based, aerodynamic and chemical techniques. According to Departmental guidelines (detailed in Annex 2 of SMI 3.1), any installation that performs R&D activities related to isotopic separation techniques and is capable of performing the function of an isotope separation plant, is to be treated as a facility regardless of the inventory or annual throughput of nuclear material. Advice is needed on the minimum separation capacity for an installation to perform "the function of an isotope separation plant". Also, a methodology should be developed to estimate the separative capacity of R&D isotope separation installations for the various separation techniques under development. A catalogue (including description and possibly drawings and pictures) of R&D equipment which might be used for enrichment purposes would be useful to help the design information evaluation and verification of such facilities.

*2.6. Reprocessing plants*

Work is continuing on the approval of the integrated safeguards approach for the Rokkasho Reprocessing Plant (RRP). A major milestone in this project was achieved at the end of 2007 with the presentation of the entire approach in QMS format to the joint TRC and SISC for review.

Given the unique circumstances of large scale reprocessing, a generic model integrated safeguards approach for reprocessing plants is not necessary. There, however, remains scope for research with regard to the application of near real time material accountancy and process monitoring, and also enhancing our understanding of the small scale clandestine reprocessing that could be carried out by potential proliferators.

*2.7. Spent fuel conditioning and encapsulation facilities and geological repositories*

Development work on repository safeguards is currently concentrated on the repository that is now under construction at Olkiluoto, Finland. It is likely that the Finnish facility will be among the first geological repositories to come under Agency safeguards. Therefore the highest priority is given to developing a site-specific integrated safeguards approach for that facility. The geological baseline for safeguards purposes was established in 2004 prior to first disturbance of the site. To enable smooth implementation of effective and efficient safeguards, appropriate techniques have

to be identified, evaluated and integrated into the Agency's safeguards approaches well in advance. Based on the Olkiluoto experience, novel evaluation methods and safeguards technologies are to be developed.

*2.8. Pebble bed modular reactor*

A pebble bed modular reactor (PBMR) is being developed in South Africa. According to the current schedule, construction should start in 2009 and commissioning is expected in 2013. A generic safeguards approach for the PBMR was approved by DDG-SG in May 2005 as a basis for further investigation of relevant safeguards techniques. The next steps are to identify safeguards-relevant PBMR operational parameters, including data from facility instrumentation and to develop methods to detect safeguards significant facility modifications that may occur between design information re-verifications.

*2.9. Pyroprocessing facilities*

Due to the increased interest in pyroprocessing either for recycling activities or waste treatment in advanced fuel cycles, the Department needs to gather information on this particular technology to be prepared to develop and implement effective and efficient safeguards approaches when future need arises.

*2.10. Facilities undergoing decommissioning*

Many nuclear facilities are nearing the end of their life cycles and others are being taken off-line on account of economic or political considerations. The Department needs to devise suitable safeguards approaches for facilities in various stages of the decommissioning process. Also, methods to determine whether particular types of facilities have been effectively decommissioned and remain decommissioned need to be improved.

*Support the improvement of the efficiency and effectiveness of safeguards implementation including:*

*2.11. Provide support for the implementation of State level integrated safeguards approaches*

As the number of State level integrated safeguards approaches developed and approved is rapidly increasing and integrated safeguards are implemented in a significant number of States with substantial nuclear programmes, experience both in development and in implementation of the approaches quickly accumulates. This experience should be reviewed and analyzed and the results should be utilized in future development work to ensure that similar approaches be developed for countries with similar country-specific factors. The results of the analysis could also contribute to the future expansion and updating of the conceptual framework for integrated safeguards.

*2.12. Develop guidelines for the resolution of anomalies in the implementation of integrated safeguards*

In the Agency's safeguards terminology, an 'anomaly' is an unusual event that may indicate a diversion of nuclear material or misuse of material, equipment or facilities. Prior to integrated safeguards, the seriousness of an anomaly was judged in terms of its effect on the Agency's ability to draw a positive safeguards conclusion about the individual facility where the anomaly occurred. In the context of integrated safeguards, more emphasis is placed on drawing safeguards conclusions at the State level, and on considering the significance of the anomaly in terms of the general safeguards situation in the State. Conceptual development work is needed to firmly establish the relationship between anomalies at individual facilities and the overall safeguards conclusion for a State.

*2.13. Develop suitable approaches for monitoring and evaluating the effectiveness of safeguards implementation in States with integrated safeguards*

In order to facilitate the evaluation and comparison of the results for different States, a common set of three generic State level safeguards objectives, applicable to each State, have been defined as follows:

- To detect undeclared nuclear material and activities in the State as a whole;
- To detect undeclared production or processing of nuclear material at declared facilities; and,
- To detect diversion of declared nuclear material.

Although the generic State level safeguards objectives would necessarily be the same for all States, it is important to define State level specific objectives based on an analysis of acquisition paths, i.e. the routes to acquire nuclear weapons usable material, State-specific nuclear fuel cycle features and characteristics and other information provided in the safeguards State Evaluation Report (SER) and to choose safeguards activities accordingly for a specific State.

*2.14. Provide assistance to States to improve the performance of their SSACs*

Many States have highly developed State systems for accounting and control of nuclear material (SSACs), with substantial manpower and diverse technical capabilities. Enhanced cooperation with SSACs and a fuller use of their technical capabilities in the implementation of State level approaches is a possible way of increasing the efficiency of integrated safeguards.

▲ Geological Repository

## 3. Activities

The following planned project activities include those funded by the regular budget as well as those expected to be funded by Member State Support Programmes.

*3.1. Revise the Physical Model (Objective 2.1.)*

Revisions to Volumes 3 (Uranium Enrichment) and 7 (Heavy Water) of the Physical Model were provided by the UK and the Canadian Support Programmes respectively, under the joint project C 1389. The updated volumes are in the final stage of review and editing and are expected to be released in January 2008.

The UK and US Support Programmes under Projects JNT C 1660 and JNT C 1683 have initiated revisions to Volumes 2 and 4 (Conversion 1 & 2). A June 2007 meeting was held in Vienna to finalize the work plan for those tasks. The current plan is to incorporate both volumes into a single document. The final version of that document is tentatively scheduled to be released in July 2008.

Task proposal 07/CCA-004 has been initiated to update Volume 12 (Weaponization). The requested MSSPs are the French, UK, and US Support Programmes. If that task is accepted, the anticipated completion date is December 2009.

*3.2. Improve the proliferation resistance of facilities and fuel cycles (Objective 2.2.)*

The Agency will continue to provide guidance and technical support for the assessment of

innovative nuclear reactor concepts and associated fuel cycles in relation to proliferation resistance, both under the Agency INPRO Project and under the Generation IV International Forum.

The INPRO methodology defines Basic Principles and User Requirements that must be fulfilled to make a nuclear energy system satisfactorily proliferation resistant. A central user requirement is that the diversion of nuclear material should be reasonably difficult and detectable. This user requirement led to the definition of "safeguardability" as the degree of ease with which a system can be effectively and efficiently put under safeguards. It is affected by the design of the nuclear installation, the nuclear material involved, and the process and way the installation is operated. Further development is still necessary with regard to the "safeguardability" concept. According to the INPRO Action Plan for Phase 2, updating and further development of the assessment methodology is still required. For the INPRO assessment studies (INPRO collaborative projects initiated in 2007) the developed manual on how to apply the INPRO methodology will be applied. Subsequently, the methodology (Basic Principles, User Requirements and Criteria) will be revised based on the feedback from the assessment studies. The method of aggregation and consolidation of the assessment results is still to be developed.

The 'Evaluation Methodology for Proliferation Resistance and Physical Protection of Generation IV Nuclear Energy Systems' developed by the Proliferation Resistance & Physical Protection Working Group (PR&PP) will have to be further tested using case studies. The case currently considered is a fuel cycle involving fast reactors and recycled fuel through pyroprocessing. The Department of Safeguards will continue to participate in the PR&PP working group.

3.3. *Develop integrated safeguards approach for storage facilities with un-irradiated direct use material (Objective 2.3.)*

Timeliness requirements under integrated safeguards have not been changed for non-irradiated plutonium or HEU. However, it may be possible to identify other efficiencies in safeguards approaches at MOX and HEU facilities that would be suitable for States with integrated safeguards. In particular, there is a possibility that the annual number of interim inspections could be reduced if randomly scheduled inspections could be used, in conjunction with remote monitoring methods and operator mailbox declarations. A Japanese Support Programme task (C 1553), under which possible applications of randomly scheduled inspections and mailbox declarations to a MOX fuel fabrication facility in Japan are being developed and tested, will be completed by the beginning of 2008. Further development will be continued to similar types of facilities.

3.4. *Develop safeguards approaches, including integrated safeguards approaches, for enrichment facilities (Objective 2.4.)*

In 2008–2009, priority will be placed on developing a model integrated safeguards approach for gas centrifuge enrichment plants (GCEPs). Facility-specific approaches based on the appropriate model will also need to be prepared and implemented. Of particular challenge will be implementation of effective and efficient approaches for the very large GCEPs currently under safeguards and for those expected to come under safeguards in the biennium. Initiation of support programme tasks to assist in the development and testing of components of the approaches may be required.

3.5. *Develop guidelines for evaluation of the safeguards relevance of activities and equipment used at R&D installations engaging in isotope separation activities (Objective 2.5.)*

Under the task GER C 1473, entitled "Development of Techniques to Estimate the Separative Capacity of R&D Isotope Separation Installation", the coordinator of the German Support Programme stated in 2007 that reports would be made exclusively to the DDG-SG. Under the task USA C 1476, the US Support Programme provided in 2007 a report entitled "Evaluation of Potential for Uranium Enrichment Production from R&D Capabilities (UCRL-TR-227287)", which is a useful reference

tool for addressing issues relating to R&D facilities. These reports will be used in the future work to determine the minimum separative capacity for an installation to perform the function of an isotope separation plant in order to develop guidelines to be used by inspectors to estimate the separative capacity of R&D isotope separation installations for the various separation techniques and, to determine the capability for undeclared production of enriched uranium at an installation.

3.6. *Reprocessing plants (Objective 2.6.)*

During 2008 final approval of the integrated safeguards approach for the Rokkasho reprocessing plant (RRP) will be a Departmental priority as RRP is on the verge of commercial operation. It is expected that experience gained in the implementation of the integrated safeguards approach at RRP will raise issues with regard to its efficiency and effectiveness that will require further development.

3.7. *Develop generic and facility-specific safeguards approaches applicable to spent fuel conditioning and encapsulation facilities and geological repositories (Objective 2.7.)*

A safeguards approach is under development for the Finnish geological repository, which is currently under construction at Olkiluoto. This activity will, inter alia, include consideration of measures for nuclear material accountancy, containment/surveillance, design information verification and complementary access. The Finnish Support Programme supported this work through an evaluation presented in the form of a report entitled, "Evaluation of Monitoring Methods available for Safeguards use at Olkiluoto Geological Repository" (FIN C 1572).

A group of experts thereafter referred to ASTOR group (Application of Safeguards to Geological Repositories), works on practical aspects of a generic integrated safeguards approach for geological repositories sites and safeguards techniques applicable to specific geological repository sites. The group proves to be an excellent forum to foster exchanges between participants and it provides support to the Agency through reviewing of elements of integrated safeguards approaches for specific geological repositories, sharing of safeguards-relevant information on geological repositories, promoting of better understanding of safeguards requirements and implications relevant to geological repositories.

3.8. *Further develop safeguards approaches for the pebble bed modular reactor and the related fuel cycles (Objective 2.8.)*

In May 2005, a generic safeguards approach for the pebble bed modular reactor have been approved by DDG-SG as a basis for further investigation of relevant safeguards techniques. There is still a need to identify what reactor parameters involve safeguards relevant data and should be collected for verifying proper reactor operation and fuel consumption. There is also a need to quantify the time frame and amount of undeclared nuclear material that could potentially be produced or diverted based on the various reactor operation scenarios and how such activities would be evident through analysis of prescribed recorded reactor parameters. Under the task USA C 1547, a report concluded that the fully burnt PBMR spent fuel would not satisfy current safeguards criteria for termination of safeguards on measured discards. Therefore work should be continued under the task proposal 02/OB2-002 to provide the Agency Safeguards Department with a sound technical basis for the development and implementation of cost-effective safeguards measures for this type of facility. It is expected that the Australian Support Programme will continue to support the Agency regarding Design Information Verification at the PBMR (AUL C 1562).

3.9. *Gather safeguards relevant information on facilities implementing pyroprocessing technology (Objective 2.9.)*

A task proposal will be drafted to enable the Department of Safeguards to gather information on pyroprocessing technology, aiming at the development of safeguards approaches for effective and

efficient application of safeguards at those facilities.

3.10. *Develop safeguards approaches for facilities undergoing decommissioning and guidelines for verifying decommissioned status (Objective 2.10.)*

Under the task GER C 1612 the German Support Programme, after having studied literature and selected candidate facilities for case studies in a Phase 1, will implement a Phase 2 intending to perform those case studies. Work is further needed to make the Agency able to develop safeguards guidelines for the determination of decommissioned status of RRCA and LWR-type facilities. Costs of decontamination and reconstitution remain an important element to be assessed.

3.11. *Develop guidelines for the resolution of anomalies in the implementation of integrated safeguards (Objective 2.12.)*

Preliminary conceptual work on establishing the relationship between anomalies at individual facilities and the overall safeguards conclusion for a State has started. However, more comprehensive basis for dealing with anomalies under integrated safeguards must still be developed, based on experience gained in States where integrated safeguards are already implemented. The intention is to complete an Anomalies Procedure in the course of 2007–2009. The procedure would incorporate the results of improvements to the State Evaluation Procedure as a whole and the wider use of State level safeguards objectives. The increase in the number of States firstly with a broader conclusion and secondly under integrated safeguards will change the emphasis on resolution of individual anomalies, and this will be factored into the overall procedure. It is anticipated that technical methods for anomaly resolution especially of open-core anomalies will rapidly improve, and use of these methods will be accepted and become routine. The overall thrust is intended to be on continuous improvement of the anomalies procedure, once a working feedback and operating experience methodology has been established.

3.12. *Develop suitable approaches for monitoring and evaluating the effectiveness of safeguards implementation in States with integrated safeguards (Objective 2.13.)*

The design of an effective and efficient State level approach (SLA) for a State should take into account the following elements considering the State-specific features and characteristics and adapting the model IS approaches for specific facility types:

- the basic principles established for IS;
- the three generic State level safeguards objectives;
- the State level specific objectives;
- the State-specific conditions for optimizing the effectiveness and efficiency of safeguards measures, including the use of advanced safeguards technology, the use of unannounced or short notice inspections and the opportunities for cooperation with the State or regional system of accounting for and control of nuclear material (SSAC or RSAC) in implementing safeguards; and,
- the optimization of safeguards at facilities, including considerations of grouping of facilities that are related by location, type or function.

SAGSI has advised the Secretariat that the implementation and evaluation of integrated safeguards should be influenced by State-specific factors, to identify in detail the specific factors that should be taken into account, and to develop suitable formulations for how the factors should influence safeguards implementation and evaluation, especially if the proposal is to reduce the level of safeguards that would be applied in a particular State.

Development work will be performed during the planning period to address some of the above

issues. The focus will be on the identification of State level specific objectives that can potentially influence the design and evaluation of integrated safeguards.

*3.13. Provide assistance to Member States to improve the performance of their SSAC's (Objective 2.14.)*

To facilitate the enhanced cooperation between the Agency and the SSACs, the SSACs need detailed guidance on the Agency's requirements and recommendations on SSAC obligations, responsibilities and cooperation opportunities under the strengthened safeguards regime (CSA + AP, Integrated Safeguards).

In 2007 an updated version of the Agency's document "Guidelines for States' Systems of Accounting and Control of Nuclear Material" providing a short overview of the new obligations and responsibilities was submitted for publication. This short Guideline will be followed in 2008–2009 by more detailed guidelines covering all relevant aspects of SSAC operation and cooperation in sufficient technical detail and containing good practice examples and Member State experience as well. The detailed guidelines are planned to be published in two separate volumes, one specifically targeted at SSAC's of SQP States, while the other one aimed at SSAC's of States with significant nuclear infrastructure.

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

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

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| AUL | C 1567 | Safeguards Technology for Design Information Verification at the PBMR | So far no progress achieved on this task which nevertheless stays a very important issue to be considered over the whole plan period. |
| AUL | C 1208 | Consultant – Re-Examination of Basic Safeguards Implementation Parameters | Extended till 2009. |
| BEL<br>CAN<br>CZ<br>FIN<br>FRA<br>GER<br>HUN<br>SWE<br>USA | JNT C 1611 | Application of Safeguards to Geological Repositories (ASTOR), Group of Experts | Task will stay active over the whole plan period and more. |
| GER | C 1473 | Development of Techniques to Estimate the Separative Capacity of R&D Isotope Separation Installations (A.33) | Task to be terminated. |
| GER | C 1612 | Determination of Decommissioned Status of Facilities (A.36) | |
| GER | C 1690 | Application of a Mailbox System at the Gronau Enrichment Facility (A.40) | Almost completed. |
| JPN | C 1501 | Determination of Decommissioned Status of Facilities | Final report on decommissioned status of a Gas Cooled Reactor to be finalized in 2008. |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| JPN | C 1553 | Randomly Scheduled Inspections for Integrated Safeguards | |
| ROK | C 1703 | Support to Regional Technical Meeting on Additional Protocol Implementation in Asia and the Pacific Region | Accepted November 2007. |
| UK | C 1660 | Enhancement of Physical Model Conversion 1 and Conversion 2 Sections (A7(g)) | |
| UK | C 1265 | Conceptual Development Support for Integrated Safeguards | |
| USA | C 1547 | Develop a PBMR Operational Model to Identify and Quantify Proliferation Indicators and Possible Diversion Scenarios (C.114) | A preliminary task report was delivered in 2006 which gave evidence of further needs for work to be performed under that important task. |
| USA | C 1476 | Development of Techniques to Estimate the Separative Capacity of R&D Isotope Separation Installations (C.113) | Further work is needed under that task on the various technologies to be possibly used for enrichment activities. |
| USA | C 1561 | Determination of Decommissioned Status of Facilities | Final report expected in 2007. |
| USA | C 1683 | Enhancement of Physical Model Conversion 1 and Conversion 2 Sections (C.120) | |
| USA | C 1134 | Consultant-Services, Safeguards Issues | |
| USA | C 1451 | Consultant-Development Support for Integrated Safeguards (C.112) | |
| USA | C 1677 | Consultant-Development of Safeguards Documentation (C.119) | |

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| 07/CCA-004 | Review and Update of the Physical Model Volume 12 (Weaponization) | |
| 07/CCA-XXX | Application of Safeguards to Pyroprocessing Facilities | Under development. |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

| Activity Designation | Activity Title | Comments |
|---|---|---|
| Proliferation resistance of facilities and fuel cycles | INPRO and GEN.IV / PR&PP | Active. |

# SGCP-101

## Quality Management

### Project Manager: John Patten — Division: SGCP

#### 1. Background

The Secretariat of the Agency is committed to providing soundly based safeguards conclusions to the Board of Governors regarding the non-diversion of nuclear material placed under safeguards and, as appropriate, the absence of undeclared nuclear material and activities.

To support this commitment, the Department of Safeguards is implementing a quality management system, based on the requirements of ISO 9001:2000. The quality management system aims to enhance further the effectiveness and efficiency of the Department's verification and evaluation activities. This document describes the plans for developing and implementing the system during the period 2008–2009 within project SGCP-101. It has been prepared consistent with the Department of Safeguards Strategic Objectives 2006–2011.

The two-year period that the plan covers combines both development of new elements of the quality management system and its wider implementation and ongoing operation of those elements of the system already in place. Those elements of the quality management system that have already been established and form part of the day-to-day activities of all staff within the Department will continue throughout 2006–2011 and beyond. Within the scope of the quality management system are the needs of the Department with respect to developing defined and structured knowledge management processes and the development of a methodology for assessing safeguards implementation costs.

Member State Support Programme (MSSP) activities will be able to provide assistance to this project in a number of ways such as: assistance from experts in quality management tools and techniques if those skills do not already exist within the Department; development/provision of tools to help implementation of the quality management system (e.g. software); independent review of the quality management system and provision of training on quality management. These requirements are equally applicable to knowledge management, as a component of the quality management system, in order to ensure that the Department maintains and enhances its ability to draw soundly based safeguards conclusions.

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.

#### 2. Objectives

The objectives of this project derive principally from the goals and related key activities of the Department of Safeguards Strategic Objectives 2006–2011 including:

- Continue to develop processes and tools to maintain the knowledge required for the Department to produce credible conclusions (2.3.1.v).
- Ensure that an effective Departmental security system, including staff awareness, and physical and electronic measures, is in place (2.3.1.vi).
- Implement a Quality Management System (QMS) that ensures soundly based safeguards conclusions and supports efficient implementation of safeguards verification and evaluation activities (2.4.1.i).
- Continue to improve the organisation capability to more effectively carry out the mission of the Agency by (2.4.1.ii):
    - analyzing and, where needed, improving processes and practices within the Department with the

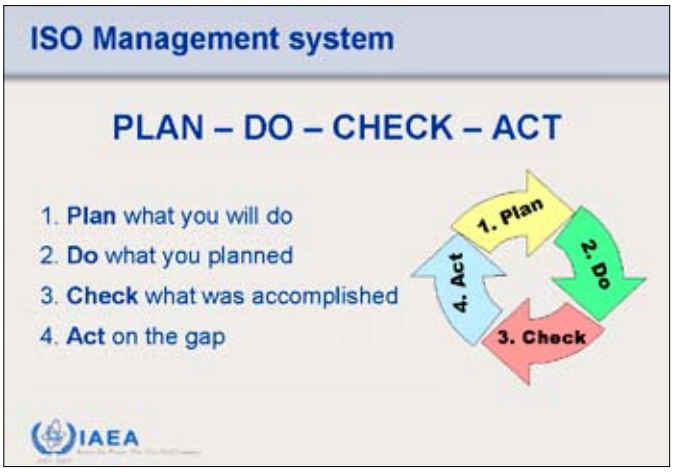
view of optimizing the use of resources, thereby implementing organizational and operational changes where needed;

- implementing best practices for the management of projects, in particular for cross-departmental activities.

- Maintain a unified approach to address preservation of institutional memory and the promotion of knowledge management, while maintaining competence in the Department of Safeguards (2.4.1.v).
- Seek a closer cooperation with the Member States in order to jointly address current and future non-proliferation issues and challenges (2.6.1.ii).

The principle objective of the project is:

***Implement a Department wide quality management system and monitor, analyze and report the adherence to and effectiveness of the quality management system.***




▲ PDCA cycle

The Department selected ISO 9001:2000 as the basis of its quality management system because it is an international system, it is widely accepted and used and, more importantly, it is sufficiently flexible to enable the Department to introduce a system appropriate to its own needs. The Standard fits into a process of Plan-Do-Check-Act (PDCA), which is shown below in the diagram taken from An Introduction to quality management in the Department of Safeguards, an internal training session for all staff members of the Department.

In particular the following specific objectives can be identified:

2.1. *Develop and implement a communication plan for all stakeholders involved in the quality management system to ensure all stakeholders understand the objectives of the system and their role within it;*

2.2. *Carry out a review to assess compliance against the requirements of ISO 9001:2000 – updating the gap analysis carried out in 2005;*

2.3. *Complete the mapping of the Department's processes;*

2.4. *Identify appropriate measurement and analysis systems relating to the Department's processes to provide positive assurance that the processes are operating effectively and efficiently and identify weaknesses where they exist;*

2.5. *Develop a methodology for assessing safeguards implementation costs;*

2.6. *Implement arrangements for management review of the QMS so that planned management review is carried out, and continue to develop the role of management within the management system;*

2.7. *Develop a system to identify preventive actions and thus manage business risks to the Department;*

2.8. *Ensure that the approach to competence, training and development of all staff meets the requirements of ISO 9001:2000;*

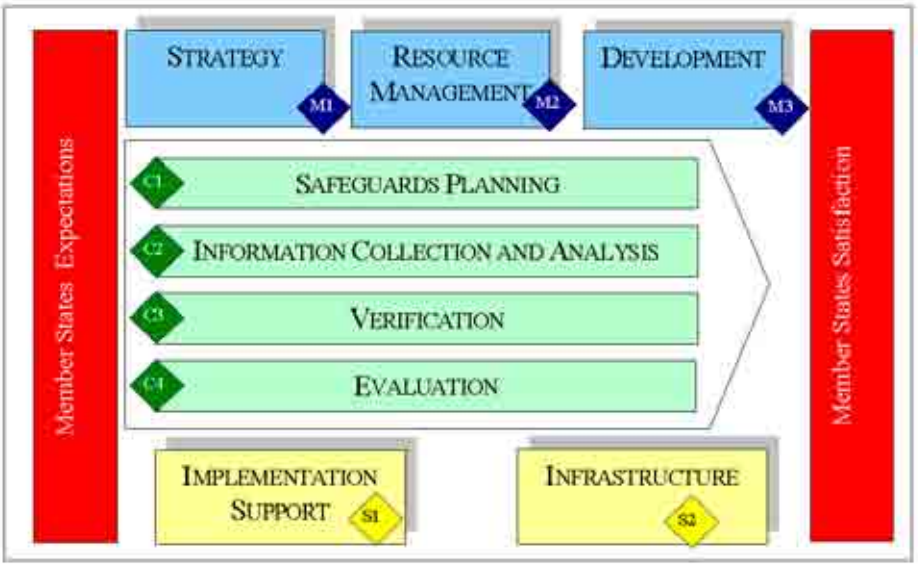
2.9. *Develop comprehensive arrangements to ensure that effective knowledge management practices are implemented in the Department and that institutional memory is retained, built upon and readily accessible to those who need it;*

2.10. *Complete the delivery of quality management training to support the implementation of the system;*

2.11. *Develop a system to manage the design and development of new processes and activities;*

2.12. *Complete the transition of the current Safeguards Manual into the management system documentation and develop the Departmental Quality Manual;*

2.13. *Conduct internal quality audit, as determined by the Annual Internal Quality Audit Programme, and develop the audit process as required by the needs of the Department.*




▲ Macroprocess Map

2.14. *Develop and implement a plan to further enhance the security of information assets held and generated by the Department of Safeguards and to ensure the physical security of the Department, both in Headquarters, Regional Offices and in field.*

## 3. Activities

The following activities include those funded from the regular budget and those expected to be funded by Member State Support Programmes.

3.1. *Develop and implement a communication plan for all stakeholders involved in the quality management system to ensure all stakeholders understand the objectives of the system and their role within it (Objective 2.1.)*

- Review the role and responsibilities of the Divisional Quality Managers (Target date: March 2008);
- Undertake stakeholder analysis and identify, select and implement relevant communication mechanisms (Target date: April 2008).

3.2. *Carry out a review to assess compliance against the requirements of ISO 9001: 2000 – updating the gap analysis carried out in 2005 (Objective 2.2.)*

- Hold a workshop with quality managers to assess the current state of compliance with ISO 9001:2000 (Target date: March 2008)

3.3. *Complete the mapping of the Department's processes (Objective 2.3.)*

- Complete the mapping of Department processes in line with the ISIS Re-engineering Project and make process descriptions documents available (Target date: June 2008). The diagram below shows the high level process map for the Department. The work covered in Objective 2.3. will describe the underlying processes.

3.4. *Identify appropriate measurement and analysis systems relating to the Department's processes to provide positive assurance that the processes are operating effectively and efficiently and identify weaknesses where they exist (Objective 2.4.)*

- Develop a measurement system that allows clear identification of trends in performance from measurable performance indicators and gives assurance that core processes are operating effectively and efficiently (Target date: June 2009);
- Develop a methodology for reliability analyses and reporting for the next generation safeguards surveillance and unattended monitoring systems (Target date: December 2009).

3.5. *Develop a methodology for assessing safeguards implementation costs (Objective 2.5.)*

- Collect and analyse relevant data (Target date: June 2008);
- Develop detailed costing models based on the output of analysis (Target date: December 2008);
- Develop supporting information technology system as required (Target date: June 2009);
- Implement the system across the Department (Target date: October 2009).

3.6. *Implement arrangements for management review of the QMS so that planned management review is carried out, and continue to develop the role of management within the management system (Objective 2.6.)*

- Approve management review procedure (Target date: February 2008).

3.7. *Develop a system to identify preventive actions and thus manage business risks to the Department (Objective 2.7.)*

- Develop and implement procedure for preventive action (Target date: December 2008).

3.8. *Ensure that the approach to competence, training and development of all staff meets the requirements of ISO 9001:2000 (Objective 2.8.)*

- Complete work on identifying competence profiles for inspectors (Target date: June 2008);
- Identify competence profiles for all staff members (Target date: December 2009).

3.9. *Develop comprehensive arrangements to ensure that effective knowledge management practices are implemented in the Department and that institutional memory is retained, built upon and readily accessible to those who need it (Objective 2.9.)*

- Implement basic knowledge transfer arrangements to ensure that all staff leaving the organisation contribute to the Department's accumulated body of knowledge (Target date: March 2008);
- Develop supplementary knowledge transfer arrangements for staff leaving the organisation whose respective departures incur high risk to business continuity (Target date: December 2008);
- Enhance awareness of the importance of sound knowledge management techniques (Target date: June 2008);

- Train appropriate staff in knowledge management techniques and tools (Target date: December 2008).

3.10. *Complete the delivery of quality management training to support the implementation of the system (Objective 2.10.)*

- Complete the delivery of training on continual process improvement and corrective action to all staff (Target date: December 2008);
- Review introductory training for new staff members in conjunction with implementation of the computer based training provided by the Canadian Safeguards Support Programme (Target date: March 2008);
- Review the future needs for 2 day seminars and 5 day workshops provided by the US Support Programme (Target date: June 2008).

3.11. *Develop a system to manage the design and development of new processes and activities (Objective 2.11.)*

- Develop Departmental guidelines for the management of projects (Target date: June 2008) Many of the activities that come within the scope of design and development in the context of ISO 9001:2000 are managed as projects within the Department. Therefore to meet this requirement and meet an identified need of the Department this will be addressed by developing guidelines for the management of projects.

3.12. *Complete the transition of the current Safeguards Manual into the management system documentation and develop the Departmental Quality Manual (Objective 2.12.)*

- Develop software to support the document control system (Target date: June 2008);
- Integrate the Safeguards Manual into document control system (Target date: June 2008);
- Prepare Quality Manual for Department (Target date: June 2008);
- Agree and implement plan for integrating other 'legacy' documents into system (Target date: December 2008).

3.13. *Conduct internal quality audit, as determined by the Annual Internal Quality Audit Programme, and develop the audit process as required by the needs of the Department (Objective 2.13.)*

- Prepare annual internal quality audit programmes for 2008 and 2009 (Target date: January of each year);
- Implement the internal quality audit programme (Target date: as required by programme);
- Arrange for an external assessment of the Department's quality management system (Target date: June 2009).

3.14. *Develop and implement a plan to further enhance the security of information assets held and generated by the Department of Safeguards and to ensure the physical security of the Department, both in Headquarters, Regional Offices and in field. This objective is included within the project plan for the quality management system as it directly relates to ISO 9001:2000 requirements for protecting "customer property". In terms of the Department of Safeguards this is considered to be State-supplied information. (Objective 2.14.)*

- Define the roles and responsibilities required within the organisation to ensure a comprehensive approach to security (Target date: June 2008);
- Determine most appropriate organisational arrangements to implement roles and responsibilities and put into practice (Target date: June 2009).

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

### *4.1. 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) | Active – limited to minor updates of software |
| USA | JNT B 1277 | Workshop on Quality Assurance Techniques (99/PST-001) | Active |

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

| Task Proposal No. | Task Title | Comments |
|---|---|---|
| 05/PST-003 | External Quality Audit of Departmental Quality Management System | Timing to be agreed |
| To be determined. | Consultancy to Review the Cost Methodology Approach | Timing to be agreed |
| To be determined. | Development of Methodology for Reliability Analyses and Reporting for the Next Generation Safeguards Surveillance and Unattended Monitoring Systems | |

# SGCP-102

## Training

### Project Manager: Haroldo Barroso

### Division: SGCP

#### 1. Background

This document describes the plans for developing and implementing training within the Department of Safeguards for the period 2008–2009. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011.

▲ Field Training with ICVD

As a result of the changes in Safeguards technology and the increasing focus on the Additional Protocol and on the State Evaluation approach, the implementation of new training courses and consistent updating of the existing ones need important and specific resources. As underlined by a recent Office of Internal Oversight Services 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." Safeguards staff and Member States personnel require skills and competence to effectively implement international Safeguards. With the training support provided by Member States Support Programmes (MSSPs) the Department of Safeguards is able to offer to its customers improved training sets matching the latest developments in Safeguards concepts, methods, equipment and techniques.

The training path for SG inspectors, support personnel and Member States staff is being redesigned to meet, without delays, the most recent needs. Technical training involving nuclear material or full scope training in nuclear facilities is only possible through MSSPs when it is a key factor in the process of qualifying SG inspectors to perform their tasks. Implementation of increasing number of SSAC (State Systems of Accounting

for and Control of Nuclear Material) training courses, workshops and organization of ISSAS (IAEA SSAC Advisory Services) missions during the following two years play an important role in the effectiveness and the efficiency of SG activities for Member States as for the Agency.

## 2. Objectives

The objectives of this project are principally derived from the following goal and related key activity of the Department of Safeguards Strategic Objectives 2006–2011:

- Have the best management practices in place to optimize delivery of the nuclear verification programme.
- Ensure that the training programme fully meets staff needs and current and future organizational requirements.

***The primary objective of the SGCP-102 project is to build a broad integrated training approach emphasizing not only technical knowledge and skills but also human factors knowledge, skills and attitudes. This approach, supported by an in depth needs analysis and taking into consideration improved SG concepts and techniques will bring, as a result, enhanced verification capabilities and improved SSACs.***

The following specific project objectives are identified:

2.1. *Intensify cooperation between the Agency and Member States through the organization of SSAC training courses, workshops and ISSAS missions to support the development and improvement of SSAC capabilities where appropriate and other relevant infrastructure with the view of ensuring more efficient and effective safeguards.*

2.2. *Develop a comprehensive training package providing a career path for SG inspectors, managers, supervisors and support staff. This training path shall cover nuclear material verification, Additional Protocol related on-site activities and State Evaluation process, with the objective of delivering to SG Staff the knowledge, skills and abilities they need to successfully complete their assignment, and capturing the necessary expertise for the Department as a whole, in both technical and soft skills areas. This training package shall be based on comprehensive SG tasks, training needs analysis and the defined consequent SG Staff competency profiles. It will require strong evaluation and feed back mechanism processes. Active learning and computer based training are to be strengthened with a view to offering more convenient opportunities for refresher training.*

## 3. Activities

The following projected activities include those funded by the regular budget and those accepted for the past R&D programme and expected to be funded by MSSPs on an on-going basis. Newly proposed tasks are in para 4.2.

### *3.1. Member States Training*

Support for Member States training is provided by MSSPs through different mechanisms. Partnerships for organisation, implementation and delivery of SSAC training courses and workshops, support for the development of Traineeship Programmes and specific training sets open to the participation of Member States personnel are the most used tools in this regard:

▲ ICAS Classroom Training at VIC

| | |
|---|---|
| Consultations and Support to Member States | FRA B 1447 |
| Physical Inventory Taking (PIT) Computer Based Training (CBT) | USA B 1464 |
| Support to SSAC (A10) | UK B 1321 |
| Training Courses for SSAC Personnel | RUS B 1107 |

In-Field training in the Framework of the Safeguards Traineeship Programme HUN B 0813 has been extremely important in the process of preparing trainees for future SG activities in their national authorities or in the Agency. The task should continue and support the 2008 Traineeship Programme.

| | |
|---|---|
| Regional Training Course on SSAC, Australia | 07/CTR - 008 |
| International, regional and national training courses and workshops for SSAC personnel | 07/CTR - 007 |

3.2. *Development of a comprehensive training package providing a career path for SG inspectors, managers, supervisors and support staff.*

The training curriculum for SG staff should be updated in a continuous basis in order to meet Department needs. Enhanced training sets on additional protocol implementation, complementary access, integrated safeguards and the State level approach are incorporated in this curriculum.

- Nuclear Material Verification

  The basic training in NDA techniques is conducted in the USA with support provided under US B 0086. A course is to be developed with the EC (pilot course in 2008). This course is mandatory for newly recruited inspectors.

Spent Fuel Training, CAN B 0688, FIN B 1435 and SWE B 1709. These courses remain part of the training programme and will be required long-term. A complete revision of the agenda was performed with the inclusion of the DCVD within the scope of presentations and practical activities with the comprehensive set of SF measurement equipments.

The Advanced Plutonium Verification Course is conducted in the USA with support provided under US B 0086 and in Russia (a pilot course took place in 2007, task in preparation). This course remains part of the training programme and will be required for long-term planning.

Training on Remote and Unattended Monitoring, USA B 1337.

Training on Spent Fuel Verification Using Gamma and Neutron Detection Techniques, RUS B 1053.

Physical Inventory taking (PIT) Computer Based Training USA B 1464 is still under development

Nuclear Material Solution Accountancy and Verification Training, EC B 0620. This course remains part of the training programme and will be required long-term. Four SG inspectors have been trained each year.

Inspector Training for CANDU Facilities, CAN B 1624. The Agency's requirements for CANDU training have been expressed in a task proposal accepted by the Canadian Support Programme. Course program and training material are being revised by the Canadian Support Programme.

- Additional Protocol related on-site activities

The Comprehensive Inspection Exercise for LWRs is supported by CZ B 1431 and Slovakia with BEL B 1433, FIN B 1054, and HUN B 1065 as backup. These courses have been improved by strengthening the complementary access component and are mandatory for newly recruited inspectors.

The Comprehensive Inspection Exercise at Bulk Handling Facilities is supported by UK B 1384 and SWE B 1328. Two courses will be required per year.

DIV Exercise at Bulk Handling Facilities, UK B 1618. This course remains part of the training programme and will be required for long-term planning.

Inspector Training for CANDU Facilities, CAN B 1624. The Agency's requirements for CANDU training have been expressed in a task proposal accepted by the Canadian Support Programme. Course agenda and training material are being revised by the Canadian Support Programme.

Workshop on Additional Protocol Activities, FIN B 1422, HUN B 1525, US B 1415, EC B 1563. These courses, designed as full scope training for the implementation of complementary access, are based on realistic scenarios jointly developed by the Department and the MSSP. They have been expanded to train the inspectors to a wide range of facility types and operational situations.

Advanced Training in Nuclear Fuel Cycle Facilities UK B 1550. This course remains part of the training programme and will be required for long-term planning.

Training Workshop in Design Information Review for the Entire Life Cycle of Research Reactors, USA B 0984 was completed in March 2007. Considering the current situation of RR in the world, this task has to be reactivated

Enhanced Observational Skills, USA B 1446 and Enhanced Communication Skills USA B 1245. This task continues to support inspectors training both for new inspectors and experienced inspectors.

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

Familiarization Visit to La Hague for RPP FRA B 1562 has been conducted successfully in the previous years and should be kept available.

- State Evaluation and nuclear fuel cycle expertise

The Nuclear Fuel Cycle and Proliferation Pathways, UK B 1394. This course remains as a mandatory part of the training programme and will be required for long-term planning.

Pyroprocessing course US B1669. This new course has been conducted for the first time in 2007. Task is to be continued.

Safeguards Training Course: Enrichment Technology, USA B 1001. This course remains part of the training programme and will be required for long-term planning.

Support I Laser Isotopes separation Technology FRA B 1506, new course is planned for 2008

Training for Information Collection and Analysis for AP Verification FRA B 1427 has been extremely useful. Task should continue.

The Safeguards for Support Staff training Course has been supported by Czech Republic and Slovakia with visits to NPPs in both Countries.

Satellite Imagery Training Courses, CAN B 1483, SWE B 1373 should continue.

Specialist Training for Agency's Imagery Analysts, FRA B 1439, US B 1442, GER B 1456. Some aspects are still under discussion but tasks should be maintained available since new activities are planned to 2007 and 2008.

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

### *4.1. 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 | Accepted October 2007 |
| BEL | B 1433 | Comprehensive Inspection Exercise at LWRs | On going |
| CAN | B 1688 | Spent Fuel Verification Training Course | On going |
| CAN | B 1624 | Inspector Training for CANDU Facilities | On going |
| CAN | B 1483 | Satellite Imagery Training Program, | Ongoing, reference to project SGIM-02 |
| SWE | B 1373 | | |
| CZ | B 1558 | Training Course on Nuclear Material Accounting in Action | On going |
| CZ | B 1526 | Technical Visit - Uranium Mines | On going |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| CZ | B 1431 | Comprehensive Inspection Exercise at LWRs | On going |
| EC | B 1563 | Workshop on Additional Protocol Activities | On going |
| EC | B 0620 | Nuclear Material Solution Accountancy and Verification Training | On going |
| EC | B 1702 | NDA Training Course | Accepted October 2007 |
| FIN | B 1435 | CVD/SFAT Training | On going |
| FIN | B 1422 | Workshop on Additional Protocol Activities | On going |
| FIN | B 1054 | Comprehensive Inspection Exercise for New Agency Inspectors | Standby |
| FIN | B 1699 | Training and Evaluation of the Necessary Soft Skills for Safeguards Activities | Accepted October 2007 |
| FRA | B 1708 | Training and Evaluation of the Necessary Soft Skills for Safeguards Activities | Accepted May 2007 |
| FRA | B 1562 | Familiarization Visit to La Hague for RRP Inspectors | On going |
| FRA | B 1506 | Support in Laser Isotopes Separation Technology | On going |
| FRA | B 1447 | Consultations and Support to Member States | On going |
| FRA | B 1427 | Training for Information Collection and Analysis for Additional Protocol Verification | On going |
| FRA | B 1710 | Revision to Nuclear Fuel Cycle Training Manuals | Accepted December 2007 |
| HUN | B 1525 | Workshop on Additional Protocol (Complementary Access) Activities | On going |
| HUN | B 1065 | Comprehensive Inspection Exercise Training (CIET) | Standby |
| HUN | B 0813 | In-Field Training in the Framework of the Safeguards Traineeship Programme | On going |
| JAP | B 1713 | Revision to Nuclear Fuel Cycle Training Manuals | Accepted in December 2007 |
| RUS | B 1107 | Training Courses for SSAC Personnel | On going |
| RUS | B 1053 | a) Training in Spent Fuel Verification Using Gamma and Neutron Detection Techniques<br><br>b) Training in Implementation of Safeguards at Uranium Gas Centrifuge Enrichment Plants | On going |
| SWE | B 1328 | Comprehensive Inspection Exercise for Bulk Handling Facilities | On going |
| SWE | B 1709 | Spent Fuel Verification Course | Replaces SWE B 0975 |
| UK | B 1618 | Design Information Verification at Bulk Handling Facilities Training Course (C1(c)) | On going |
| UK | B 1550 | Advanced Training in Nuclear Fuel Cycle Facilities (C1(i)) | On going |
| UK | B 1394 | Training on the Nuclear Fuel Cycle and Proliferation Pathways (C1f) | On going |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| UK | B 1384 | Comprehensive Inspection Exercise at Bulk Handling Facilities (C1(r)). | On going |
| UK | B 1321 | Support to SSAC (A10) | On going |
| UK | B 1698 | Training on the Nuclear Fuel Cycle and Proliferation Pathways (C1f) | Aim of focusing on lab scale activities Accepted October 2007 |
| USA | B 1669 | Pyroprocessing Training Course (B.102) | On going |
| USA | B 1464 | Physical Inventory Taking (PIT) Computer Based Training (CBT) (B.99) | Completion after CBT is tested and approved |
| USA | B 1446 | Enhanced Observation Skills (B.98) | On going |
| USA | B 1415 | Workshop on Additional Protocol Activities (B.96) | On going |
| USA | B 1337 | Training on Remote and Unattended Monitoring (B.91) | On going |
| USA | B 1245 | Enhanced Communication Skills (B88) | On going |
| USA | B 1001 | Safeguards Training Course : Enrichment Technology (B82) | On going |
| USA | B 0086 | Training - Agency Participation in US Sponsored Courses (B.93) | On going |

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

| Task Proposal No. | Task Title | Comments |
|---|---|---|
| 07/CTR-011 | State Evaluation Process Workshop Evaluation and Training | New proposal high priority |
| 07/CTR-010 | Revision to Nuclear Fuel Cycle Training Manuals | The current manuals are almost obsolete. France and Japan accepted in December 2007. |
| 07/CTR-007 | International, regional and national training courses and workshops for SSAC personnel | Under Review |
| 07/CTR-005 | Comprehensive Inspection Exercise at Bulk Handling Facilities | Under review to take into account recent feed back |
| 07/CTR-004 | Update of the "Explanatory Notes and Model Response for Design Information Questionnaires" | Under Review, Need has to be confirmed |
| 07/CTR-003 | Production of a Computer Based Training Course on Environmental Sampling | Outstanding high priority, ES is a sensitive and important activity for the implementation of the AP. A CBT tool is necessary for refresher training |
| 07/CTR-001 | Training on Export Control Concepts and Standards from International Perspective | Outstanding, high priority |
| 05/TTR-008 | Training and Evaluation of the Necessary Soft Skills for Safeguards Activities | Pending, high priority<br><br>EC, UK Reject; Finland and France accepted |
| 04/TTR-002 | DVD Training Course for Environmental Sampling | Outstanding |
| 06/TTR-001 | Advanced Highly Enriched Uranium Measurement Course | Under Review |

| Task Proposal No. | Task Title | Comments |
|---|---|---|
| 04/TTR-005 | Training course on Reprocessing Technology | Under Review |
| New Task 1 | Environmental Sampling Training (swiping plan, specific analysis requests, evaluation and interpretation of analysis results…) | SP-1 under preparation ES is a sensitive activity of which results are of the highest importance for the State Evaluation Process |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

| Activity Designation | Activity Title | Comments |
|---|---|---|
| 1 | Development of the Training Quality Manual | Active |
| 2 | Training the Trainers | Proposed |
| 3 | Writing skills course | Active |

# SGTS-01

## NDA Techniques

### Project Manager: Roland Carchon

### Division: SGTS

#### 1. Background

This document describes the plans for developing and implementing Non Destructive Assay Techniques and Methods (project SGTS-01) within the Department of Safeguards for the period 2008–2009. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011 and the Strategic Equipment and Technology Development Plan for 2006–2011 prepared by the Division of Technical Support.


▲ Ground Penetrating Radar

The project addresses the development, evaluation, and implementation of attended portable and facility-resident non-destructive assay (NDA) instrumentation used in a great diversity of safeguards applications.

Portable equipment is mostly hand-carried by inspectors, used in facilities and brought back to HQ, although a lot of portable equipment has "resident" status and is kept at the facility for practical reasons. This equipment is mainly battery powered and miniaturized to facilitate transportation and use.

Facility-resident equipment is deployed and used in facilities. It is often more bulky, not so portable and transportable. Maintenance is essentially done in the installations.

The project includes radiation detectors and associated hardware, analogue and digital signal processing electronics, instrument computers and dedicated software for data collection and evaluation.

Some of the equipment components may, with some adaptations, also be used in unattended mode. The basic thinking is indeed going to include this extension into the field of scope, with the additional challenge of internal communication of the unattended devices, the Universal NDA Data Acquisition Platform (UNAP) protocol being the guideline to this achievement.

Research and development is needed to cope with more stringent safeguards requirements, in varying experimental situations and circumstances.

The end users are the Divisions of Operations carrying out safeguards verification activities.

#### 2. Objectives

The objectives of this project are principally derived from the following goal and related key activities of the Department of Safeguards Strategic Objectives 2006–2011:

- Enhance detection capabilities through the development of new or improved safeguards approaches and techniques, and acquisition of more effective verification equipment

Key activities:

- Optimize safeguards equipment and technology development with the view of further improving present detection capability, increasing reliability of equipment while ensuring the security of information transmission from the field and improving sustainability and timeliness.

- Use where possible equipment and technology already available with the view of adapting it to departmental needs.

- Pursue R&D activities in the development of novel technologies for detection of undeclared activities using, inter alia, Member States Support Programme mechanisms as well as internal resources and expertise.

The primary objective of the project is:

***Pursue NDA developments with the highest priority given to activities that improve present detection capability, reduce deficiency and vulnerability of current equipment and address the highest safeguards strategic needs. Such needs include equipment required for the implementation of the Additional Protocol and integrated safeguards approaches as well as, more specifically, methods and techniques for the detection of undeclared nuclear materials and activities.***

In particular the following specific objectives can be identified:

2.1. *To improve detection capability for safeguards*

Methods and equipment development and evaluation related to traditional safeguards focus on new generations of attended and unattended equipment and on finding solutions to unresolved issues, such as verification of material flow in enrichment plants.

2.2. *To enhance the capability of detecting undeclared materials and activities*

Inspection activities conducted under the terms of the additional protocol often require either enhancing existing instrument capabilities or applying entirely new technologies. In the short term, the Agency must have equipment that can be adapted as quickly as possible, while in the long term, development must concentrate on providing unique and flexible methodologies capable of satisfying a variety of needs.

2.3. *To improve efficiency and effectiveness*

For all equipment in routine use or under development, SGTS wishes to maximize the effectiveness of the equipment for a reasonable and useful lifetime, to minimize cost of purchase and maintenance. The aspects related to this objective relate to sustainability, standardization, and increased reliability.

2.4. *To implement support to Operations Divisions*

The aspects covered by this objective include maintenance, training of inspectors in the proper use of equipment, proposing solutions for unresolved issues, etc.

## 3. Activities

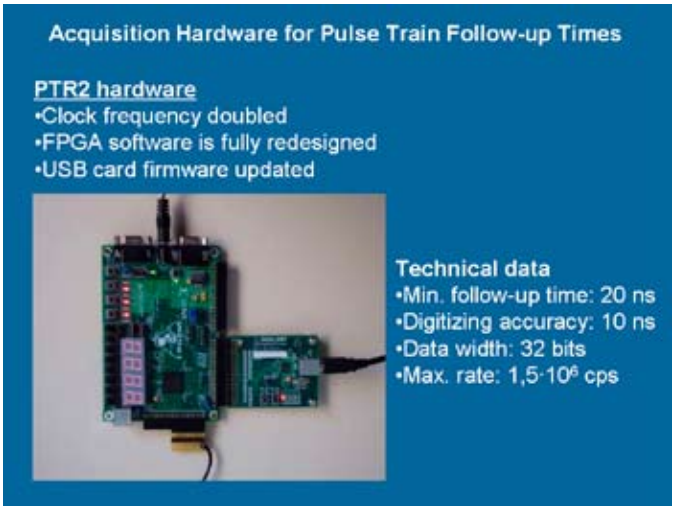
The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes.

### *3.1. To improve detection capability for safeguards*

- EC A 1507 Compucea Upgrading

  COMPUCEA (Combined Procedure for Uranium Concentration and Enrichment Assay) is a transportable system 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, and combines K-edge densitometer and U235-enrichment meter measurements on liquid uranium samples. The device is utilized as joint-use equipment with Euratom.

  The Joint Research Center-Trans Uranium Institute (JRC-TUI) developed a second generation of COMPUCEA aiming at elimination of radioactive sources (to facilitate transportation), and using room temperature detectors to avoid in-field LN2 cooling, and relying on L-edge to reduce the high voltage of the X-ray generator. The test report has to be provided to the Agency, to support the authorization Cat. A for inspection purposes. Expected time frame is end 2008.




▲ Aquisition Hardware for Pulse Train Follow-up Times

- USA A 1607 Development of ISOC Self Modeling Capabilities (A.267)

  In 2003, the Agency introduced the In Situ Object Counting System (ISOCS) use of numerically calibrated gamma spectrometry systems for safeguards applications. The method was used successfully for the assay of uranium retained in waste and as hold up in a fuel fabrication plant. The aim of the task is to further develop the second phase of the task, being the internal optimization of the experimentally derived parameters, such as system efficiency. The uncertainty estimator for the calculated isotope activities (derived from a gamma spectrometry measurement) was the first part of the task.

  The complete contract was accepted by the USA SP and by Canberra Industries to perform the development, and the second phase is under discussion, and the kick off meeting for the phase 2 development is planned for the 4th quarter 2007, the task to take place in 2008, and being ready by end 2008.

- FRA A 1480 Evaluation of Thick CdZnTe Detectors for High Sensitivity and High Energy Measurements

  The Agency extensively uses room temperature gamma spectrometry (RTGS) for a number of safeguards applications. At the moment, existing detector technology has limitations in energy

resolution, sensitivity and ability to measure high-energy gammas. To cover this need, the French Support Programme proposed the development of CdZnTe crystals of various thickness able to measure gamma emitters in wide ranges of energy (up to 1.5 MeV) and evaluation of the probes by comparing them against existing technologies. Since the start, the task suffered from lack of internal funding, as no commercial partner could be found. The task has to be terminated, in mutual agreement with the French Support Programme.

- HUN A 1503 Verification of Pu in Pu-Be Neutron Sources by Neutron Assay

  The plutonium in the PuBe sources must be accounted for during routine inspections. The method for measuring the plutonium content in the PuBe, being developed through the Hungarian Support Programme, uses a combination of neutron coincidence counting and high resolution gamma measurements to more accurately determine the plutonium mass.

  The measurement method including the associated analysis has been developed and demonstrated to the Agency. The next step in the process is to optimize the design of the neutron detector. Once the new detector is available, it will be calibrated using the mass values obtained from the established calorimetry results.

  The Hungarian Support programme is expected to issue the final documentation, being (1) a report describing the measurement procedure, related calibrations and correction factors, (2) a final version of the source measurement report, (3) prepare a consolidated calibration curve for the use of the R/T method.

  A further activity under this task could be to investigate the applicability of the gamma and neutron method on capsules embedding multiple sources.

  The reports and documents are expected by mid 2008. Task finalization is foreseen by end 2008.

- HUN A 1667 Development and Evaluation of a Multiplicity Spectrometer Prototype

  The purpose of the task is to explore the design, production, and implementation of a multiplicity spectrometer prototype as a practical experimental tool for the evaluation of the usefulness of advanced time correlation information for safeguards measurements. This work is being carried out by the Institute of Isotopes in Budapest. The researchers active in this project have participated in an international, inter-laboratory comparison of these types of electronics prototypes that is being performed under the auspices of the ESARDA NDA working group. A first progress report was delivered to the Agency in July. The hardware development is completed and evaluation is underway. This task was accepted by the Hungarian Support Programme in March of 2007, and will continue till end 2009.

- USA A 1239 Evaluation of Miniature GRAND Electronic Unit (A.242)

  Recent MiniGRAND development and evaluation efforts have focused on unattended monitoring applications. The Master Processor Board (MPB) has been redesigned to enhance old features and incorporate new features.

  It is anticipated that by mid-2008, new functional test procedures, as well as a report on the nature of degree of severity of the MiniGRAND's behaviour in high-humidity environments, will be delivered by LANL to the Agency. Unless corrective action is indicated, at this time all R&D efforts regarding the MiniGRAND will cease. Similarly, by mid-2008 the upgraded Master Processor Board (with modifications to rectify identified deficiencies) will be delivered to the Agency; it is expected that this will end the R&D efforts on this board also.

- Improve methodology for research reactor verification by monitoring reactivity

The implementation of Agency safeguards at research reactor facilities includes the need to verify the reactor design information and amount of fissile material in the reactor core to protect undeclared manipulations in the reactor fuel cycle. The currently used criticality method can not provide full assurance that no undeclared activities could take place. The new techniques based on monitoring reactor reactivity could provide both verification of the reactor design information, and quantitative verification of the fissile material mass inside the reactor core. The preliminary tests of the new techniques have been performed in two research reactors in Kiev and in Vienna. The results are being evaluated. The further research and development of the new techniques has to be continued. End date is end 2009.

- Safeguards applications of a neutron detector with gadolinium-doped liquid scintillator

  Instruments based on neutron coincidence counting technique in use in the Agency are all based on helium-3 gas detectors. Helium-3 gas detectors have been proven being robust and effective but still have some drawbacks. In particular they need to be surrounded by moderating material, as they are sensitive only to thermal neutrons. This leads to high die-away time, which prohibits some applications. Additionally, relatively low efficiency requires the use of large number of individual tubes to achieve efficiencies consistent with coincidence and multiplicity analysis. In practice it makes the instruments expensive and bulky.

  Liquid Scintillators have been proposed as neutron detectors for applications related to the verification of fissile material in excess. Liquid Scintillators are of potential interest for various Agency applications that include:

  -Replacement of He-3 based detector for coincidence counting instruments,

  -Creation of high-efficiency neutron counter for multiplicity analysis,

  -Verification of spent fuel casks by detection of fast neutrons emerging from the cask,

  -Use of time-of-flight techniques to locate the origin of the neutrons,

  -Associate fast-neutron and gamma detection in a compact probe for fingerprinting applications.

- New Approaches to Neutron Coincidence Data Acquisition and Analysis for Safeguards

  The workhorse of neutron coincidence data collection, the shift register, has been in use now for over 20 years. It has long been known that the shift register, although expedient and robust, does not allow the NDA analysis to exploit some additional useful information about the emitted fission spectrum. Modern electronics are now making it possible for researchers to economically gather and process the detailed pulse streams collected by neutron coincidence detectors. NDA researchers are investigating how the accessibility of these data can help safeguards. Important recommendations from an experts meeting in April 2007 on this topic advised the Agency to encourage continued research into the application of new electronics as well as the expansion of the theoretical base upon which neutron NDA is based. In particular, new approaches would advance safeguards by:

  -Improving detector characterization and calibration

  -Allowing for more complex monitoring of process flow and material movement

  -Improving QA and QC for neutron NDA instrumentation

  -Improving the flexibility to adapt to new safeguards measurement challenges that may arise with new fuel cycle development.

-Aiding authentication of signals from complex neutron detectors.

-Improving understanding of the mechanisms that cause some types of measurement biases due to detector dependent variables and providing means to reduce and/or correct for these biases.

- Develop technologies to support verification of waste and hidden in-process inventories

  Waste and hidden in-process inventories are a particular challenge for the Agency, specifically to rely on portable or transportable equipment in order to keep full independence from Operator equipment. Indeed, there exist rather bulky devices that apply neutron or gamma detection in passive or active mode, but that belong to the facility operators. The Agency has the need for equipment that can easily be deployed in the field. The potential of ISOCS for measuring waste barrels was investigated and recognized, but the investigations of other methods should continue, and include neutron methods. The task continues till end 2009.

- Explore technologies to detect and quantify enrichment and reprocessing

  Enrichment and reprocessing activities belong to the sensitive part of the fuels cycle, and were submitted to further scrutiny. The activities continue under the newly conceived project SGTS-12.

- Investigate detection methods for shielded nuclear material

  Shielded nuclear materials require longer measurement times to obtain good counting statistics and very often the standard analysis software for the determination of enrichment or isotopic composition is not applicable. Alternative analysis software has to be applied and provided as a standard package. A typical example is the enrichment measurement on UF6 cylinders, as well with non-reprocessed as with reprocessed uranium. This is an in-house effort. Task continues until the end of 2009.

- Improve detection capability of alternative detectors and methods.

  The Agency uses routinely various detectors to perform gamma spectrometry. However improving detection capability, specifically towards resolution and sensitivity, is a continuous challenge. The proposed detectors LaCl3 and LaBr3 are new developments, were performance tested on reference nuclear materials. This type of detector combines a better detector sensitivity (30%) with an increased resolution (2% at 122 keV), compared with a NaI(Tl) detector of the same size. This type of detector could be used for isotope identification, and in uranium enrichment applications that could profit from the better resolution. The semi-gaussian peak fitting software NaIGEM can be used with LaCl3 and LaBr3 recorded spectra. The actual price of the detectors does not allow large scale deployment, but individual applications can be considered.

  Attention was also given to alternative detectors and methods, such as Xe detectors, to be used for gamma spectrometry in a gas centrifuge enrichment plant, pixel detectors as actually used for imaging of Cerenkov light in spent fuel assemblies, and cryogenic detectors for broad photonic gamma spectrometry as investigated in LLNL, NIST and the institute for photonic technologies (Jena).

  Neutron detectors under investigation are LiI(Eu) and Boron carbide.

  No concrete results are obtained so far, but safeguards applications look promising, and the studies have to be continued. These are currently in-house efforts, in close contact with the developers, but MSSP assistance may be needed.

*3.2. Enhancing the capability of detecting undeclared materials and activities*

- Adapt hand-held devices originally designed for illicit trafficking monitoring to fulfill traditional safeguards needs.

  The monitoring of illicit trafficking makes use of a series of hand-held devices, which could be useful for safeguards purposes, provided some changes are made. The rapidly developing market in the framework of homeland security is followed. This is a continuous in-house effort, in close contact with the developers, but MSSP assistance may be needed.

- FRA A 1438 Evaluation of Geophysics Non-destructive Methods

  The Ground Penetrating Radar (GPR) is under evaluation, as support for Design Information verification (DIV) during regular inspections and for possible detection of undeclared facilities. All effort was concentrated on the Ground Penetrating Radar that was tested under various experimental conditions. This task was initiated to evaluate commercially available equipment, to consider the most appropriate geophysics methods, and to consider the applicability and limitations for safeguards purposes. The research work was combined with the starting implementation, providing technical assistance to the inspectors, and their training.

  The task has to continue with other geophysical methods, such as ultrasonic, magnetic, electric, and other methods, with the aim to define the potential for DIV, including also determining capabilities and limitations of the technique, to prepare procedures and documentation in order to authorize selected equipment for routine inspection use, and to familiarize with the software for data interpretation. The task continues until the end of 2009.

*3.3. Improving efficiency and effectiveness*

- USA, EC, FRA JNT A 1684 Sustainability and Maintenance of Software for Pu-isotopics and U-enrichment (C.119)

  The Agency has a need to ascertain and standardize software used for the analysis of U-enrichment and Pu-isotopics, and clarified this at the November 2005 International Workshop on "Gamma Evaluation Codes for Plutonium and Uranium Isotope Abundance Measurements by High-Resolution Gamma Spectrometry: Current Status and Future Challenges" (Karlsruhe – Germany). Clear guidelines were identified for future challenges (including technical developments). As a follow-up the Agency issued a roadmap for future developments of gamma codes that culminated in the submission to several MSSPs (USA, European Commission and France) of a request of support in this field.

  In parallel a different initiative was carried on under the framework of the US-DoE/ABACC bilateral safeguards cooperation agreement AS14 with the establishment of an Isotopic Measurements Working Group (focusing only on uranium enrichment measurements).

  Therefore it was considered by those involved in the development, control and use of these gamma evaluation codes to continue the positive experience of AS14, enlarging the participation to the international community, broadening the scope in order to include plutonium isotopic measurements in order to establish a working group (WG) that would respond the needs expressed by the Agency.

  Since AS14 already includes many of the American subject matter experts, it was quite straightforward to look at ESARDA, and in particular to the NDA working group as the catalyser for the institution of this dedicated WG. The proposal to launch the institution of an international Working Group on Gamma Spectrometry Techniques for U/Pu Isotopics was decided in a meeting organised in Aix-en-Provence on the 21st of May 2007.

The task continues until the end of 2009.

- BEL A 1086 Calibration of Underwater Coincidence Counter

  The Agency now has a standardized Underwater Coincidence Counter (UWCC) for the verification of fresh MOX assemblies stored underwater. Calibration of the UWCCs is being supported by task BEL A 1086. Fuel at the Venus Critical Assembly (SCK-CEN) is used to mock-up either 17x17 or 16x16 PWR fuel and 9x9 BWR fuel. The mock-up fuel assemblies along with the UWCC can be placed in a tank filled with water in order to determine calibration coefficients for the detector. Effects of boron content in the water can be implemented by adding boron in increasing amounts. The UWCC experiments are performed on a one meter long simulated fuel column. The task allows to cross-calibrate the existing UWCCs and to calibrate new-UWCCs in the future.

  The current task is continued since a facility for calibrating existing and new UWCCs is needed. An advantage is the ability to calibrate all UWCCs with identical fuel and to cross-calibrate with Euratom UWCCs. The task is continued until the end of 2009.

- EC A 0860 Qualification Testing of New Safeguards Equipment

  The authorization of new equipment for routine use in inspections requires qualification tests to assure the conformity to the Agency's requirements and specifications. The Agency does not have its own test laboratory for these purposes. Therefore the Agency has an ongoing need to conduct such tests on a frequent basis. Task EC A 0860 provides facilities and capabilities for testing equipment at the EC JRC Ispra. This task will be used for testing new instruments and has to continue till December 2009. Testing concentrated mainly on the Electronic Seals (EOSS).

  The document "Common Qualification Test Criteria for New Safeguards Equipment", Technical Note No I99.105, which is the basis for common activities with the EC, was reviewed and discussed in the Agency, as a preparation of the meeting with the EC, aiming at updating of the document, considering that most of the basic standards have changed since 1999. This document has to be approved and authorized. The nuclear part of the testing is removed from the document, and is under review by the Fraunhofer Institute (Germany). A separate meeting was held, and resulted in a draft document.

- EC A 1362 Modeling, Testing and Training for NDA and URM Equipment

  The authorization of new equipment for routine use requires functional tests at different stages of the development process (prototype, pre-production model, final model) to assure conformance to the Agency's requirements and manufacturer's specifications. The new equipment also requires, before implementation, that Agency technicians are trained in commissioning and troubleshooting. In the case of NDA and URM equipment a wide range of SNM samples is needed in order to simulate real measurement conditions both for functional tests and training.

  This is a long lasting umbrella task, covering various aspects of modeling, testing and training for NDA and UMS equipment. JRC-ISPRA will continue assisting the Agency in developing models (e.g. MCNP-PTA) for coincidence counting instrument.

  Numerical simulation applied to non-destructive assay (NDA) is a very effective and low cost alternative to experimental approaches and the Agency plans to use more and more Monte Carlo computation. Main applications of Monte Carlo simulations will be to investigate the feasibility of NDA measurements in specific cases and to calibrate special NDA instruments. The Agency has established in-house resources to perform some of these calculations but must also rely on MSSPs or an external contractor to perform them. The Agency still needs formal guidelines for performing modeling and for describing appropriate steps for validation of the

simulations. In addition to the guidelines, the Agency has a need for expertise in Monte Carlo simulation in order to prepare and validate complex NDA models.

Training was discussed in the Agency, to rely better on the services offered by the JRC-Ispra with access to the PERLA facilities and high variety of nuclear materials.

The Agency does not have a laboratory where different samples of SNM can be handled for these purposes. Therefore, the Agency has an ongoing need to have a laboratory available with these capabilities. This task has to continue until December 2009.

- GER A 1271 Software for Hand Held Gamma Spectrometer (C.35)

  The multipurpose HM-5 is used in routine inspections, in inspections under terms of the additional protocol and in detecting illicit trafficking activities. The functions performed by the HM-5 are dose rate mode, spectrum mode, identification mode, search mode, attribute mode, active length mode, and uranium enrichment determination. Further actions involve implementation support, software upgrading and training of Agency staff.

  Ongoing developments, essentially related to the detector stabilization with LED instead of a cesium source, have to be followed up.

  Testing and debugging has to continue, specifically in the NaIGEM port to HM-5. The LaBr3 version has to be further explored.

  Formalising the ideas about a new generation portable gamma device to succeed HM-5, a draft HM-6 specification has been written, but needs further consideration.

  The task continues until the end of 2009.

- UK A 1408 Technical Manuals and Procedures for Safeguards Instrumentation (E.11)

  Agency instrumentation documentation is an essential support to SGOs to assure correct NDA measurements. Assistance in writing is needed because the workload exceeds available SGTS resources. Task UK A 1408 provides for this assistance. The documentation for each instrument and method consists of a reference manual (RM) for reference and training, and an abbreviated checklist procedure (CP) for in-field use.

  According to the agreed task outline, Reference Manual and Checklist Procedure will be prepared for neutron coincidence devices and applications.

  The task was completed in October 2007 although a similar scope of work will be reconsidered under a new related task proposal.

- USA A 0931 Implementation Support - Instruments and Techniques (A.252)

  This task is an umbrella task covering various subjects that provide direct support for implemented instruments or software. The request for support is made by simple letter, which means that tasks are added according the need. An actual task running under this task number is the development of FDMS and RR codes (A.252.14), possibly towards unattended mode operation. Task is continuous, until end 2009.

- Characterization of the Chernobyl spent fuel

  The characteristics of the Chernobyl #4 spent fuel are determined with the Origen Isotope build-up and depletion code. The RBMK libraries are now available from the developer (through task proposal 05/TNS-016). The former calculations, based on BWR libraries, have to be repeated for consistency. The development goes on until the end of 2008. The calculation capability has to be

kept operational for SGOC applications.

- Quantification of the Cerenkov glow of spent fuel

  The characteristics of reactor spent fuel are determined with the Origen-ARP Isotope build-up and depletion code, version 2.2. Libraries were available from the developer, for PWR, BWR, RBMK reactors, allowing the selection of those fission and activation products that have gamma energies higher than 520 keV. Through Compton Effect, these gammas can produce electrons with sufficient energy to produce Cerenkov glow. Knowledge of the ultra violet light as a function of energy allowed quantifying the Cerenkov glow from spent fuel assemblies as a function of irradiation history and cooling time. The direct contribution of the electrons can be calculated as well. The new software version, with the upgraded libraries allow for new assessments of the source term.

### *3.1. Implementation and field support to Operations Divisions*

- Continue to improve portable inspection kits for CA and inspections under IS safeguards, including the miniaturization of next generation equipment. Investigate new advanced supporting tools for inspectors in the field. Investigate the usefulness and availability of a neutron detector for CA purposes. Make available, upon request of Operations Divisions, specific tools, e.g. RRCA kit. This is an in-house continuous effort.
- Continuous in-house tasks:

  -Continue methods and equipment training for inspectors, and contribute to the training programme organized by SGCP-CTR.

  -Continue to adhere to the quality assurance principles specified in the Agency's equipment authorization procedure.

  -Improve field service by making use of resident technicians in the Tokyo and Toronto Regional Offices and make an extensive use of the technical capability present in the these offices.

  -Implement preventive maintenance policies in order to further extend lifetime of equipment.

  -Judiciously choose sustainable and long-life equipment/components.

  -Maintain control of software packages.

  -Design software to keep pace with rapidly changing computer technologies.

  -Improve security of data and minimize equipment vulnerability.

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

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

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| BEL | A 1086 | Calibration of Underwater Coincidence Counter | Continuous task. Extension till 2009/12 needed. |
| EC | A 0860 | Qualification Testing of New Safeguards Equipment | Continuous task. Extension till 2009/12 needed. |
| EC | A 1362 | Modeling Testing and Training for NDA and URM Equipment | Continuous task. Extension till 2009/12 needed. Also replaces task EC A 1505. |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| EC | A 1505 | Numerical Calibration of Neutron Coincidence Counting Instruments | Task is closed. Activities continue under EC A 1362. |
| EC | A 1507 | Compucea Upgrading | Continuation in plan 2008–2009. |
| FRA | A 1438 | Evaluation of Geophysics Non-Destructive Methods | Continuation in plan 2008–2009. |
| FRA | A 1480 | Evaluation of Thick CZT Detectors for High Sensitivity and High Energy Measurements | Task is sleeping. Decision is needed on continuation or termination. |
| GER | A 1271 | Software for Hand Held Gamma Spectrometer (C35) | Continuation in plan 2008–2009. |
| HUN | A 1667 | Development and Evaluation of a Multiplicity Spectrometer Prototype | Continuation in plan 2008–2009. |
| HUN | A 1503 | Verification of Pu in Pu-Be Neutron Sources by Neutron Assay | Continuation in plan 2008–2009. |
| UK | A 1408 | Technical Manuals and Procedures for Safeguards Instrumentation (E11) | Continuation in plan 2008–2009 although through a related new task proposal. |
| EC<br>FRA<br>USA | JNT A 1684 | Sustainability and Maintenance of Software for Pu-isotopics and U-enrichment (C.119) | Continuation in plan 2008–2009. |
| USA | A 1678 | Junior Professional Officer - NDA Assistant - Research Position, Nuclear Physics (Tompkins) (A.272) | Continuation in plan 2008–2009. |
| USA | A 1607 | Development of ISOCS Self Modeling Capabilities (A.267) | Continuation in plan 2008–2009. |
| USA | A 0931 | Implementation Support - Instruments and Techniques (A.252) (Umbrella Task) | Continuation in plan 2008–2009. |
| USA | A 1157 | NDA Verification Techniques and Procedures for the BRN- Centrifuge Enrichment Plant (A233) | Task will be closed, with agreement of SGOB. |
| USA | A 1239 | Evaluation of Miniature GRAND Electronic Unit (A242) | Continuation in plan 2008–2009. Extension till 2009/12 needed. |
| USA | B 1401 | Neutron Pulse Simulator for Training and Testing (B.94) | |

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

| Task Proposal No. | Task Title | Comments |
|---|---|---|
| New Task 1<br>Objective 2.1 | Improved Methods and Techniques for Safeguarding Nuclear Materials, based on the detection of gamma rays, neutron counting, detection of Cerenkov radiation, or any other relevant technique. | As needed and application specific. |
| 07/TAU-005 | Geophysical Techniques for Design Information Verification | Submitted to FIN SP, and meant as complementary to FRA A 1438. |
| 06/TNS-005 | Software and Hardware Support for the Hand-Held Gamma Spectrometer HM-5 | USA will consider concrete proposal. Complementary to GER A 1271. |
| 05/TNS-016 | Origen ARP Evolution Code Development for Supporting Agency Safeguards Activities | Origin code is extended with libraries for RBMK and electrons. |

| Task Proposal No. | Task Title | Comments |
|---|---|---|
| New Task 1<br><br>Objective 2.1 | Improved Methods and Techniques for Safeguarding Nuclear Materials, based on the detection of gamma rays, neutron counting, detection of Cerenkov radiation, or any other relevant technique. | As needed and application specific. |
| 07/TAU-005 | Geophysical Techniques for Design Information Verification | Submitted to FIN SP, and meant as complementary to FRA A 1438. |
| 04/TNS-013 | Junior Professional Officer (JPO) - Engineers Support to the Section for NDA Systems and Seals | |
| 04/TNS-002 | Guidelines for Application of Monte Carlo Simulation to Agency Safeguards | |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

| Activity Designation | Activity Title |
|---|---|
| 1 | Improve detection capability of alternative detectors and methods |
| 2 | Improve methodology for research reactor verification by monitoring reactivity |
| 3 | Safeguards applications of a neutron detector with gadolinium-doped liquid scintillator |
| 4 | New Approaches to Neutron Coincidence Data Acquisition and Analysis for Safeguards |
| 5 | Develop technologies to support verification of waste and hidden in-process inventories |
| 6 | Investigate detection methods for shielded nuclear material |
| 7 | Adapt hand-held devices originally designed for illicit trafficking monitoring to fulfill traditional safeguards needs |
| 8 | Characterization of the Chernobyl spent fuel |
| 9 | Quantification of the Cerenkov glow of spent fuel |
| 10 | Improve portable inspection kits for CA and inspections under IS safeguards, including the miniaturization of next generation equipment. Investigate new advanced supporting tools for inspectors in the field. Investigate the usefulness and availability of a neutron detector for CA purposes. Make available, upon request of Operations Divisions, specific tools, e.g. RRCA kit. |
| 11 | Continuous in-house tasks:<br><br>Continue methods and equipment training for inspectors, and contribute to the training programme organized by SGCP-TTR.<br><br>Continue to adhere to the quality assurance principles specified in the Agency's equipment authorization procedure.<br><br>Improve field service by making use of resident technicians in the Tokyo and Toronto Regional Offices and make an extensive use of the technical capability present in the these offices.<br><br>Implement preventive maintenance policies in order to further extend lifetime of equipment.<br><br>Judiciously choose sustainable and long-life equipment/components.<br><br>Maintain control of software packages.<br><br>Design software to keep pace with rapidly changing computer technologies.<br><br>Improve security of data and minimize equipment vulnerability. |

# SGTS-02

## Improved Techniques and Instruments for Sealing and Containment Verification

**Project Manager: George Weeks** **Division: SGTS**

### 1. Background

This document describes the plans for the R&D and implementation support for sealing and containment verification systems for the period 2008–2009. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011 and the Strategic Equipment and Technology Development Plan for 2006–2011. In addition, the objectives have been revised to accommodate some of the feedback on the R&D Programme received in 2006 and 2007. The project covers the development and implementation of seals and sealing instrumentation needed for new safeguards applications or for replacement of obsolete and unreliable equipment as well as for routine Safeguards inspection activities. The Seals Unit provides sealing systems and containment verification systems for use by the Operations Divisions as they execute Safeguards activities.

### 2. Objectives

The objectives of this project are principally derived from the following goal and related key activities of the Department of Safeguards Strategic Objectives 2006–2011:

Enhance detection capabilities through the development of new or improved safeguards approaches and techniques, and acquisition of more efficient verification equipment. Key activities include:

- Develop, implement and revise, as appropriate, safeguards approaches for new safeguards situations (e.g. integrated safeguards), facility types and operating conditions, taking into account experiences, conceptual and technological developments and on-going needs for effectiveness and cost-efficiency.
- Optimize safeguards equipment and technology development with the view of further improving present detection capability, increasing reliability of equipment while ensuring the security of information transmission from the field and improving sustainability and timeliness.
- Use where possible equipment and technology already available with the view of adapting it to departmental needs.

***The primary objectives of this project are to 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.***

Specific R&D objectives include the following:

2.1. *Sustain the availability of metal seals and the associated metal seal verification system and provide for the modernization and increased tamper resistance of all system components.*

2.2. *Sustain the availability of both active and passive in-situ verifiable seals, and provide for the modernization and increased tamper resistance of all associated components.*


▲ Enhanced Cobra Seal

2.3. *Develop and maintain seals for facility specific applications and respond to problems arising from worldwide inspection activities conducted by the Agency's Operations Divisions.*

2.4. *Develop techniques, tools and procedures for containment verification.*

2.5. *Establish activities that provide for increased access to advanced concepts and novel technologies related to the development of sealing and containment verification systems, vulnerability assessment methods, and vulnerability mitigation techniques.*

## 3. Activities

3.1. *Sustain the availability of metal seals and the associated metal seal verification system and provide for the modernization and increased tamper resistance of all system components (Objective 2.1.).*

- Laser Surface Authentication of the Metal Seal (Contractor supported activity)

  A UK contractor has conclusively demonstrated the ability of the Laser Surface Authentication (LSA) technique to extract an intrinsic material signature from both the copper and brass parts of the Agency metal seal. Such a technique, if successfully implemented, could augment and potentially replace the subjective imagery analysis method of comparing metal seal optical images. Augmentation will provide strong protection against counterfeiting. Replacement could provide better through-put for verification of metal seals in the Seals Lab. The next steps include a 3rd party vulnerability assessment and the development of two prototypes for the Seals Lab.

- UK E 1691 Laser Surface Authentication (LSA) Design Vulnerability Assessment

  The objective of this Task is to provide a design vulnerability assessment (VA) of the LSA signature method. The LSA technology is a new technique for identifying materials using an intrinsic surface "fingerprint" extracted by a laser scanning device as described above. This

task provides for an investigation by an independent 3rd part of the vulnerability of such a technique. Four basic subtasks are envisioned: an initial vulnerability review, accomplished on 18 September 2007, with the developers of the technology; an investigation of signature replication vulnerability; an investigation of signature removal and replacement; and an investigation of other significant vulnerabilities. A final report is expected on/about 30 June 2008.

- UK E 1692 Vulnerability Assessment of the Agency Metal Sealing System

  The task was accepted on 21 August 2007 with partial discussions on the full statement of work taking place on 18 September. The objective of this Task is to provide a vulnerability assessment (VA) of the Agency metal sealing system in its current configuration and in potentially new configurations. Technology developments over the last decade dictate that a VA of the Agency Metal Sealing System be conducted by an independent party. Since a formal VA of the metal sealing system has not been done for many years, the Agency needs to be informed regarding the impact of new technologies on the vulnerability of the current system. The results of the work will allow the Agency to conduct risk/benefit analyses with respect to metal seal authentication and tamper indication capabilities and new concepts. The Task was accepted on 21 August. Work should begin 4th quarter 2007 and be completed by 4th quarter 2008.

- USA E 1532 Ultrasonically Interrogated Metal Seal (UIMS) (E.144)

  The original objective of this Task was to examine the feasibility of interrogating the Agency metal seal using ultrasonic technology approaches. There were two subtasks. One effort was devoted to ultrasonically interrogating the metal seal optical signature. This effort has been completed, both at the Idaho National Laboratory (INL), and the Pacific Northwest National Laboratory (PNNL). The other subtask, which continues, is to determine the feasibility of interrogating the wire loop outside the seal so as to detect attempts at cutting and splicing the wire. Ultrasonic approaches to this were not successful, but PNNL demonstrated during the first quarter of 2006 proof-of-principle for an eddy current probe approach for detecting cut and splice attempts on standard Agency insulated wire. PNNL has subsequently demonstrated proof of principle for all Agency wire types, and has determined the operating characteristics of a potential instrument. Phase 3 of the project, development of two prototype instruments for the Seals Lab, was approved on 1 August 2007. The prototypes are scheduled to be delivered by mid 2008, at which time the Agency will begin a formal evaluation.

- USA E 1534 Feasibility Study for Change Detection Software Applied to Metal Seal Signatures (E.146)

  The priority of this task has changed and it is currently in standby. The original objective of the Task was to provide a feasibility study and demonstration to determine the usefulness of the Change Detection Software (CDS) technique for Agency sealing systems and containment verification purposes. A feasibility evaluation of the CDS technique as applied to the metal seal optical signature was fully accomplished in 2005. Although funding limitations have prevented continued work in this area, the Task is in standby because the technology is significant and valuable given that the subtasks are revised. Pending funding and Agency staffing availability, the following tasks in priority order should be funded. 1. Adhesive Seal Vulnerability Mitigation. It has been conclusively demonstrated that it is difficult to perform an adhesive seal comparison without using a photographic comparison method. CDS should be evaluated for this purpose. 2. Metal Seal Quality Control. The Agency will be evaluating optical signatures of metal seals for many years, given the large inventory deployed. The CDS technique is particularly useful for analyzing seals that have been corroded or whose signature has been degraded. A CDS implementation in the Seals Lab should be accomplished. 3. CDS Applied to Containment Verification. CDS may be particularly valuable in containment verification situations where a simple sealing system is not possible. A proposal to demonstrate this was found technically acceptable in 2007, but other priorities, coupled with both funding and staffing limitations have prevented project award. This project should remain in standby.

3.2. *Sustain the availability of both active and passive in-situ verifiable seals, and provide for the modernization and increased tamper resistance of all associated components (Objective 2.2.)*

- Adhesive Seal Design Contract (In-house activity with contract support)

  Design of the next Agency adhesive seal, called the VOID-3, is now well under way, with three (3) separate designs having been completed and the final production design under review. However, an iterative VA on the developing design (see below) has disclosed at least one feature which needs to be improved before going forward with a production run. Plans are to introduce the VOID-3 seal, pending these design improvements, in calendar year 2008.

- CAN E 1557 Vulnerability Assessment of the Data Seal

  The Data Seal is an inexpensive electronic seal which communicates via RF with a seal reader and is designed to work in very harsh environmental conditions. Preliminary radiation and environmental tests to confirm the functionality of the seal were successful, and the Canadian Support Program provided an initial vulnerability assessment (VA) in 2005 with a report in 2006. The first phase of this task was a limited scope VA specifically aimed at evaluation of the security of the seal wire. These results were satisfactory and as a result, several modifications of the seal have been recommended. Phase 2 of this task, currently on standby waiting for the manufacturer to make the recommended design changes, will be a full VA of the modified seal. However, given the time and funding required seal modifications, Phase 2 will probably not begin before the 3Q 2008. Further, the manufacturer recently underwent a number of high level management changes and now shows little interest in making the necessary design changes for the small market presented by the Agency. Unless there is a change in this position, this task will be cancelled.

- GER E 0994 Electronic Optical Sealing System (EOSS) Deployment (D.27)

  The EOSS seal, selected in July 2005 as one candidate out of three electronic seals candidates to replace the old VACOSS seal, was moved to category A in November 2005. EOSS inventories began in 2006, with about 1000 seals on hand by 31 December 2007. Planned work for 2008 includes deployment of a critical key management system which includes both hardware and procedures. Deployment of the EOSS in its remote monitoring mode is expected to be tested thoroughly in 2008 in a facility already under safeguards. Once all crypto-tokens are delivered, a large-scale implementation of EOSS seals should occur in 2008 and 2009 as the EOSS replaces the VACOSS.

  This task is also the vehicle being used to fund the development a new irradiation test procedure. The German Support Programme has funded the Fraunhofer Institut (FHI) to develop the procedure. A first version was reviewed in December of 2006. Although the basic science of was sound, no usable procedure was produced. As a result the Agency sent a draft user requirements document for the procedure to the German Support Programme in September 2007. The German Support Programme expects to fund the development of a new procedure in 2008.

- USA E 1533 Adhesive Seal Vulnerability Assessment (E.145)

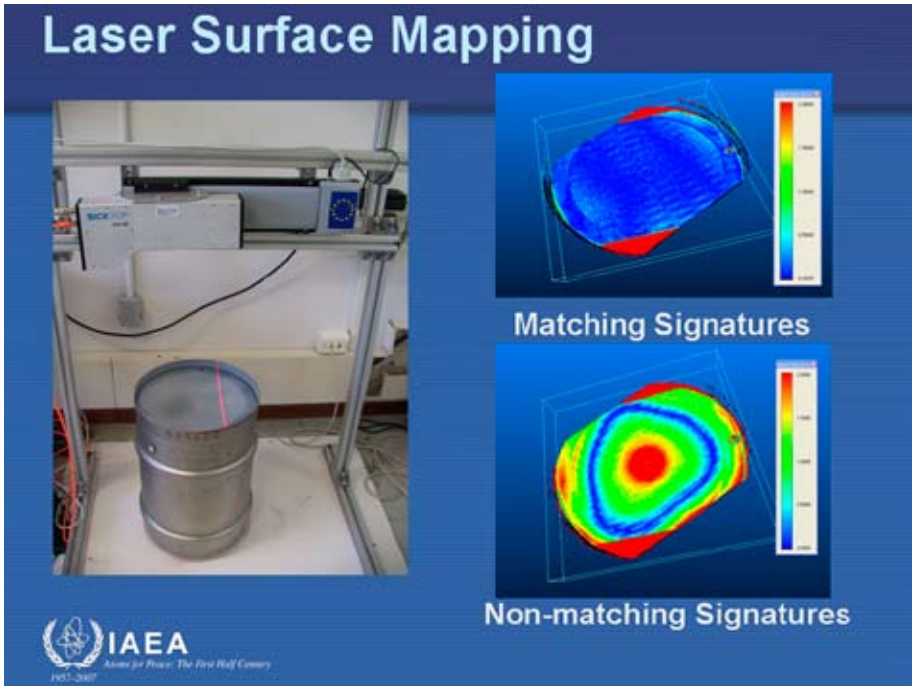
  The objective of this Task is to provide a vulnerability assessment (VA) of the existing Agency adhesive seal, and to provide input with respect to vulnerability mitigation on the design of the next Agency seal, currently being developed by a private sector contractor. A formal VA of the existing seal was completed in 2006 along with subsequent assessments of the developing prototypes. Upon production of the final version of the VOID-3 seal, the Vulnerability Assessment Team will provide a final evaluation, a rank ordered listing of any remaining vulnerabilities, and a training session for Agency staff on how to detect and mitigate these vulnerabilities. This work is planned for completion by mid 2008.

- USA E 1475 Enhancement of the COBRA Fiber Optic Seal System (E.140)

The Enhanced Cobra Seal project, our most important in-situ verifiable passive seal, passed a significant milestone early in 2007 when two prototypes were delivered to the Agency for test and evaluation. The seal, which features an automated verification system as opposed to subjective image comparison, performed extremely well on newly designed Cobra seals with fiber optic cable lengths ranging from a few centimeters to 30 meters. The project has been approved for the next phase, which will provide 4 production prototypes to the Agency for further evaluation in calendar year 2008 and eventual authorization of the new seal, expected by mid 2009.

- 07/TSR-005 Development of the Remotely Monitored Seal Array

Due to the high costs associated with the EOSS seal, it in necessary to develop as sealing system




▲ Laser Surface Mapping

for use in large arrays, such as in large spent fuel storage facilities. With increasing needs for remote monitoring of seals to meet integrated safeguards requirements, this new system needs to be an inexpensive electronic seal. To meet this requirement, the DataSeal and a new international safeguards seal under development at Sandia National Laboratories in the USA are being evaluated. Both of these seals are nearing completion of their respective development cycles. Costs for both of these seals appear to be about an order of magnitude less than the cost of the EOSS. However, recently, Hi-G-Tek has become less interested in adapting the DataSeal for Agency use. For that reason the Sandia International Safeguards Seal (SISS) will be the basis of the new system. This task will fund the final development of the seal as well as the hardware and software necessary to interface the SISS with existing and planned Agency safeguards and remote monitoring equipment. The task is planned to begin in early 2008.

3.3. *Develop and maintain seals for facility specific applications and respond to problems arising from worldwide inspection activities conducted by the Agency's Operations Divisions (Objective 2.3.)*

- CAN E 1364 Implementation Support for IRUSS Systems (pending with European Commission and US Support Programmes)

This task continues to be important as the Agency moves to replace older ARC seals with the

Ultrasonic Sealing Bolt (USSB), discussed below. Although no specific plans for IRUSS support are pending, the Canadian Support Program has been asked in the past to provide reading heads for ARC seals in the field, provide consulting support to resolve sealing problems with the ARC as that system ages, and to provide assistance with correlation results on an as needed basis. This task will be required as a contingency task until such time as the USSB has undergone a full VA and is authorized for use.

- EC E 1559 Update of the Ultrasonic Sealing Bolt

  First prototypes of replacements for the ARC seal were received in early 2006. With the success of the first filed trials conducted in 2006, the field trial was expanded, in October of 2007, to include one half of the seals in the Cernavoda Power Station unit one spent fuel bay. Two versions of the bolt, one for CANDU systems, and another for dry storage, were demonstrated in early 2007, and the need for a 3rd party VA was also recognized at that time. The JRC completed an internal design VA, and is poised to support a 3rd party VA now scheduled for calendar year 2008. Besides this support, continued JRC support for the USSB is expected in 2008 during field trials at facilities currently under Agency Safeguards. The JRC has provided, and will continue to provide, training as required.]

- USA E 1535 MMS Software Update (E.147)

  The TRFS seal, a Category B system since 2003, has been developed to meet not only facility specific requirements but also to demonstrate the first use of remote monitoring (RM) of in-situ seal data. The system has been operational at KAMS since 2004, with RM capabilities demonstrated in 2005, and routine RM from Agency HQ implemented in 2006. It is now clear that a software upgrade is required and the Agency expressed a desire for a new and simpler approach to the Material Management System (MMS) software. Due to lack of funds, no further work has been completed since early 2006. The software update is still required and the task should remain in standby.]

- USA E 1700 Vulnerability Assessment of the Ultrasonic Sealing Bolt

  As discussed above, the European Commission Joint Research Centre in Ispra, Italy is developing an enhancement, including two applications variations, of the existing Ultrasonic Sealing Bolt, or USSB, as currently used elsewhere in Europe. The new system uses multiple independent, but spatially related unique identity elements making the bolt difficult to counterfeit. The new system reads the unique identity elements using an ultrasonic transducer and compares the spatial relationships between them. The seal integrity element is identical to the previous version of the USSB. While the USSB as currently configured is authorized for safeguards use, significant changes to the USSB, including the dual application, require that a 3rd party VA of the new systems be conducted as part of the authorization process. Though the number has not been assigned, the US Support Programme accepted this task on 3 October 2007, with award to Sandia National Laboratories, Albuquerque, NM, USA. The work will be conducted in 2008.

*3.4. Develop techniques, tools and procedures for containment verification (Objective 2.4.)*

- EC E 1549 Laser Surface Mapping of Canister Closure Welds

  The Joint Research Centre, Ispra, made significant progress on a containment verification system which provides for the verification of a container surface. This is done by the acquisition of reference scans on the container which can later be verified by the acquisition and inspection of a single verification scan against a single sampled reference from the same container. Agency staff received training on this system in 2007, and given the ability to verify complete containment, the requirement to identify closure welds may be dropped. Plans for 2008 include design of options to significantly reduce cost, improvement and further development of the software, and test and evaluation required to proceed with authorization.

- USA E 1588 Development of a Conduit Monitoring System

  ORNL is developing a conduit monitoring system that will detect attempted conduit tampering in real time. Under this task this system will be tested using Agency standard conduit and cables to the prove feasibility of using this method to identify attempted tampering with conduit carrying sensitive instrument signal cables. An important performance parameter will be the ability of the system to discriminate genuine tampering attempts from other events that are more properly classified as noise. A demonstration of the technology in 2007 showed the system is able to correctly classify most conduit manipulation attempts. Planned work includes further development of both hardware and software systems in order to improve system performance, testing of prototypes at the Agency as they become available, environmental testing, and preliminary vulnerability assessments.

- USA E 1608 Vulnerability Assessment of the Tamper Indicating Foil

  The EOSS seal contains a unique vulnerability resistant tamper indicating foil. The Agency is considering using this tamper foil technique with other instrumentation and perhaps in expanded applications such as containment verification. However, the foil requires a focused vulnerability assessment if its applications are to be extended. Sandia National Labs began the Vulnerability Assessment of the Tamper Indicating Foil in mid 2006, and has since provided a valuable report, recommending enhancements to the foil design. Plans for 2008 are to pursue these enhancements with the developer.

- Wall Containment Sensor System (WCSS) Testing and Qualification (In-house activity)

  The purpose of the WCSS instrument is to detect attempts to break through large containment areas, particularly walls or roof-tops. One objective under SGTS-02 is to evaluate containment verification systems and provide standardized equipment. In this case, there is a specific objective of evaluating the WCSS system and approving it for inspection use (Cat. A). Major elements of this activity will include prototype acquisition, functional testing, required safety reviews, a vulnerability assessment, qualification tests, field testing, and final documentation. Elements of the prototype instrument have been obtained, but evaluation efforts will not begin until 2009 due to staff working higher priority projects. Work could begin in 2008 if additional staff, such as an intern, could be found.

3.5. *Establish activities that provide for increased access to advanced concepts and novel technologies related to the development of sealing and containment verification systems, vulnerability assessment methods, and vulnerability mitigation techniques (Objective 2.5.)*

- Sealing Systems and Containment Verification Technical Meeting (In-house activity with contractor support)

  A second Technical Meeting on Sealing Systems and Containment Verification Methods was again conducted in February 2007, following the January 2004 meeting. The regular examination, by calling together a group of experts, of future sealing techniques and containment verification tools consistently results in significant enhancements to the long-lead planning for technology development and deployment under Project SGTS-02. In particular, the technical meetings help the Seals Unit articulate well-defined work plans for short, medium and long term activities. Based on this result and other workshop recommendations, a follow-on SVC workshop is planned for the calendar year 2009 or 2010.

- Vulnerability Assessment Capability Development (In-house activity)

  The Agency has now developed an initial laboratory bench-scale vulnerability assessment capability in order to screen newly developed sealing systems and containment verification designs. This equipment has been used to screen developing prototypes for the new adhesive seal. Sealing systems and containment verification hardware systems are included, but software

issues are also relevant as the Agency moves towards increased reliance on remote monitoring of sensitive in-situ seal data. A new data security specialist (P-staff) member has been hired for this purpose, and a new VA laboratory specialist (G-staff) will come on board in 2007. Plans for 2008 are to increase the Agency's capabilities in these areas.

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

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

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| CAN | E 1364 | Implementation Support for IRUSS Systems | Standby as required pending USSB deployment |
| CAN | E 1557 | Vulnerability Assessment of the Hi-G Tek DataSeal | Standby for Phase 2 |
| EC | E 1549 | Laser Surface Mapping of Canister Closure Welds | Ongoing. |
| EC | E 1559 | Update of the Ultrasonic Sealing Bolt | Ongoing. |
| GER | E 0994 | Electronic Optical Sealing System (EOSS) (D.27) | Ongoing |
| UK | E 1691 | Laser Surface Authentication (LSA) Design Vulnerability Assessment | Ongoing |
| UK | E 1692 | Vulnerability Assessment of the Agency Metal Sealing System | Ongoing |
| USA | E 1475 | Enhancement of the COBRA Fiber Optic Seal System (E.140) | Ongoing |
| USA | E 1532 | Ultrasonically Interrogated Metal Seal (E.144) | Eddy Current Wire Probe in development |
| USA | E 1533 | VOID-3 Vulnerability Assessment (E.145) | Ongoing |
| USA | E 1534 | Feasibility Study for Change Detection Software Applied to Metal Seal Signatures (E.146) | Standby |
| USA | E 1535 | MMS Software Update (E.147) | Standby |
| USA | E 1588 | Development of a Conduit Monitoring System | Ongoing. |
| USA | E 1608 | Vulnerability Assessment of the Tamper Indicating Foil | Ongoing |
| USA | E 1700 | Vulnerability Assessment of the Ultrasonic Sealing Bolt (E.154) | Accepted Oct 07 by US Support Programme. |

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| 06/TNS-001 (Objective 2.4) | Eddy Current Based Containment Verification System | Outstanding – To be withdrawn |
| 07/TSR-005 (Objective 2.2) | Development of the Remotely Monitored Seal Array | Sent to US Support Programme |

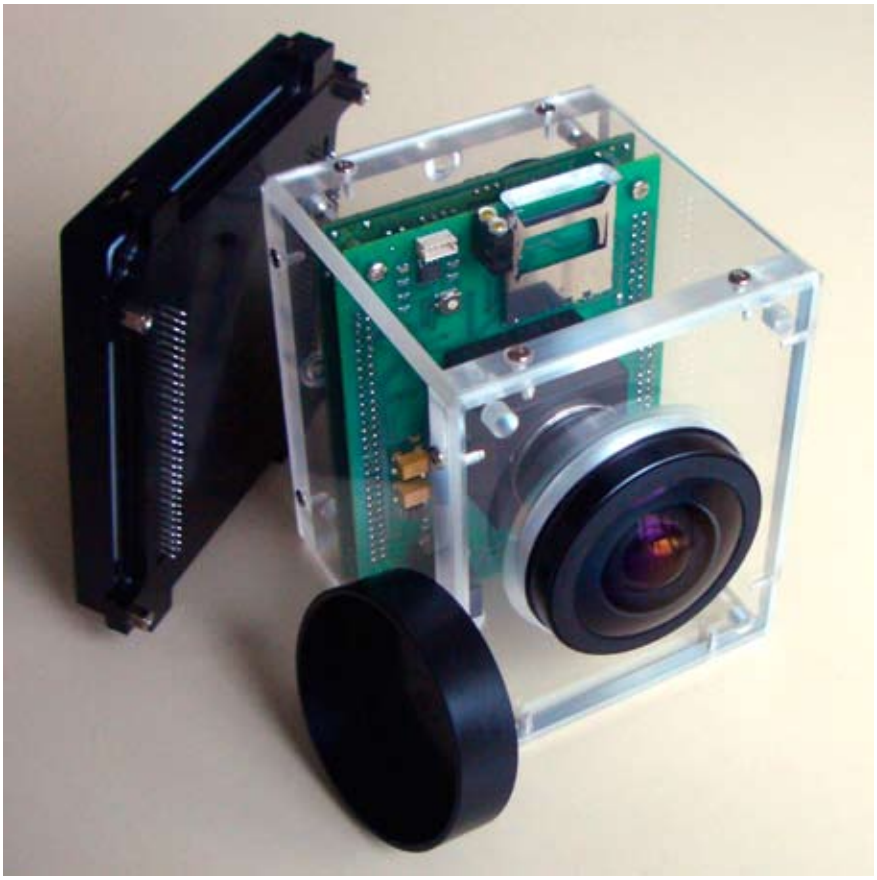
# SGTS-03

## Next Generation Surveillance Systems

### Project Manager: Martin Moeslinger — Division: SGTS

### 1. Background

This document describes the plans for developing and implementing optical surveillance equipment within the Department of Safeguards for the period 2008–2009. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011 and the Strategic Equipment and Technology Development Plan for 2006–2011 prepared by the Division of Technical Support. In addition, the objectives have been revised to accommodate some of the feedback on the development programme received in 2006 and 2007. The project covers the development and implementation of optical surveillance equipment needed for new safeguards applications, for the replacement of obsolete or unreliable equipment and surveillance instruments for routine safeguards inspection activities. The SGTS Surveillance Unit provides optical surveillance equipment, lighting solutions and laser based verification instruments to all Agency Operations Divisions as they execute safeguard activities.



▲ NGSS Prototype Dome Camera and Safeguards Core Component (SCC)

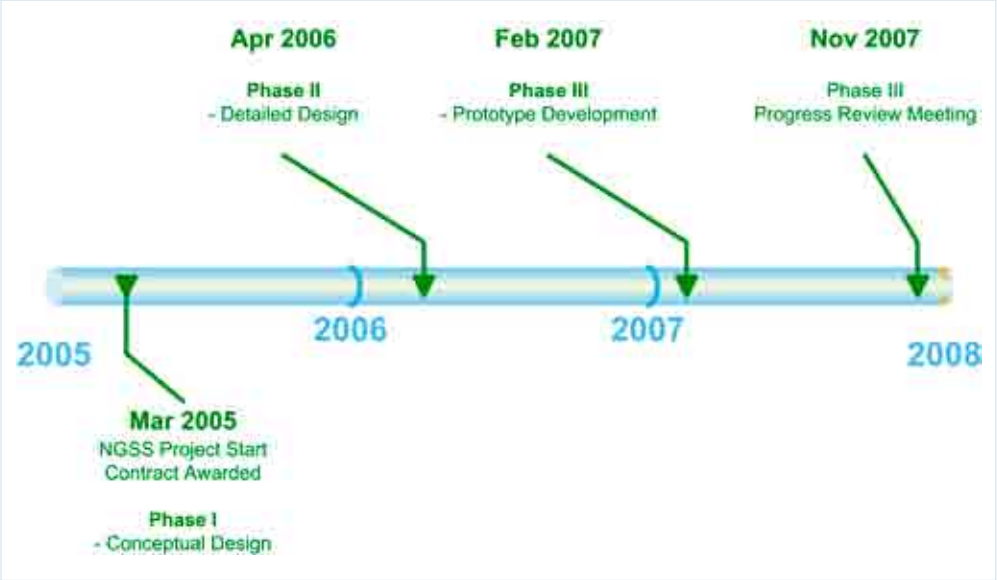
One of the project's main objectives is the development of the Next Generation Surveillance System (NGSS) designed to replace the current Digital Image based surveillance (DIS) technology which has reached the end of its lifespan. Funding for most of the described development and R&D activities is foreseen to be provided to a large degree by Member States Support Programmes (MSSPs) which continue to play an important role in achieving the stated project objectives.

### 2. Objectives

The objectives of this project are principally derived from the following goal and related key activities of the Department of Safeguards Strategic Objectives 2006–2011:

Enhance detection capabilities through the development of new or improved safeguards approaches and techniques, and acquisition of more effective verification equipment. Key activities include:

- Optimize safeguards equipment and technology development with the view of further improving present detection capability, increasing reliability of equipment while ensuring the security of information




▲ NGSS Timeline Until End of 2007

transmission from the field and improving sustainability and timeliness.

- Use where possible equipment and technology already available with the view of adapting it to departmental needs.
- Pursue R&D activities in the development of novel technologies for detection of undeclared activities using, inter alia, Member States Support Programme mechanisms as well as internal resources and expertise.

***The project's overall objective is to develop and implement optical surveillance equipment needed for new safeguards applications, for the replacement of obsolete or unreliable equipment and provide surveillance instruments for routine safeguards inspection activities.***

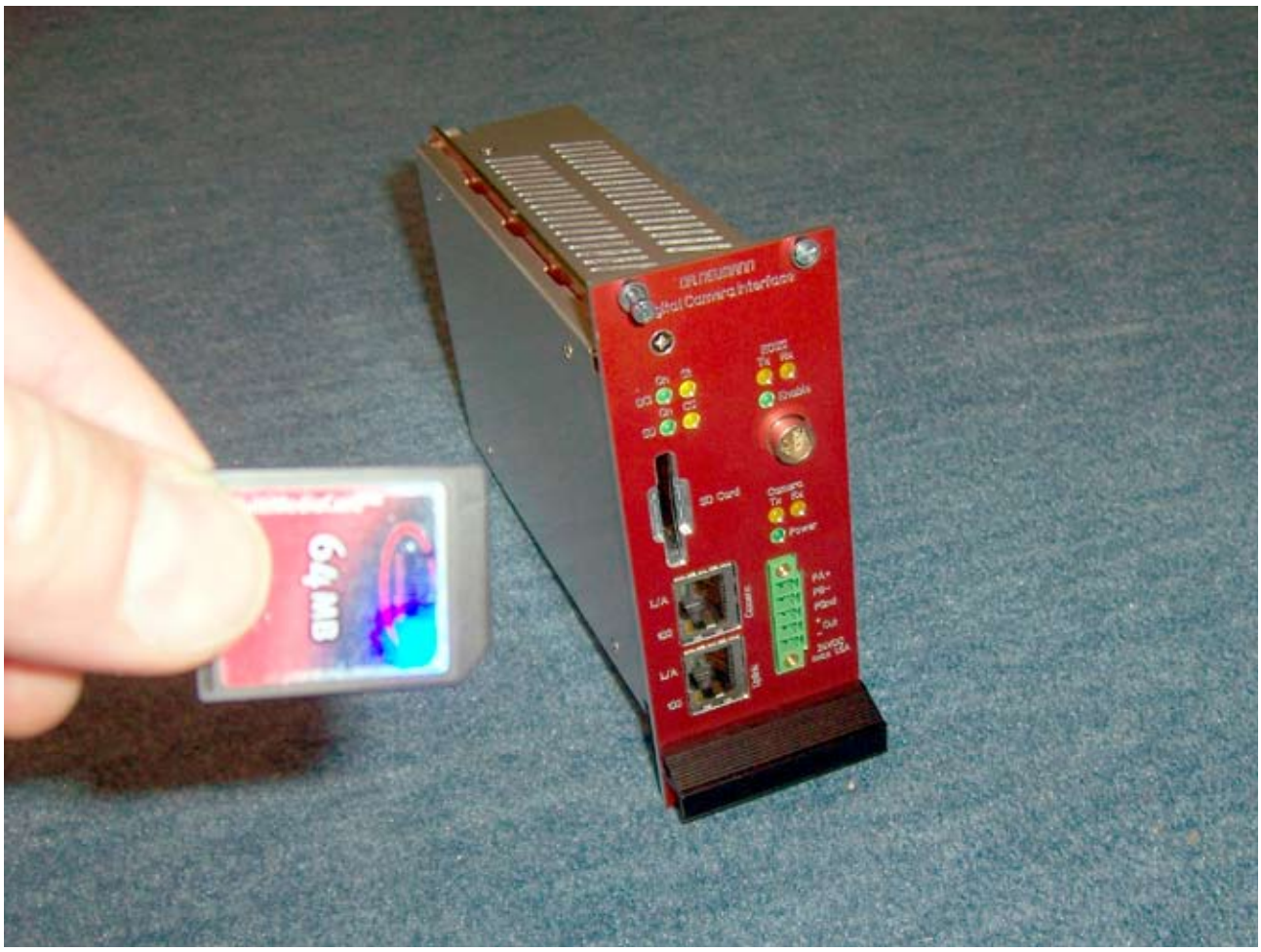
In particular the following specific objectives can be identified:

2.1. *Based on Departmental user requirements, develop, test and authorize next generation surveillance equipment that will be used in both classical and new safeguards regimes and will replace aging DCM14-based systems by the end of 2009.*

2.2. *Develop and implement 3D imaging that would allow improved inspector vision and enhanced pattern recognition.*

2.3. *Enhance surveillance capabilities by further developing non-video based systems (laser, radar, etc.) for both imaging and design verification application.*

2.4. *Implement stronger image and data authentication encryption techniques, based on open certified standards.*




▲ NGSS Digital Camera Interface

*2.5. Expand current capabilities by extending surveillance beyond the visible light spectrum.*

*2.6. Develop components to better sustain surveillance implementation.*

## 3. Activities

The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes.

*3.1. Develop, test and authorize next generation surveillance equipment. (Objective 2.1. and Objective 2.4.)*

- JNT E 1437 GER/USA Next Generation Camera Module and Server-Based Surveillance System

  The Next Generation Surveillance System (NGSS) is designed to cover the future Agency surveillance needs for both current and new safeguards verification regimes. The development of NGSS is broken down into four phases to facilitate effective and efficient project management and to allow phased funding. Development Phase 3 (NGSS Prototype Development) is planned to be finished in March 2008 while Phase 4 (Prototype Construction and Testing Support) which will ultimately put deployable NGSS technology into the hands of the Agency is foreseen to be completed at the end of 2009. While the NGSS development contracts are funded through Member State Support Programmes (MSSPs) significant Agency staff resources will be required to manage the NGSS task and to carry out system and authorization activities until the end of 2009.


▲ NGSS Timeline 2008 to Completion

- Hawk Digital Imaging System (HDIS) (In house activity)

  HDIS is a self contained, light weight and portable back-up surveillance camera. HDIS is based on commercially available technology, modified to meet Agency requirements and was developed to sustain the implementation of portable, temporary surveillance facing the end of the life cycle of currently used equipment (ALIP all-in-one-portable surveillance camera). The development of HDIS is entirely carried out with regular Agency financial and staff resources in cooperation with a US contractor. Activities related to the equipment authorization process as well as technology improvements on the speed on which internally stored surveillance images can be accessed will be ongoing until the end of 2008.

3.2. *Develop and implement 3D imaging that would allow improved inspector vision and enhanced pattern recognition (Objective 2.2.)*

- EC E 1636 - Software Engineering Support for 3D Camera Development

  Task EC E 1636 is foreseen to move back to active status with the implementation of the integration of JRC's 3D camera technology with the Next Generation Surveillance System (NGSS) camera hardware. Additional in-house resources will be required until the end of 2009. It is planned to ask the US Support Programme for additional assistance in case hardware device support is identified as being required from the NGSS side.

3.3. *Enhance surveillance capabilities by further developing non-video based systems (laser, radar, etc.) for both imaging and design verification application (Objective 2.3.)*

- EC E 1425 3D Laser Range Finder for Design Verification in RRP

  The 3D Laser Range Finder device (3DLR) was developed in cooperation with the EC Joint Research Center Ispra and under significant contribution by the EC Support Programme. Further improvements of the 3DLR software will be required. The 3DLR encryption module has to be revised and has to undergo validation and authorization. The described task is planned to be completed by the end of 2008.

- EC E 1696 - Laser Item Identification System (L2IS) and FRA E 1682 Field Testing.

  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. The data generated by the L2IS system installed at Rokkasho has to be analyzed in order to further improve the L2IS prototype and to meet all requirements of SG operations divisions. Significant (regular) financial and staff resources are required to complete the system development and the safeguards equipment

authorization process until the end of 2009. The French Support Programme is assisting with field testing of the technology under task FRA E 1682.

*3.4. Expand current capabilities by extending surveillance beyond the visible light spectrum (Objective 2.5.)*

- Feasibility study for use of surveillance cameras beyond the visible light spectrum

  A feasibility study to investigate the performance of optical sensors operating outside the visible light range and their applicability in regard to safeguard requirements and applications will be conducted in 2008. Funding for this study will be sought from MSSPs and a corresponding request to SPA will be made by June 2008.

*3.5. Develop components to better sustain surveillance implementation (Objective 2.6.)*

- GER E 1341 - Remote Monitoring and Unattended Digital Surveillance Systems

  This task is used for a maintenance contract with DNC, Dr. Neumann, the manufacturer and designer of DCM-14 based digital surveillance systems currently used by the Agency. The task aims at providing resources for the implementation of reliable standard DIS based surveillance systems.

- USA E 1108 - Manufacturer Support for DIS Systems

  In addition to two DIS (Digital Imaging System) factory support engineers working within the framework of this task to support the implementation of DCM-14 based surveillance systems one additional engineer is provided until August 2008 to assist in the recovery from this "SDIS Y2K7 bug". A review of the required resources and workload to be covered by the SGTS Surveillance Unit within the next two years confirms the ongoing need for at least the current level of factory support until the end of 2009 and beyond.

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

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

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| EC | E 1425 | 3D Laser Range Finder for Design Verification in RRP. | Ongoing - Completion date Dec. 2007 |
| EC | E 1696 | Laser Item Identification System (L2IS) | Ongoing – Completion date Dec 2008 |
| EC | E 1636 | Software Engineering Support for 3D Camera Development | Stand-By. Concept under review, to get reactivated in 2008 |
| FRA | E 1682 | Laser Item Identification (L2IS) System Field Testing Phase 2 | Ongoing – Completion date Dec 2008 |
| GER | E 1341 | Remote Monitoring and Unattended Digital Surveillance Systems (D.34) | Ongoing - Completion date Dec. 2007 |
| GER<br>USA | JNT E 1437 | Next Generation Camera Module and Server-Based Surveillance Systems | Ongoing - Completion date Dec. 2008 |
| USA | E 1108 | Manufacturer Support for DIS Systems (E.133) | Ongoing - Completion date Dec. 2008 |
| USA | E 1249 | Upgrading of GARS Review Software (E.119) | Ongoing - Completion date Dec. 2008 |

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

| Task Proposal No. | Task Title | Comments |
|---|---|---|
| Planned task 1 | 3D Spatial Imaging Techniques to Enhance Current 2D Optical Surveillance | Concept under development. Expected to be submitted to SPA by December 2007 |
| Planned task 2 | Feasibility Study for Use of Surveillance Cameras Beyond the Visible Light Spectrum | Concept under development. Expected to be submitted to SPA by June 2008 |
| Planned task 3 | Fuel Rods Pins Identification in Storage Magazine | Requested by SGOA for JMOX, to be submitted to SPC in 2008 |
| Planned task 4 | MOX Canisters Serial Number and Content Identifier | Requested by SGOA for RRP, to be submitted to SPC in 2008 |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

| Activity Designation | Activity Title | Comments |
|---|---|---|
| Task 1 | Hawk Digital Imaging System (HDIS) | Ongoing through 2008 |

# SGTS-06

## Destructive Analysis of Nuclear Materials for Safeguards

**Project Manager: Roger Lafolie** **Division: SGTS**

### 1. Background

This document describes the plans for developing and implementing techniques for the destructive analysis of Nuclear Materials for the period 2008–2009. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011 and the Strategic Equipment and Technology Development Plan for 2006–2011 prepared by the Division of Technical Support.

Destructive analysis (DA) of Nuclear Materials is carried out for the Department of Safeguards by the Seibersdorf-based Safeguards Analytical Laboratory (SAL) in cooperation with the Agency's Network of Analytical Laboratories (NWAL) in Member States, to provide timely and accurate results. The DA results allow the Department of Safeguards to (1) verify that nuclear materials are properly accounted for, and (2) that detection of the diversion of a significant quantity of nuclear material can be made with a high probability. Other applications of nuclear material DA include (1) the characterisation of working standards for the calibration of non-destructive analytical instrumentation, (2) the verification of the operator's measurement system, (3) the validation of the quality and independence of on-site laboratory measurements, and (4) the preparation and validation of large-sized dried spikes for assay determination by isotope dilution mass spectrometry of spent fuel and high-active liquid waste samples from reprocessing plants.

▲ Nuclear Material Samples Handled in Glovebox

The implementation of integrated safeguards will, in some cases, reduce or even eliminate the need for collection of nuclear material samples, therefore DA sampling strategies (number and size of samples) and the laboratory resources necessary for supporting DA capabilities will need to be re-evaluated.

SAL currently analyses about 95% of nuclear material samples. The capacity of the NWAL for nuclear material DA is presently limited, partly due to the attrition of DA-capable laboratories over the past decade and partly due to the increasing cost of shipping nuclear materials within and across State borders. The current situation for the Agency, in which the shutdown of SAL would indefinitely terminate most DA testing for the Department of Safeguards, is being addressed through an aggressive plan to identify and qualify new laboratories for nuclear material DA.

This project examines the present concept of DA for the Department of Safeguards, from the sampling to the evaluation of the analytical results, with the intent of economizing sample size and sample numbers where possible, while maximizing the efficacy and timeliness of the DA results for making meaningful conclusions.

This outcome of the project will benefit the entire Safeguards analytical chain:

- The facility operator will receive validation of its measurement system;
- The inspector will receive high-quality and timely analytical results;
- The evaluator may draw accurate conclusions from fewer DA results;
- Member States will continue to receive accurate statements on their declarations.

## 2. Objectives

The objectives of this project are derived from the following goal and related key activities of the Department of Safeguards Strategic Objectives 2006–2011, which assures quality and timely performance of DA tasks.

Goal: Enhance detection capabilities through the development of new or improved safeguards approaches and techniques, and acquisition of more effective verification equipment.

- Optimize safeguards equipment and technology development with the view of further improving present detection capability, increasing reliability of equipment while ensuring the security of information transmission from the field and improving sustainability and timeliness.
- Use where possible equipment and technology already available with the view of adapting it to departmental needs.
- Pursue R&D activities in the development of novel technologies for detection of undeclared activities using, inter alia, Member States Support Programme mechanisms as well as internal resources and expertise.

***The primary objective of this project is to establish a functional, cost effective network of laboratories for nuclear material DA analysis while optimizing the external resources provided to the Agency by Member States, in order to reduce the time response, the shipment costs and the waste production.***

The specific objectives for the project address the need for continuous research, development and implementation activities that must be applied in the following three directions:

2.1. *To optimize external resources provided to the Agency by Member States, with a focus to re-examine sample collection procedures, reduce shipment costs, improve timeliness and minimize radioactive waste production.*

2.2. *To the extent possible, establish a functional, cost-effective network of laboratories for nuclear material DA. These combined NWAL should have adequate capacity to carry out a significant portion of the annual sample load, on short notice, in case of a shut-down of SAL.*

2.3. *To maintain a high level of analytical performance, capability and capacity at SAL.*

## 3. Activities

To support the project's objectives, the following general activities will be pursued:

3.1. *Revise the sampling procedures in order to reduce the shipment costs and waste production at SAL, while maintaining sufficient analytical quality (Objective 2.1.)*

- Identify sampling approaches

  According to the purpose of the sampling, to define the level of precision required, the analysis type that is fit for purpose and the time response needed. Currently, the sampling criteria are not reflected in the STR69 for the various purposes of analytical results (i.e. "correctness of declaration" in the case of a routine inspection, or "completeness of declaration" in the case of a complementary access).

  An MSSP task request (1) will be prepared to perform a complete study for different approaches of sampling according to the need of the Safeguards Operations and the performance of the associated modern analytical techniques.

- Update of the Safeguards Technical Report 69

  The STR 69 is regularly updated and is the guide for the inspectors and analysts with regard to the size of samples according to the nature and/or the associated analytical technique, the shipment regulations, etc.

  An MSSP task request (2) will be prepared to perform a complete revision of the document.

- Update of the International Target Values (ITV)

  The ITV defines the minimum level of performance requested from the different analytical techniques. This document, in association with the STR 69, requires an update. The update of document is carried out on a regular period by the ESARDA Working Group DA. The Agency will contribute to the update of this document.

  An MSSP task request (3) will be prepared to perform an update of the document.

- UF6 sampling technique

  The sampling of the UF6 at enrichment facilities is difficult and time consuming. The shipment of the samples is expensive (dangerous goods) and the maintenance of the containers is expensive and labor intensive.

  Brazil has published a study of a new principle to complex the gas UF6 in alumina pellets to avoid transporting gas samples.

  An MSSP task request (4) will be prepared to study and develop a sampling technique for UF6. To be submitted to Brazil.

- JPO to assist with the management of the development

  In addition, to process with all these new tasks, the Agency will request the support from the MSSP for the participation of a JPO.

*3.2. Optimisation of external resources in order to develop the NM DA NWAL (Objective 2.2.)*

- Network laboratories strategy for nuclear material DA

  The main goal of this objective is to provide a back-up to SAL for nuclear material DA. Nevertheless, expanding the NWAL of DA of nuclear material should be driven with a solid strategy to guarantee the participants a regular sample load in order to avoid the atrophy of capabilities as was the case a few years ago. A key driver for the maintenance of a nuclear material DA NWAL will be cost effectiveness. The Agency must review the full spectrum of logistics-related tasks that will impact the overall cost-benefit of keeping an exercised NWAL for DA. In parallel, a quality assurance (QA) management plan should be established so that all qualified members of NWAL satisfy the Safeguards requirements for analytical results.

▲ Samples Prepared for Destructive Analysis

An MSSP task proposal (5) will be prepared to study, develop and implement a plan of expansion of the NWAL and an associated QA management system.

- Qualification of the Agency's Network of Analytical Laboratories for nuclear material

  In June 2004 the CEA Valduc was nominated by the FRESPAS for qualification for analysis of nuclear material, including impurities measurements. According to the procedure of qualification all quality control documents have been provided and the test samples should be analysed by the end of 2007. The final evaluation is expected by January 2008. Task FRA A 1479 – CEA Valduc

  02/TCS-001 for other MSSPs to be submitted to East Europe countries in priority for shipment cost reasons.

- Development of "in-State" DA techniques

  Some of the Member States have the capability to perform analytical measurements through national laboratories. The idea is to investigate the benefit the Agency could obtain by using this capability (infrastructure associated with an inspector presence or blind samples provided to national laboratories) to perform, locally, the measurements of the samples taken. This achievement will benefit by shipment costs saving.

  An MSSP task proposal (6) will be prepared to study the feasibility of the in-state approach, or at least defining the acceptability of the concept.

- Development of "in-the-field" DA techniques

  This activity is also related to novel technology. EURATOM uses a technique called COMPUCEA, to analyse in the field the concentration and enrichment of uranium pellets and powders produced in the conversion and fuel fabrication facilities.

  An MSSP task proposal (7) will be prepared to study and implement a similar technique for the Agency's inspectors. To be submitted to European Commission Support Programme.

### 3.3. *Maintain a high level of performance and expertise at SAL (Objective 2.3.)*

Procedures, equipment systems and infrastructure for nuclear material analysis

The main techniques used for analysis of nuclear materials are: potentiometric titration (for U samples), coulometry, spectrophotometry (for Pu samples), K-edge X-ray fluorescence (for all U, Th and Pu materials containing a sufficient amount of the analyte), TIMS (for determination of NM isotopic composition), IDMS (for U and Pu assay from samples with low content of NM and high-active samples), ICP MS (for measurement of impurities in NM).

The current and future tasks planned for 2008–2009, related to procedures, equipment and infrastructure used for destructive analysis of safeguards samples are:

- SAL infrastructure

  USA D 1523 Software Development Support: Laboratory Information Management System for SAL (D.156):

  Support is required to facilitate software development for a laboratory information management system (LIMS) at SAL. The current, obsolete laboratory information management system needs to be replaced.

  The US Support Programme performed the first subtask of the proposal, a top-to-bottom review of work done to date and the project plan; to define scope of project and sub-projects and estimate their costs, resource requirements and schedule; to assess risks and prepare a feasibility study. In 2007 the task is in the second phase, which should support SAL with equipment and expert consultation to implement the new LIMS.

- SAL reference material qualification technique / coulometry

  USA A 1049 Controlled Potential Coulometry at SAL — Technical Support for 3-5 mg Pu Determinations Using the SRL Coulometer (A.218):

  SAL uses the SRL coulometer for determination of milligram amounts of Pu after its quantitative chemical separation from potential interfering species. With the help of the US Support Programme, procedure and equipment for purification of Pu samples prior to coulometric measurements were installed at SAL, and related hardware and software were upgraded.

  The annual calibration of the instrument, review of data, and attendance to analytical problems associated with instrument electronics by Savannah River Site experts is required to maintain highest measurement quality.

- Spectrophotometry

  JPN B 1347 Plutonium-VI Spectrophotometry for Verification Measurement of HALW (JC-19):

  The method of plutonium-VI spectrophotometry has been developed and tested for independent on-site verification measurements of samples taken from HALW solutions at the Rokkasho Reprocessing Plant. The equipment is in the process of authorization for inspectors' use.

- X-ray fluorescent analysis

  USA A 1369 Enhanced ANM Capability for HKED Software at SAL (A.250.01):

  A prototype X-ray fluorescence measurement system for the determination of Np, Am, and Cm on the base of the Hybrid K-edge Densitometer instrument has been developed and installed at SAL and is being tested. The major task objectives have been met. Outstanding issues

essentially surround code validation, especially with regard to Np in Pu and MOX samples. SAL is currently pursuing acquisition of spectra from TRP-Japan as a proxy for running actual samples, which is prohibitively costly. In the future SAL would like to maintain its link to LANL HKED expertise through this task.

- Inductively coupled plasma mass spectrometry

  A new ICP Mass Spectrometer is being installed at SAL; it will be used to directly support the rapid analysis of nuclear waste impurities, clean lab blanks, special samples originating from complementary access, and nuclear materials seized from illicit trafficking.

  04/SAL-004 Technical Support for Sample Preparations for ICP MS Impurities Analysis:

  Submitted to the French Support Programme in June 2004.

  07/SAL- SP1 Mass Spectrometry Training

  A new umbrella task covering all types of mass spectrometers (ICP/MS, TIMS, SIMS,..)

  Submitted to the European Commission Support Programme, October 2007

- External QA programme on analysis of nuclear material

  SAL and NWAL participate in REIMEP (IRMM), EQRAIN (CETAMA), BNM and SME (NBL) inter-laboratory measurement evaluation programmes.

  The current and future tasks planned for 2006–2011, which relate to these activities are:

  EC A 0267, Analytical Quality Control for SAL (REIMEP);

  FRA A 1100, Analytical Quality Control Services fro SAL and NWAL (EQRAIN);

  FRA A 1304, Participation of SAL in the Inter-laboratory Test of BNM;

  USA A 1497, Analytical Quality Control – Participation of SAL in NBL SME Programme (A.264);

  External Quality Control of NWAL Analytical Services (NET A 1467, RUS A 1514, CZ A 1516 – participation in EQRAIN).

- Traceability of analytical results

  SAL is provided with specially developed certified reference materials for analysis of NM. The related tasks planned for 2008–2009 are:

  Certification of Pu alpha spectrometry standards.

  EC A 0318, Special Reference and Source Materials for Destructive Analysis

  Provision of certified U isotopic mixtures.

  FRA A 1101, Special Reference and Source Materials for Destructive Analysis

  Provision of certified Pu metal and MOX powder reference materials.

  USA A 1496, Traceability of Destructive Analysis Measurements (A.263)

Provision of NBL Certified Reference Materials.

03/SAL-007, Provision of Certified LWR MOX Pellet Standards for SAL

Submitted to the UK Support Programme.

Re-packaging and validation of Pu-240, HEU mixed spike solutions for NM measurements: New task proposal, to be submitted to the European Commission Support Programme in 2009.

Long term supply of stoichiometric PuO2 powder from BNFL:

New task proposal, to be submitted to the UK Support Programme in 2008.

Certification of PuO2 supplied by BNFL:

New task proposal, to be submitted to the European Commission Support Programme upon acceptance of the related task proposal by the UK Support Programme.

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

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

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| **Development Tasks** | | | |
| USA | A 1049 | Controlled Potential Coulometry at SAL: Technical Support for 3-5mg Pu Determinations Using the SRL Coulometer (A218) | This task (technical support) is of continuous nature |
| USA | A 1369 | Enhanced ANM Capability for HKED Software at SAL (A.250.01) | This task (technical support) is of continuous nature |
| **Implementation Tasks** | | | |
| CZ | A 1516 | External Quality Control of Analytical Services | This task is of continuous nature. |
| EC | A 0267 | Analytical Quality Control Services (MT13b) | Ongoing task of continuous nature. |
| EC | A 0318 | Special Reference and Source Materials for DA (MT10a) | This task is of continuous nature. |
| EC | A 1606 | Study on Optimization of a New LSD Spike | |
| FRA | A 1100 | Analytical Quality Control Services | Ongoing task of continuous nature. |
| FRA | A 1101 | Special Reference and Source Materials for DA | To be extended till the end 2008. |
| FRA | A 1479 | Qualification of the Agency's Network of Analytical Laboratories for Analysis of Nuclear Materials | To be extended till beginning 2008. |
| FRA | A 1565 | Technical Support for Sample Preparations for ICP MS Impurities Analysis | Task to be completed by the end 2008 |
| NET | A 1467 | External Quality Control of Analytical Services | This task is of continuous nature. |
| NET | A 1467 | External Quality Control of Analytical Services | This task is of continuous nature. |
| RUS | A 1514 | External Quality Control of Analytical Services | This task is of continuous nature. |
| RUS | A 0491 | Special Reference and Source Material for Destructive Analyses (A25) | Stand by |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| UK | A 1058 | Analytical Standards and Services to SAL (B1(f)) | Work planned to be completed in 2008 |
| USA | A 1496 | Traceability of DA Measurements - Provision of NBL Certified Reference Materials (A.263) | This task is of continuous nature. |
| USA | A 1497 | Analytical Quality Control - Participation of SAL in NBL SME Programme (A.264) | This task is of continuous nature. |
| USA | D 1523 | Software Development Support: LIMS for the SAL (D.156) | Second subtask to be completed in 2008. |

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| **Development Tasks** | | |
| | None at present | |
| **Implementation Tasks** | | |
| 03/SAL-007 | Provision of Certified LWR MOX Pellet Standards for SAL | Submitted to UK. |
| 07/SAL-001 | Workshop for SAL on the use of GUM Workbench, a Tool for Estimating Measurement Uncertainty. | Submitted to US in 2007 |
| New task proposal | Re-packaging and Validation of Pu-240, HEU Mixed Spike Solutions for Nuclear Material Measurements. | Submit to EC in 2009. |
| New task proposal | Long Term Supply of Stoichiometric PuO2 Powder from BNFL | Submitted to UK in 2006, now in standby, to be reconsidered. |
| New task proposal | Certification of $PuO_2$ supplied by BNFL. | To be submitted to EC upon acceptance of the new task proposal # 3 by UK. |
| 00/SAL-008 | Supply of 240Pu/Ga Metal as QC Material for IDMS | Outstanding, UK |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

| Activity Designation | Activity Title | Comments |
|---|---|---|
| New Task | Review the STR69 | Completion planned for September 2009 |
| New Task | Update the International Target Values | ISPRA to be contacted as soon as possible |
| New Task | Identify New Sampling Approaches - according to the purpose (diversion, undeclared or origin of nuclear material | Completion planned for July 2009 |
| New Task | Develop and Implement UF6 Sampling using Pellets | Completion planned for September 2008 |
| New Task | Define a Network Strategy to Allot all Network Laboratories with SAL as Centre of Expertise | Completion planned for September 2008 |
| New Task | Qualification of the Agency's Network of Analytical Laboratories for NM | On going |
| New Task | Development of On-Site DA Techniques | Completion planned for September 2009 |
| New Task | Test of Feasibility on-site COMPUCEA for Uranium Bulk Handling Facilities | Completion planned for September 2008 |

## 6. List of acronyms

| | |
|---|---|
| BNFL | British Nuclear Fuel Laboratory (UK) |
| BNM | Bureau National de Metrologie (France) |
| CEA | Commissariat à l'Energie Atomique (France) |
| CETAMA | Commission d'Etablissement des Methodes d'Analyse (France) |
| CGM | Consultants Group Meeting |
| CPC | controlled potential coulometry |
| 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 |
| HALW | high-active liquid wastes |
| HKED | hybrid K-edge densitometry |
| Agency | International Atomic Energy Agency |
| ICP MS | Inductively coupled plasma mass spectroscopy |
| IDMS | mass spectrometry with isotope dilution |
| 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 |
| KRI | Khlopin Radium Institute (Russia) |
| LSD | large-size dried [isotopic spike] |
| MEP | measurements evaluation programme |
| MOX | mixed oxides [nuclear fuel] |
| MSSP | Member States Support Programme |
| NBL | New Brunswick Laboratory (USA) |
| NM | nuclear material |
| NWAL | Network of Analytical Laboratories |
| OSL | On-Site Laboratory (Agency-Japan) |
| PIV | physical inventory verification |
| REIMEP | Regular European Interlaboratory MEP |
| QAP | quality assurance programme |
| QC | quality control |
| SAL | Safeguards Analytical Laboratory |
| SGTS | Safeguards Division of Technical Support |
| SRS | Savannah River Site (USA) |
| TIMS | thermal ionization mass spectrometry |
| XRF | X-ray fluorescence |

# SGTS-07

## Improved Techniques and Instruments for Spent Fuel Verification

**Project Manager: Alain Lebrun** **Division: SGTS**

### 1. Background

This document describes the plans for developing and implementing instruments and methods for the verification of spent fuel and irradiated nuclear material within the Department of Safeguards for the period 2008–2009. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011 and the Strategic Equipment and Technology Development Plan for 2006–2011 prepared by the Division of Technical Support.

The scope of this project is focusing on the verification of spent fuel but it also includes the verification of material resulting from processing spent fuel and other irradiated nuclear material. At nuclear power stations and research reactors, the Agency also needs to verify the absence of undeclared fissile material generation. This results in the need to perform nondestructive assay on items to certify the absence of any nuclear material in them.

▲ Spent Fuel Casks

Over the past two 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. In the mean time, the implementation of radiation profiling supporting both the fingerprinting methodology and initial loading verification of Candu spent fuel silos was successfully pursued resulting in a new data acquisition package referred to as the Cask Radiation Profiling System, (CRPS) and the Database for Storage and Evaluation of Fingerprints (DSEF) which was developed in partnership with the Department of Safeguards' Division of Information Management. Some work is still to be done under on going MSSP tasks to better understand the physics of the radiation profiles in Candu silos in order to refine the data evaluation algorithms and derive the detection probabilities.

The problem of defining a method and related instruments to solve the problem of restoring the continuity of knowledge on LWR dry storage casks remain the first priority of this project. The innovative concept of forming images of high energy particles has been proposed by Los Alamos and Idaho National Laboratories. They need to be pursed aggressively in order to experimentally validate the concepts and then move forward developing operational instruments.

The nuclear revival results across the world into new generations of reactors and spent fuel processes. They

pose specific safeguards challenges which need to be timely addressed. The project already includes a specific task related to Pebble Bed Modular Reactors (PBMR) and other planned innovative facilities will need to initiate appropriate technological development to support the safeguards approaches currently developed by the Department of Safeguards' Division of Concepts and Planning.

In the future, the Department of Safeguards' Divisions of Operations will continue to submit special requests for the verification of irradiated material. The project will therefore continue to address those mainly internally in order to fulfill the needs by adapting or customizing existing instruments. When necessary, specific development programs will be initiated in partnership with MSSPs.

## 2. Objectives

The objectives of this project are principally derived from the following goals and related key activities of the Department of Safeguards Strategic Objectives 2006–2011:

In particular this project relates to the objective, "Enhance detection capabilities through the development of new or improved safeguards approaches and techniques, and acquisition of more effective verification equipment". Related key activities are as follows:

- Optimize safeguards equipment and technology development with the view of further improving present detection capability, increasing reliability of equipment while ensuring the security of information transmission from the field and improving sustainability and timeliness.
- Use where possible equipment and technology already available with the view of adapting it to departmental needs.

Consistent with the Department's strategic objectives, six specific project objectives have been identified:

2.1. *Develop and implement technologies capable of performing partial defect tests on spent fuel assemblies.*

The project report for the period 2006–2007 demonstrated significant achievements in the development of instruments supporting partial defect test on spent fuel. The Agency needs to complete the current developments focused on LWR fuel assemblies which are concentrating on reaching the highest detection sensitivity.

2.2. *Consolidate the implementation of spent fuel cask "fingerprinting."*

As a result of the R&D conducted during last 2 years, implementation of the fingerprinting approach for the verification of spent fuel in dry storage at Candu station is effective. However The Agency needs to improve its capability to interpret the radiation profiles supporting the fingerprinting approach

2.3. *Investigate technologies supporting direct re-verification of spent fuel storage casks.*

As the fingerprinting approach has been found un-effective to address the problem of the reverification of LWR spent fuel stored in dry storage casks, the development of methods allowing reverification without the need of a reference baseline measurement will continue to be actively pursued.

2.4. *Develop instruments and methods supporting verification of material resulting from processing of irradiated material.*

In the future, new technologies will be used to recycle or stabilize irradiated nuclear materials. In particular, the pyro-processing technology is anticipated to be deployed in the next decades as a proliferation resistant technology able to separate fission products from actinides. This kind of

facility poses new challenges (i. e. quantitative verification of the plutonium in stabilized actinide mixture) which need to be specifically addressed. As the effective deployment of such processes at industrial scale is not foreseen before a decade, the project will concentrate on elaborating the verification methods in close partnership with the Safeguards Division of Concepts and Planning rather than developing the instruments.

2.5. *Investigate the measurement technology addressing the verification of spent fuel generated by new types of reactors.*

In conjunction with the current development of new nuclear reactor technologies such as PBMR and Generation IV reactors, the Agency needs to develop the appropriate verification tools addressing the challenges associated with the specificities attached to those new reactor technologies. Again, the project will concentrate on the verification methods supporting the safeguards approaches developed by the Safeguards Division of Concepts and Planning.

2.6. *Improve existing instruments and develop customized systems for attended spent fuel verification.*

The Safeguards Division of Technical Support needs to continue developing and implementing special configurations of existing instruments as a direct support to the Safeguards Divisions of Operations to provide them with verification tools meeting their objectives.

The existing instruments involved in the verification of the absence of production of fissile material needs to be improved. In particular, their sensitivity and detection limits needs to be evaluated.

## 3. Activities

The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes.

3.1. *Develop and implement technologies capable of performing partial defect tests on spent fuel assemblies. (Objective 2.1.)*

Activities related to Objective 2.1. will concentrate in completing the currently active tasks:

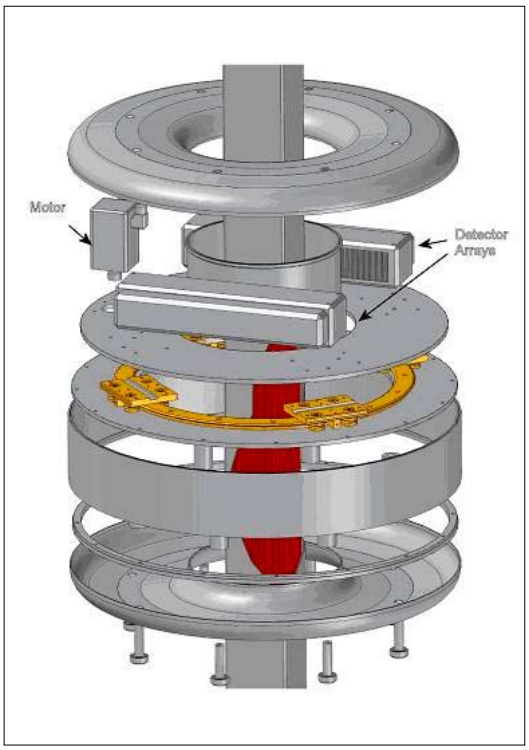
The results of the task BEL A 1493, "Monte Carlo Simulations for FDET Performance Evaluation" were presented at the 2006 Safeguards Symposium. The final report from the Belgian Support Programme was received, and the task can be finalized.

The task JNT A 1508, "DCVD Additional Capabilities Performance Testing" will continue with emphasis on the development of data interpretation tools supporting the quantitative evaluation of the DCVD images in terms of detection of missing fuel rods and detection of dummies versus fuel elements. The tasks need to be extended until end of 2009. The supporting tasks CAN SWE JNT A 1575 devoted to the development of a new lens was completed in November 2007 after incorporation of the feedback gained from field testing currently carried out.

The tasks EC FIN HUN SWE JNT A 1510, "Prototype Tomographic Spent-Fuel Detector System" need to be extended due to delays in the delivery of the CZT detector arrays. Integration of the system will be carried out during first semester 2008 to make the system ready for field testing at Ringhals NPP in 2008.

Due to the versatility of the fuel designs the quantitative verification of irradiated fuel from research reactors is a challenge. In particular, determining the initial enrichment and integrity of the assemblies may be of a high safeguards value as it covers both scenarios of diversion of fresh HEU and diversion of spent fuel. In 2006, the Advanced Experimental Fuel Counter (AEFC) designed by LANL was

field tested to verify HEU spent fuel from a DIDO reactor. The exercise demonstrated the validity of the measurement approach including the high value of active neutron measurements. However, the exercise also demonstrated the difficulty of data interpretation which at the moment requires high expertise. In order to deploy the AEFC as a universal verification device for quantitative spent fuel verification at research reactors, a straight forward data interpretation methodology needs to be elaborated. A MSSP task will be established to provide inspectors with a verification package consisting of the instrument, the data acquisition electronics and also the data interpretation tools including the depletion simulation tools.




▲ Exploded view of the Passive Gamma Emission Tomographic system (PGET)

3.2. *Consolidate the implementation of spent fuel cask "fingerprinting". (Objective 2.2.)*

Tasks ROK A 1647, RSA A 1648, CZ A 1646, ARG A 1645, "Impact of Retrieval of Spent Fuel on Radiation Traces Taken on Dry Spent Fuel Storages" will be continued in order to achieve better understanding and knowledge of the behavior of the radiation profiles taken on dry storage casks.

This knowledge will be indispensable to improve the algorithms involved in the interpretation of radiation profiles and to determine the detection probabilities of such algorithms. Related efforts could be conducted internally or through a MSSP task.

3.3. *Investigate technologies supporting direct re-verification of spent fuel storage casks. (Objective 2.3.)*

A field test under task USA A 1434, "Detection System for In Situ Measurements of Neutron Signatures from Spent-Fuel Storage Containers (A.258)" is scheduled in spring 2008 to gain experimental proof of principle for the top-of-cask high energy neutron imaging. Upon success, a task will be initiated to support the development of the operational instrument (High energy Neutron Mapping System (HNMS)) able to automatically collect the high energy neutron images. The development of the HNMS has a high priority for the Agency.

The task GER A 1178, "Passive Neutron Method for Verification of Spent Fuel in Sealed Multi-element Casks (C32)" is kept on hold to be reactivated for future field testing of the HNMS.

In case of necessity, alternative techniques will be investigated including use of high energy gamma and active methods.

3.4. *Develop instruments and methods supporting verification of material resulting from processing of irradiated material. (Objective 2.4.)*

The main process of interest is the pyro-processing of spent fuel meant to separate fission products from actinides so that they can be more effectively stored or recycled. The Agency needs to establish verification methods covering both qualitative and quantitative NDA methods and instruments to verify this kind of material as per a specific safeguards approach currently developed by the Division of Concepts and Planning.

Although the projected application for the task USA A 1668, "Spent Fuel Fissile Measurements

Using Self-Induced Neutron Resonance Densitometry (SINRD) (A.273)" was the partial defect test on spent fuel assemblies, the most promising application is now seen as the qualitative verification of nuclear material resulting from pyro-processing. In such material, the presence of plutonium needs to be verified while the actinide residue still contains the strong neutron emitting curium part of the spent fuel. Completion of the task is expected by spring 2009.

A support programme task will be established to cover the feasibility of quantitative assay of material resulting from pyro-processing.

3.5. *Investigate the measurement technology addressing the verification of spent fuel generated by research reactors and new types of reactors. (Objective 2.5.)*

New generations of nuclear reactors are developed (e. g. Pebble Bed Modular Reactor or Generation IV reactors) inducing specific safeguards challenges.

The task RSA A 1488 "Safeguards Technology for Spent Fuel Measurement at the PBMR" is meant to explore the potential of attended NDA on spent fuel tanks at PBMRs as a contribution to the overall PBMR approach which is considered under the R&D project SGOB-01 "R & D for Safeguarding Pebble Bed Reactors and Supporting Facilities". Completion of the task is expected for end of 2009.

Other MSSP tasks could be initiated to cover other arising problems like the verification of fuel elements and fertile blankets in GEN IV reactors.

3.6. *Improve existing instruments and develop customized systems for attended spent fuel verification. (Objective 2.6.)*

Requests formulated by the Safeguards Divisions of Operation for the design and implementation of customized or special design NDA systems for the verification of irradiated material will continue to be addressed internally in particular to determine if existing instruments can be used to properly cover the need. However, in case the analysis confirms the need for the development of a new instrument, specific MSSP tasks would be initiated.

The Agency already performs NDA for the verification of the absence nuclear material in particular in non fuel containers stored under the water. They have been derived from those applied to perform qualitative (i. e. attribute test) verification on spent fuel (e. g. SFAT or IRAT). They are currently used to observe the absence of spent fuel attributes thus supporting the conclusion of the absence of nuclear material. However, while the detection of an attribute is a positive and intrinsic evidence of the presence of irradiated fuel, the observation of the absence of the attribute is only an indication that the presence can be excluded above a certain detection limit. The Agency needs to improve its capability to perform verifications meant to support the conclusions on the absence of undeclared production of fissile material. Internal or MSSP tasks will be established to optimize the design of involved instrument and determine their detection limits.

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

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

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| ARG | A 1645 | Impact of Retrieval of Spent Fuel on Radiation Traces Taken on Dry Spent Fuel Storages | Task on hold |
| BEL | A 1493 | Monte Carlo Simulations for FDET Performance Evaluation | Task to be closed. |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| CAN SWE | JNT A 1508 | DCVD Additional Capabilities Performance Testing | Task to be extended till end of 2009 |
| CZ | A 1646 | Impact of Retrieval of Spent Fuel on Radiation Traces Taken on Dry Spent Fuel Storages | Task on hold |
| CZ | A 1566 | Test Bed Facility for Spent Fuel Verification Systems | On going task to be extended to end of 2008 |
| EC FIN HUN SWE | JNT A 1510 | Prototype Tomographic Spent-Fuel Detector System | Completion by end of 2008 |
| GER | A 1178 | Passive Neutron Method for Verification of Spent Fuel in Sealed Multi-element Casks (C32) | Task to be kept on hold (related to task USA A 1434). |
| ROK | A 1647 | Impact of Retrieval of Spent Fuel on Radiation Traces Taken on Dry Spent Fuel Storages | First results expected beginning of 2008 |
| ROK | A 1574 | Optical Fiber Radiation Probe System for Spent Fuel Verification | Task to be completed by mid 2008 |
| RSA | A 1488 | Safeguards Technology for Spent Fuel Measurement at the PBMR | Task to be reactivated. Completion expected by September 2008 |
| RSA | A 1648 | Impact of Retrieval of Spent Fuel on Radiation Traces Taken on Dry Spent Fuel Storages | Task on hold |
| USA | A 1434 | Detection System for In Situ Measurements of Neutron Signatures from Spent-Fuel Storage Containers (A.258) | Experimental proof of principal to be gained in spring 2008. |
| USA | A 1668 | Spent Fuel Fissile Measurements Using Self-Induced Neutron Resonance Densitometry (SINRD) (A.273) | Completion date March 2009 |
| USA | A 1666 | Junior Professional Officer - Support to the Section for NDA and Seals (Shepard) (A.271) | A new JPO to be selected and recruited beginning of 2008 |

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| New task 1 (Objective 2.1.) | Package for Quantitative Verification of Research Reactor Spent Fuel | To be submitted in 2008 |
| New task 2 (Objective 2.3.) | High Energy Imaging of Spent Fuel Casks | To develop inspection tools when proof of principle has been achieved.<br><br>To be submitted in 2008 |
| New task 3 (Objective 2.3.) | Feasibility of Active NDA for Reverification of Spent Fuel Dry Storage | Several tasks to address various dry storage designs and active techniques.<br><br>To be submitted in 2008 if high energy neutron imaging fails |
| New task 4 (Objective 2.5.) | Development of NDA for Verifications at New Spent Fuel Processing Facilities (e. g. pyro processing) | To be submitted in 2008 |
| New task 5 (Objective 26.) | Development of NDA Method Addressing Specificities of GEN IV and Other New Reactor Technologies | To be submitted in 2009 |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

| Activity Designation | Activity Title | Comments |
|---|---|---|
| 1 | Internal Customization of Existing NDA Systems for Verification Irradiated Material | On going development activity |
| 2 | Improvement of Algorithms for Data Evaluation of Radiation Profiles Taken at Candu Dry Storage | To be initiated upon completion of MSSP tasks ROK A 1647, RSA A 1648, CZ A 1646, ARG A 1645 |
| 3 | Optimization of Instruments Used for Verification of the Absence of Irradiated Nuclear Material in Non Fuel Items at Nuclear Stations | To be initiated in 2008 |

# SGTS-08

## Novel Techniques and Instruments for Detection of Undeclared Nuclear Facilities, Material and Activities

**Project Manager: Julian Whichello** **Division: SGTS**

### 1. Background

Project SGTS-08 was established within the Department of Safeguards' Division of Technical Support (SGTS) in July 2005 to address emerging needs in the areas of improving safeguards implementation and enhancing current capabilities. With the Project's establishment, the Department has introduced a dedicated and effective mechanism for identifying needs in emerging areas, while widening access to, and knowledge of, methodologies and technologies which may not have been used previously to address safeguards applications. As the Agency continues to evolve and to "stay ahead of the game"[1], novel technologies will play an increasingly important role, supplementing and complementing already developed tools, as well as providing efficient and effective solutions to meet future inspection implementation challenges.

This document details Project SGTS-08 activities and Member State Support Programme (MSSP) tasks, for the 2008 to 2009 planning period, which have been proposed to meet the specific Departmental objective for the detection of undeclared nuclear facilities, material and activities, and the goals defined in the Strategic Equipment and Technology Development Plan for 2006–2011 prepared by the Division of Technical Support (SGTS).

### 2. Objectives

The Agency Department of Safeguards Strategic Objectives[2] determine the Department's overall goals in accordance with the Agency's mandate and Medium Term Strategy (MTS)[3] for the period 2006–2011 and the actions required to meet those goals. The Strategic Objectives are used as a basis for the development of the planning document that identifies programmes needed for the implementation of the strategy before the detailed development of the Agency's Programme & Budget 2008–2009 / 2010–2011. They are reviewed on a regular basis to ensure that the objectives are in line with the evolving non-proliferation environment and programme requirements.

Project SGTS-08 addresses Section 2.2 of the 2006–2011 Departmental Strategic Objectives:

- Enhance detection capabilities through the development of new or improved safeguards approaches and techniques, and acquisition of more effective verification equipment

Specifically, the Project addresses a key activity, Section 2.2.1(iv), of the Strategic Objectives:

- Pursue R&D (research and development) activities in the development of novel technologies for detection of undeclared activities using, inter alia, MSSP (Member State Support Programme) mechanisms as well as internal resources and expertise.

### 3. Activities

In the period 2008–2009, the Project will address the above objective and key activity (Section 2.2.1(iv)) by carrying out the following:

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1 Statement to the Fifty-First Regular Session of the IAEA General Conference 2007 by IAEA Director General Dr. Mohamed ElBaradei

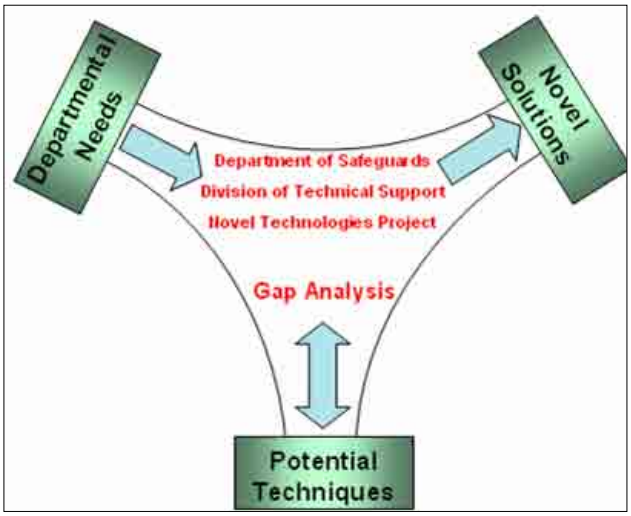
2 Policy on IAEA Department of Safeguards on Strategic Objectives 2006 – 2011, SG-MN-GNRL-PL-0001, March 2007

3 GOV/2005/8

- Assess and integrate previously gathered recommendations from Novel Technologies Unit organized and supported Technical Meetings[4] and Workshops[5] for Departmental prioritization.
- Organize further surveys to gather needs, convene focussed technical meetings and workshops and identify further current and emerging Departmental Safeguards implementation needs in the areas of applied methodologies and technologies for the detection of undeclared nuclear activities.
- Review the processes within the nuclear fuel cycle (NFC - see figure A1 in the Appendix) to identify useful indicators that will uniquely identify the presence of a particular process and signatures emanating from that process when it is in operation. (see figure A2 in the Appendix)
- With respect to proposed methodologies and technologies, conduct expert gap analyses, identifying areas where the Agency has an implementation deficiency.
- Where necessary, and with MSSP or other expert assistance, establish appropriate R&D tasks, based on end-user requirements, that will deliver efficient and effective novel technical solutions meeting Departmental needs.
- Attend international conferences to both present the Project to a wider audience, as well as gather information and ideas.
- Collaborate to create synergies with other Departmental Projects, functional units and expert groups within the Agency, particularly those concerned with new technologies and Projects, nuclear security, satellite imagery, environmental sampling and information analysis.

### *3.1. The Overall Gap Assessment Process*

Figure 1 shows the overall process adopted by Project SGTS-08. Prioritized Departmental needs will be assessed applying a gap analysis, against proposed technologies and methods, to determine the most effective and efficient solution for development and/or evaluation for subsequent Safeguards implementation.




▲ Figure 1. The Project's process of analysing gaps between Departmentally-prioritized needs and potential techniques to identify appropriate, efficient and effective novel solutions

By the above process, an identified and prioritized Departmental need will be subjected to a gap

[4] *Technical Meeting on Techniques for IAEA Verification of Enrichment Activities,* April 2005 (STR-349), *Technical Meeting on Noble Gas Monitoring Sampling and Analysis for Safeguards*, September 2005 (STR-351) and *Technical Meeting on Application of Laser Spectrometry Techniques in IAEA Safeguards*, August, 2006 (STR-352).

[5] *US Support Programme-IAEA Workshop on Advanced Sensors for Safeguards*, 23-27 April 2007 Santa Fe NM, JAEA-*Agency Workshop on Safeguards Technology for the Future Nuclear Fuel Cycle*, 13 - 16 November 2007, Japan

analysis to determine the existence of a "new" or "novel" method, or technical solution[6]. Working with the designated end-user, the Novel Technologies Unit (NTU) will continue to create sets of general technical requirements. Through access to technical databases and/or with the assistance of Agency and external experts, technical proposals will be evaluated, typically, by a "bottom-up – top-down" iterative process. The outcome of that review will decide the next actions, including the following:

- Determine the "new" or "novel" status of a proposed solution[7];
- Whether a needed solution is already available as an Agency inspection authorized (Category A) method of instrument;
- Whether a needed solution is, or will be, under development within the Agency (Category B or C);
- Whether a needed solution is, or will be, commercially available;
- Whether a needed solution will require further R&D.

### 3.2. *The Project's "bottom-up – top-down" Analytic Approach*

Project SGTS-08 has adopted a systematic and iterative "bottom-up – top-down" process to match identified needs to practical solutions. The approach will enable the NTU to:

- Systematically match safeguards needs and requirements to tools and methods;
- Identify gaps where no technology exists to address the requirements ;
- Target scarce MSSP and Departmental resources effectively and efficiently;
- Develop novel technologies to address needs and requirements in the most efficient and cost-effective manner.

Within the Agency, the primary oversight for Safeguards equipment development continues to reside with the Department of Safeguards' Division of Technical Support (SGTS). All three sections within SGTS[8] work to identify gaps where innovative technologies (new and novel) are required in support of nuclear verification. R&D tasks for needed technologies are identified departmentally, and in most cases, addressed in cooperation with MSSPs. The establishment of Project SGTS-08 has enhanced this process by the providing the following:

- Greater access to, and utilization of, novel technologies to develop safeguards tools and methods for the future
- Early identification of gaps where no safeguards tool(s) exist, or where effectiveness and efficiency can be improved through the adoption of a novel technology

Since its establishment, specific Project objectives have been reviewed annually, or more frequently, as circumstances required.

### 3.3. *Summary of Active Areas 2008–2009*

Table 1 summarises the major activity areas foreseen to meet the Project's objective in the period 2008–2009. Activities include those funded by the regular and/or extrabudgetary (MSSP) sources.

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[6] "New" refers to methodologies or technologies that enhance the safeguards tools already in inspection use by the Agency

"Novel" refers to methodologies or technologies that have not been applied previously to Safeguards applications.

[7] Because "new" needs and solutions are by definition already addressed within the Agency, the NTU will refer such cases to the appropriate functional unit(s) within the Agency.

[8] Section for Technical Support Coordination (SGTS/TTS), Section for Surveillance, Seals and Remote Monitoring (SGTS/TSR) and the Section for Attended and Unattended NDA (SGTS/TAU)

Table 1.

| Project Objective - Specific objective | Activities | Proposed Funding Source (2008/2009) | Target Date - Milestones |
|---|---|---|---|
| Enhance detection capabilities through the development of new or improved safeguards approaches and techniques, and acquisition of more effective verification equipment<br><br>- Pursue R&D activities in the development of novel technologies for detection of undeclared activities using, inter alia, MSSP mechanisms as well as internal resources and expertise. | Adopting the needs initiated, top-down, bottom-up approach outlined shown diagrammatically in figure 1 above, solicit, compile and present need proposals to the Department for consideration and prioritization | Regular budgetary | On-going periodic activity |
| | Maintain Departmentally prioritized safeguards needs | Regular budgetary | On-going periodic activity |
| | Complete and distribute the Proceedings of the JAEA-IAEA Workshop on Advanced Safeguards Technology for the Nuclear Fuel Cycle | Regular & extra-budgetary | February 2008 |
| | Complete the establishment of Project SGTS-08 infrastructure and procedures for effective and efficient proposal evaluation and task management | Regular budgetary | December 2008 |
| | Complete the 1st review of NFC processes to identify useful detection indicators and signatures | Extra-budgetary | March 2009 |
| | Convene expert and specialist meetings to discuss needs, solution, proposal evaluation, equipment-testing and technology implementation | Regular & extra-budgetary | As required |
| | Devise effective and efficient information and reference databases (incl. relevant physical model attributes, needs, technology holder register, expert register, potential funding register and technology archive of current safeguards tools & methods | Regular & extra-budgetary | As required |
| | Review all umbrella tasks with MSSPs for status, effectiveness and efficiency. Consider extensions. | Extra-budgetary | End 2008<br><br>See section 4.1 (below) |
| | Complete the following MSSP tasks:<br><br>· CAN A 1626 Laser-Induced Breakdown Spectroscopy (LIBS)<br><br>· CAN A 1627 Optically Stimulated Luminescence in Forensics (OSL)<br><br>· GER A 1643 Simulation of Atmospheric Noble Gas Concentrations to Assess Sampling Procedures for the Detection of Clandestine Reprocessing<br><br>· USA E 1663 Expert: Nuclear Technologies | Extra-budgetary | See section 4.1 (below) |

| Project Objective - Specific objective | Activities | Proposed Funding Source (2008/2009) | Target Date - Milestones |
|---|---|---|---|
| | Utilizing the results of recent Technical Meetings, workshops and the NTU Needs Gathering Exercise, and within available resources, establish R&D tasks requiring novel techniques that will meet the defined prioritized needs for verification and detection of undeclared nuclear facilities, material and activities, and establish this as an on-going process | Extra-budgetary | 2008 / 2009<br><br>See section 4.2 (below) |
| | Maintain active membership in the Departmental Technical Review Committee (TRC) | Regular budgetary | On-going periodic activity |
| | Maintain active membership in the Departmental Information Review Sub-committee (IRS-C) | Regular budgetary | On-going periodic activity |
| | Maintain active membership in the ESARDA Working Group (WG) on Verification Techniques and Methods | Extra-budgetary | As required |

## 4. Summary of Active and Proposed Member State Support Programmes Tasks

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

Project SGTS-08 has established specific product development and evaluation tasks, as well as 13 umbrella tasks[9] with 12 MSSPs and the European Community.

Table 2.

| MSSP | Task No. | Task Title | Comments / Target Completion Date |
|---|---|---|---|
| ARG | A 1637 | MSSP Umbrella Task: Support for Novel Technologies | This task will be reviewed for renewal in September 2008. |
| BEL | A 1615 | MSSP Umbrella Task: Support for Novel Technologies | This task will be reviewed for renewal in March 2008. |
| BRZ | A 1601 | MSSP Umbrella Task: Support for Novel Technologies | This task will be reviewed for renewal in March 2008. |
| CAN | A 1622 | MSSP Umbrella Task: Support for Novel Technologies | This task will be reviewed for renewal in May 2008. |
| CAN | A 1626 | Laser-Induced Breakdown Spectroscopy (LIBS) | The task target completion date is end 2008 |
| CAN | A 1627 | Optically Stimulated Luminescence in Forensics | The task target completion date is end 2008 |
| EC | A 1634 | MSSP Umbrella Task: Support for Novel Technologies | This task will be reviewed for renewal in September 2008. |

[9] Umbrella tasks will be used to carry out relatively small and/or short duration collaborative activities and to facilitate exchanges regarding novel technologies with R&D laboratories in the private and government sectors. They will also cover requests for the short-term provision of assistance to formulate technical requirements, for MSSP expert reviews of technical proposals and specifications, for support with novel technology field tests and for the facilitation of meetings between experts in the State and Novel Technologies Project staff.

| MSSP | Task No. | Task Title | Comments / Target Completion Date |
|---|---|---|---|
| FIN | A 1628 | MSSP Umbrella Task: Support for Novel Technologies | This task will be reviewed for renewal in July 2008. |
| FRA | A 1641 | MSSP Umbrella Task: Support for Novel Technologies | This task will be reviewed for renewal in June 2008. |
| GER | A 1633 | MSSP Umbrella Task: Support for Novel Technologies (A.38) | This task will be reviewed for renewal in September 2008. |
| FRA | A1707 | Equipment for Sampling and Concentrating Atmospheric Noble Gases for the Measurement of Krypton and Xenon | Accepted May 2007. The request covers the equipment necessary to concentrate atmospheric gaseous compounds, elements and isotopes for analysis. |
| GER | A 1643 | Simulation of Atmospheric Noble Gas Concentrations to Assess Sampling Procedures for the Detection of Clandestine Reprocessing (C.38) | The task target completion date is September 2008. However, after unexpected delays in the contract negotiation phase, the task completion date will be extended to end 2008. |
| HUN | A 1597 | MSSP Umbrella Task: Support for Novel Technologies | This task will be reviewed for renewal in March 2008. |
| RUS | A 1621 | MSSP Umbrella Task: Support for Novel Technologies | This task will be reviewed for renewal in June 2008. |
| SWE | A 1671 | MSSP Umbrella Task: Support for Novel Technologies | This task will be reviewed for renewal in November 2008. |
| UK | A 1599 | MSSP Umbrella Task: Support for Novel Technologies (A7(h)) | This task will be reviewed for renewal in April 2008. |
| USA | A 1616 | MSSP Umbrella Task: Support for Novel Technologies (A.269) | This task will be reviewed for renewal in June 2008. |
| USA | E 1663 | Expert: Nuclear Technologist | The task target completion date is March 2009. |

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

Table 3.

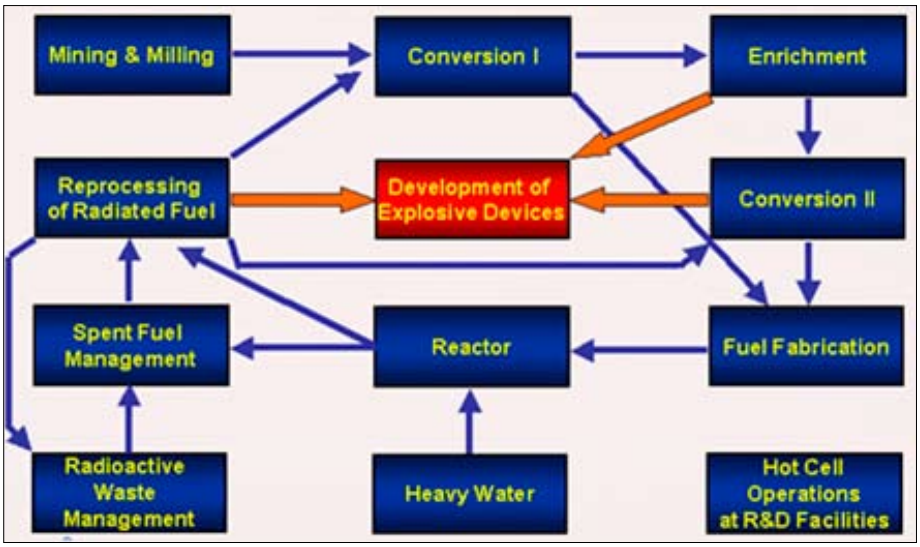
| Prop. MSSP(s) | Task Proposal ID | Task Title | Departmental Need | Comments |
|---|---|---|---|---|
| All MSSPs | 06/TDO-002 (Revised) | NFC process indicator and signature detector, based on semiconductor sensor technology | Detection of unique atmospherically-borne indicator and signature gaseous compounds within a nuclear facility | The initial SP-1 was limited to the detection of HF only. The revised SP-1 will reflect a wider range of gaseous compound |
| AUL<br>CZ<br>JPN<br>ROK<br>RSA | 06/TDO-007 | MSSP Umbrella Task: Support for Novel Technologies | Access to novel technologies and methods, and to carry out relatively small and/or short duration collaborative activities and to facilitate exchanges regarding novel technologies with R&D laboratories in the private and government sectors. | Awaiting MSSP acceptance. |

| Prop. MSSP(s) | Task Proposal ID | Task Title | Departmental Need | Comments |
|---|---|---|---|---|
| All MSSPs | 06/TDO-006 | Mobile Lidar* for Monitoring Gaseous Atmospheric Pollutants<br><br>*Lidar = light detection and ranging | Detection of unique atmospherically-borne indicator and signature gaseous compounds within, or in the vicinity of, a nuclear facility (declared, or undeclared) | The proposed technique is similar to that used by environmental monitoring agencies around the World. It provides information on compound emissions, source of release, and measurement at relatively high altitudes over soil level |
| USA<br>GER<br>JPN<br>FRA<br>UK<br>CAN | 06/TDO-009 | Junior Professional Officer | Additional technical expertise and support for Project SGTS-08 | |
| USA<br>GER<br>JPN<br>FRA<br>UK<br>CAN | TBD | Expert: Advanced sensors | Expertise in the area of advanced sensors. | This proposal is designed to "dovetail" with task USA E 1663 (Expert: Nuclear Technologist) |
| All MSSPs | TBD | UF6 Enrichment and Flow Monitor | An accurate UF6 enrichment and flow monitor that is non-intrusive to the facility operator and requires no radiation sources to operate. | Cross-reference to Project SGTS-12, Techniques and Equipment for Safeguards at Gas Centrifuge Enrichment Plants |
| All MSSPs | TBD | Feasibility study utilizing anti-neutrino detection to monitor reactor operations | More effective monitoring of research and power reactor operation | |
| TBD | TBD | Investigations into identification and detection of NFC processes by emanating electromagnetic signatures | Detection and location of undeclared NFC processes and facilities | |
| TBD | TBD | OSL Field Testing | Effective and efficient nuclear forensic methods and instruments | Follow-on task, given the successful outcome of CAN A 1627 (*Optically Stimulated Luminescence in Forensics*)<br><br>New task target completion date is end 2009 |
| TBD | TBD | LIBS Field Testing | Effective and efficient nuclear forensic methods<br><br>Effective and efficient pre-selection of on-site environmental sampling | Follow-on task, given the successful outcome of CAN A 1626 (*Laser-Induced Breakdown Spectroscopy (LIBS)*)<br><br>New task target completion date is end 2009 |

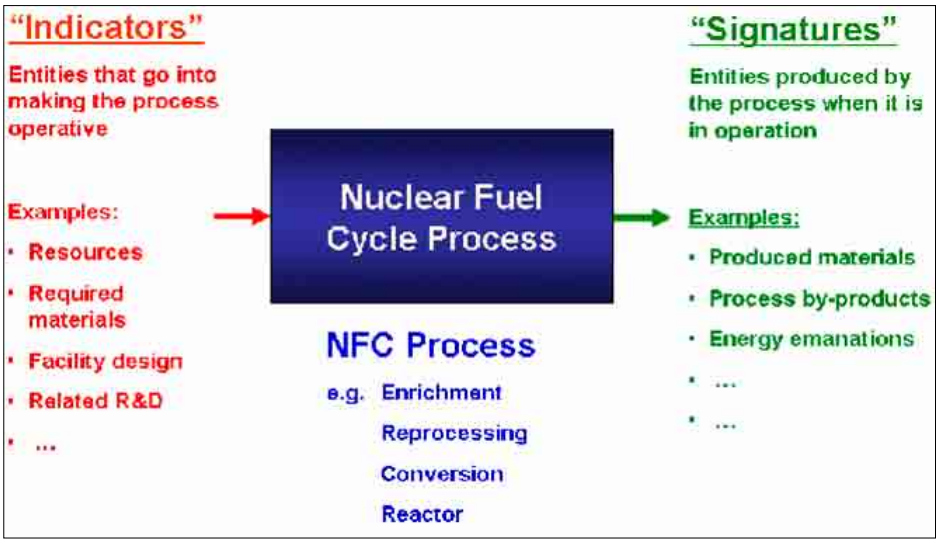
## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

With the exception of staff assessing needs and supporting gap analyses, there are no foreseen R&D activities requiring regular budget funds.

## APPENDIX




▲ Figure A1. A simplified schematic of the Nuclear Fuel Cycle (NFC)




▲ Figure A2. NFC Process indicators and signatures

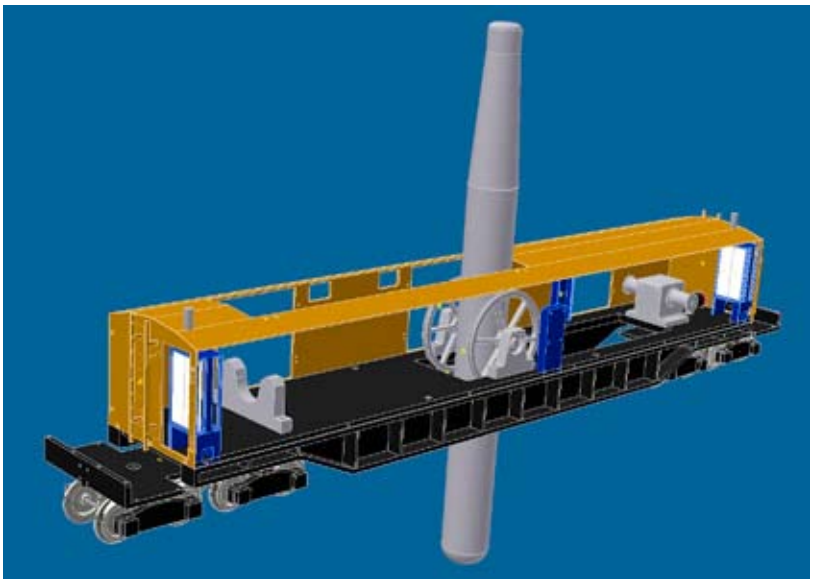
# SGTS-11

## Unattended and Remote Monitoring Systems

**Project Manager: Cesare Liguori** **Division: SGTS**

### 1. Background

This document describes the plans for unattended monitoring systems (UMS) and remote monitoring (RM) development and implementation within the Department of Safeguards for the period 2008–2009. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011 and the Strategic Equipment and Technology Development Plan for 2006–2011 prepared by the Division of Technical Support.



▲ Unattended Monitoring System (MMCT) Installed on Chernobyl Railcar

The project SGTS-11 addresses the Department's needs in the area of unattended monitoring systems and remote monitoring 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 and technological approaches. R&D activities concerning the measurement techniques are coordinated and reported also by the two other projects SGTS-07 and SGTS-12, addressing *Improved Techniques for Spent Fuel Verification* and *Techniques and Equipment for Safeguards at Gas Centrifuge Enrichment Plants*, respectively. Note also that in the activities coordinated by this project compliment the activities managed under SGTS-13, *Universal NDA Data Acquisition Platform (UNAP)*. Results of the development under SGTS-11 will be applied to the possible extent also for attended and portable systems, pursuing the goal of equipment and system components standardization.

In the area of Remote Monitoring development and implementation, the RM group 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 and new system types will be connected.

The end users who will benefit from these R&D activities are all the Operations Divisions performing safeguards verification activities.

### 2. Objectives

The objectives of this project are principally derived from the following goal and related key activities of the Department of Safeguards Strategic Objectives 2006–2011:

Enhance detection capabilities through the development of new or improved safeguards approaches and techniques, and acquisition of more effective verification equipment

- Optimize safeguards equipment and technology development with the view of further improving present

detection capability, increasing reliability of equipment while ensuring the security of information transmission from the field and improving sustainability and timeliness; and

- Use where possible equipment and technology already available with the view of adapting it to departmental needs

The primary objectives of the project are:

***Development of reliable unattended monitoring systems and components to verify flow and inventory of nuclear material, minimize intrusiveness, reduce Agency and Operator manpower requirements, and decrease personnel radiation exposure.***

***Development and consolidation of remote data transmission techniques, with particular focus on security and cost-effectiveness.***

In particular the following specific objectives can be identified:

2.1. *Develop a standardized data collection and data review platform;*

2.2. *Develop new systems, using approved components to the maximum extent, according to Operations Divisions' needs;*

2.3. *Maintain and extend lifetime of currently installed UMSs;*

2.4. *Improve the RM capable systems reliability and the data transmission efficiency. Test and implement new systems with RM capabilities;*

2.5. *Optimize the RM infrastructure and the software tools.*

## 3. Activities

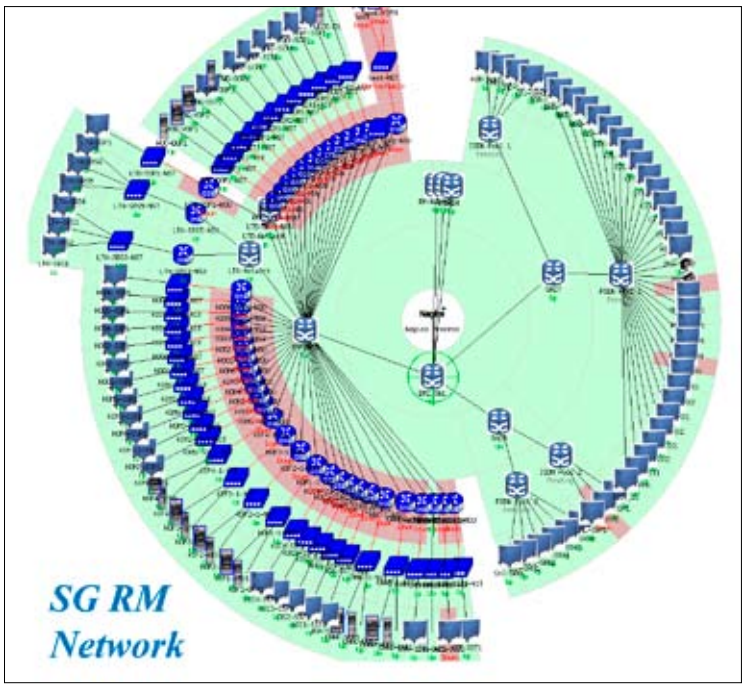
The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes.

3.1. *Develop a standardized data collection and data review platform (Objective 2.1.)*

The possibility of using a standardized software platform for data collection from different data generators offers various advantages, like better usability and serviceability, and reduced training requirements, both for end users and technicians. Agency has started since 2004 through the assistance of the U.S. Support Programme (USA A 1238) the redesign and integration into a single software suite of the different tools for data collection and data review. The main developer responsible for the complete suite is Los Alamos National Laboratory. The two main products of this suite are the Multi Instrument Collect (MIC) software and the Integrated Review Software (IRS). The development has reached now the final stage. By the end of 2008, the Agency expects to receive Baseline 3 release, considered to be the final one incorporating the complete set of functionalities requested by Agency. The software tool will then allow the users to import the operator's declarations and compare them directly with the events identified for instance by analyzing the radiation data,

flagging any mismatch and/or anomalies. The MIC software will extend its support also to new data generators, like the new family of electronic seals (EOSS).

The finalization of the development of the Digital Unattended Multichannel Analyzer (DIUM) (GER A 1269) falls under the same objective: the DIUM is expected to address the lack of a multichannel analyzer fulfilling the requirements for unattended operation, like local storage capability, automatic restart, Ethernet connectivity, data authentication. The development is expected to be completed in 2008.



▲ Safeguards Remote Monitoring Network

The activities focused on this objective will also be coordinated with the activities of the UNAP development, managed under the project SGTS-13.

3.2. *Develop new systems, using approved components to the maximum extent, according to Operations Divisions' needs (Objective 2.2.)*

A number of different UMSs will be implemented in the next years to address specific requests by Operations Divisions. In its role of system integrator, SGTAU will perform this task with internal resources using to the maximum extent standard building blocks. Support from MSSPs will be requested in those cases where the development of specific solutions will not be possible with internal resources. One area that will require support is the design and manufacturing of the different UMSs that will be installed in the JNFL MOX fuel fabrication plant. The specific activities for that facility are managed under the R&D Project SGOA-02. Other synergies are established by coordinating the activities with the two projects SGTS-07 and SGTS-12, Improved Techniques for Spent Fuel Verification, and Technique and Equipment for Safeguards at Gas Centrifuge Enrichment Facilities, respectively.

3.3. *Maintain and extend lifetime of currently installed UMSs (Objective 2.3.)*

Preventive maintenance and regular system upgrades are the key factors to ensure a seamless operation of the unattended systems and extend their lifetime, realizing an immediate saving in term of cost and manpower. This effort is supported by the MSSPs through different Factory Support tasks like CAN E 1530 (VIFM implementation support) and US E 1274 (URM Systems Standardization and Support). These tasks are on-going and assure that enough resources are devoted to adopt those improvements made possible by the use of new technologies.

Under this objective, an important activity is also the development of the Next Generation ADAM Module (CAN E 1499) aimed at providing a replacement for the aging VXI based ADAM unit used by the VIFM systems. The new unit will provide better performances and enhanced functionalities, including Ethernet connectivity for easy integration with other data generators. The first prototype is expected in 2008.

3.4. *Improve the RM capable systems reliability and the data transmission efficiency. Test and implement new systems with RM capabilities. (Objective 2.4.)*

In the field, the activity will focus on: migration from telephone to broad band internet or satellite communication, testing secure satellite communication methods, enhancement of the existing SG Equipment for RM, testing and implementing the EOSS seals remote data transmission. This activity will be conducted both with internal resources and through the support of different MSSPs, in particular in the area of satellite communication (HUN E 1596, BRZ E 1600)

3.5. *Optimize the RM infrastructure and the software tools (Objective 2.5.)*

At the HQ the RM group will continue to enhance the SGTS Data Centre configuration and the monitoring tools. The activities will be focusing on data integrity check and integration of all data carriers including data pre-review. An important part will be dedicated to prepare the integration of Next Generation Surveillance Systems (NGSS) and the Universal NDA Data Acquisition Platform (UNAP) in the SG-RM concept. The data security will be evaluated and enhanced. The Sign and Forward (SNFS) method for authenticating data will be improved and its use will be extended.

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

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

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| BRZ | E 1600 | Testing of Secure Satellite Communication for Remote Monitoring and Inspection Support | Pilot implementation expected during 2008 |
| CAN | E 1499 | Development of the Next Generation ADAM Module | Prototype in 2008 for lab testing |
| CAN | E 1530 | VIFM Implementation Support | On going task |
| EC | A 1589 | Support for Evaluation Software for Solution Monitoring at TRP | Activity in progress, completion in 2008 |
| GER | A 1269 | Digital Unattended MCA (DIUM) (C36) | Finalization of the development in 2008 |
| HUN | E 1596 | Testing of Secure Satellite Communication for Remote Monitoring and Inspection Support | Pilot implementation expected during 2008 |
| ROK | E 1529 | Implementation of Virtual Private Networking for Remote Monitoring at Wolsong Facilities | Activity in progress, to be completed in 2008 |
| UK | A 1653 | Evaluation Software Co-Development for Solution Monitoring at TRP (D2(g)) | Activity in progress, completion in 2008 |
| USA | A 1238 | Development of Integrated Review Software for UMS (A.241) | Final Baseline 3 release foreseen by the end of 2008 |
| USA | E 1274 | URM Systems Standardization and Support (E.122) | Umbrella task. On going |
| USA | E 1613 | New Shift Register Development (E.152.01) | Task expected to be completed by 2007 |
| USA | E 1581 | Vulnerability Assessment of the 'Sign and Forward System' (SNFS) (E.149) | Final report expected before the end of 2007 |
| USA | E 1701 | Unattended Monitoring System (UMS) Documentation Support (E.155) | Accepted October 2007 - Chernobyl and BN-350 UMS systems |

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| 1 - Objective 2.1. | Development of a new He3 Preamplifier | To be submitted in 2007 |
| 05/TIE-008 | Vulnerability Assessment of the Secure Satellite Communication for Remote Monitoring and Inspector Support | Submitted in October 2007 to USA, task modification for VA only. |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

| Activity Designation | Activity Title |
|---|---|
| 1 | Improve RM Automatic Data Quality Check |
| 2 | Extend use of RM as requested by SGOs |
| 3 | Integrate new UMSs as requested by SGOs |

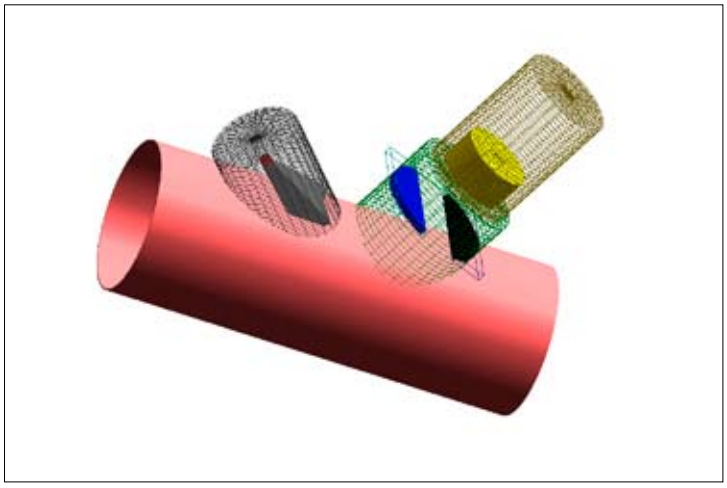
# SGTS-12

## Techniques and Equipment for Safeguards at Gas Centrifuge Enrichment Plants

**Project Manager: Alain Lebrun** **Division: SGTS**

### 1. Background

This document describes the plans for improving techniques and instruments within the Department of Safeguards for implementation of the Agency safeguards at enrichment plants. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011 and Strategic Equipment and Technology Development Plan for 2006–2011.



▲ 3D Monte Carlo Modeling (MCNP) of Upgraded CHEM Design

Safeguards at enrichment plants is a challenge for the Department of Safeguards as enrichment plants represent one of the most sensitive parts of the nuclear fuel cycle.

A technical meeting on Techniques for Agency Verifications at Enrichment Plants was organised jointly in 2005 by the Division of Concepts and Planning and the Division of Technical Support to address safeguards general issues at enrichment plants. The STR-349 document reports on the findings and recommendations formulated by the experts who attended.

More specifically, safeguards issues at commercial size gas centrifuge enrichment plants (GCEP) have been addressed by the Division of Concepts and Planning which developed a generic safeguards approach "Model Safeguards Approach for Gas Centrifuge Enrichment Plants", W. Bush, SG-OP-GNRL-0003, June 2006.

The model approach recognizes the specific nature of the enrichment facilities, including the high commercial sensitiveness of the components, thus limiting in practice the acceptable intrusiveness of Agency inspections. The generic approach also recognises the high degree of versatility of new cascade designs limiting the effectiveness of visual inspections as a means to detect undeclared operation. On line monitoring within the cascade area might be helpful, but intrusiveness and lack of precision of flow monitors are problems that would be difficult to overcome. The model approach confirms the need of establishing a material balance with 100% coverage of the nuclear material and at least 20% of material being randomly verified. The combination of annual PIV and announced interim inspections supports this SG goal. However, the model approach stresses the interest of introducing short notice random inspections (SNRI) in conjunction with a mail box system as already implemented at Fuel Fabrication Plants. Such a combination may significantly reduce the Agency inspection efforts assuming that the appropriate verification instruments and methods would be available.

Available verification tools have been developed 10 to 15 years ago and need to be modernized. New instruments and methods are needed to support the effective and smooth introduction of new inspection regime like SNRIs.

This R&D project specifically targets industrial size enrichment plants based on the centrifuge technology. It is aimed at supporting the implementation of the model approach by providing a tool box of instruments and methods within the next 2-4 years. An appropriate combination of the instruments and methods will be

deployed as per the facility-dependant SG implementation procedures. Development of proven technologies, including those recommended in the STR-349, will be undertaken in the framework of this project while longer-term development of alternative technologies will continue to be actively pursued in the other SGTS R&D projects in particular the R&D project for Novel Technologies (SGTS-08). Tasks run in the framework of this project will use as much as possible technologies and components developed within other R&D projects namely the NDA Techniques projects SGTS-01 and Unattended and Remote Monitoring Systems R&D project SGTS-11.

## 2. Objectives

The objectives of this project are principally derived from the following goals and related key activities of the Department of Safeguards Strategic Objectives 2006–2011:

In particular this project relates to the objective, "Enhance detection capabilities through the development of new or improved safeguards approaches and techniques, and acquisition of more effective verification equipment." Related key activities are as follows:

- Optimize safeguards equipment and technology development with the view of further improving present detection capability, increasing reliability of equipment while ensuring the security of information transmission from the field and improving sustainability and timeliness.
- Use where possible equipment and technology already available with the view of adapting it to departmental needs.

The R&D project aims at developing a toolbox of techniques, instruments and data interpretation methods supporting the model approach.

Main goals are to develop techniques and instruments supporting the establishment of the material balance and flow within the enrichment plants and to develop or improve techniques and instrument supporting the verification of the absence of enrichment at higher 235U concentrations than declared.

Two primary objectives have been identified with related specific project objectives as listed below:

***Make ready for implementation tools supporting the verification of the material balance for timely detection of undeclared production or diversion of DU, NU and LEU***

*2.1. Establish the feasibility of unattended measurement stations where all cylinders in and out of the facility would be identified and quantitatively assayed;*

*2.2. 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;*

*2.3. Select and develop the techniques to uniquely identify the cylinders supporting the tracking of the cylinders present at the facility including those attached to the process;*

*2.4. To engineer the cylinder measuring station;*

*2.5. Develop the techniques for attended NDA on UF6 material allowing on-site bias defect analysis.*

## *Make ready for implementation tools supporting the verification of absence of HEU production and verification of the operation status*

2.6. *Develop or improve the techniques for attended and unattended assay, aiming at estimating the enrichment of in-process material;*

2.7. *Select and develop the techniques for the verification of absence of operation at shutdown or decommissioned facilities.*

The technical objectives of the project as listed above are driven by the need to develop techniques allowing the implementation of Short Notice Random Inspections and Low Frequency Access as recommended in the model approach, with minimum frequency and to facilitate the annual Physical Inventory Verification (PIV) thus aiming at minimizing the Agency inspection effort at GCEP.

The toolbox approach for the development of the verification equipment and methods will also facilitate the implementation of the facility dependant procedures in countries under integrated safeguards. In addition, although meant to support the implementation of Agency safeguards at commercial size GCEPs, attention will be kept on the applicability to other type of enrichment facilities.

### 3. Activities

The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes.

The first activity to be carried out will be to develop a programme management plan specifying in the detail the task assignments within SGTS, estimating costs and the delivery times.

The following activities have been defined relative to the project objectives:

3.1. *Establish the feasibility of unattended measurement stations where all cylinders in and out of the facility would be identified and quantitatively assayed (Objective 2.1.)*

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. It would allow the establishment of a real time material balance thus supporting the minimization of the inspection effort for PIV and Interim inspections. The related R&D activities are:

- To investigate the existing or foreseen design of the enrichment plants to determine the appropriate critical location for unattended assay (Internal task);
- To develop users requirement in terms of design (space allocation) and any necessary features supporting the establishment of such a measurement station (Internal task).

3.2. *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 (Objective 2.2.)*

Significant work has already been carried out to develop NDA applicable to UF6 cylinders. Effectiveness of neutron methods always faces the problem of the background when the measurements take place in the storage areas. In the light of the concept of a measurement station, the performances of the neutron based method must be re assessed. The related R&D activities are:

- To investigate all neutron and/or gamma or non-radiometric NDA methods applicable to UF6 cylinders to determine both enrichment and uranium mass, taking into account that the cylinders may be not homogenized and could be partially filled. The task proposal has been submitted to several MSSPs and has been accepted by European Commission Support Programme (MSSP task, EC A 1687, "State of the Art of NDA Techniques Applicable to UF6 Cylinders");
- To select the appropriate method (or combination of methods) supporting the establishment of a material balance within the plant (Internal task);
- To initiate R&D tasks for the improvement of existing selected method and combination of them (MSSP task).

3.3. *Select and develop the techniques to uniquely identify the cylinders supporting the tracking of the cylinders present at the facility including those attached to the process (Objective 2.3.)*

R&D work is already on its way to develop a non destructive method based on the identification of the cylinders by means of laser. The related R&D activities are:

- To complete the current R&D task EC E 1697, "L2IS: Laser Item Identification System";
- To initiate development for integration of the laser based identification technology within the measurement station concept (Internal task, contract).
- The laser identification of the cylinder may not be applicable to the cylinders attached to the process (in the autoclaves). Thus alternative techniques might have to be investigated. Radio frequency identification tags (RFID) and piezoelectric transponder tags might be applicable and can be grouped under the generic term of identification tagging. The R&D activities related to identification tagging are:
- Establish user requirement for the use of identification tagging in the specific context of enrichment plants (Internal task);
- Investigate state of the art technology for both RFIDs And Piezoelectric tags against user requirements (MSSP task);
- Complete the development and industrialisation of the selected technology (Internal task, contract.

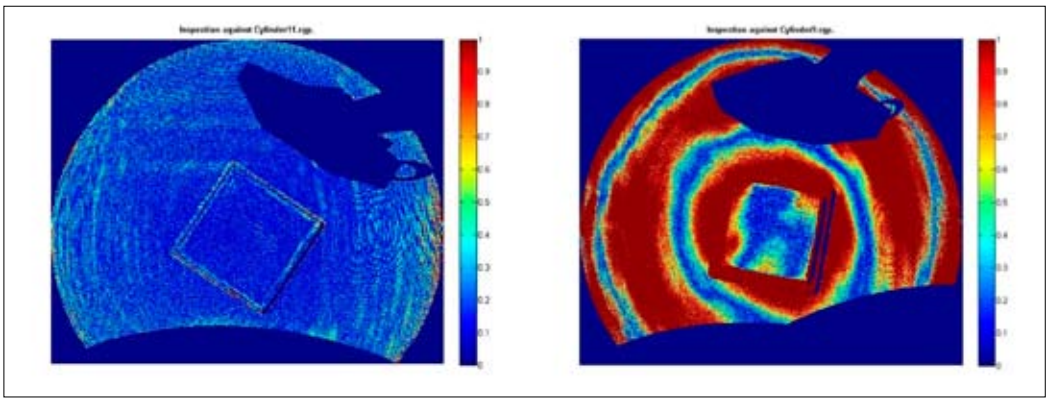
3.4. *To engineer the cylinder measuring station (Objective 2.4.)*

From the results gained out of the R&D activities 3.1. to 3.3., the development work will be to integrate the various components of the cylinder measurement station within an unattended monitoring and surveillance system. The activities are:

- To develop detailed user requirements for the integration of the components addressing the hardware issues as well as the data collection and interpretation issues (Internal task);
- To conduct the implementation of the measurement station as per Agency requirements in partnership with MSSPs and contractors.

3.5. *Develop the techniques for attended NDA on UF6 material allowing on site bias defect analysis (Objective 2.5.)*

Bias defect analysis are usually carried out by means of destructive analysis (plus accurate weighing) which imply sample taking, shipment to the laboratories and carrying out heavy 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 Agency to perform more bias defect analysis thus supporting the establishment of a real time material balance and flow estimate within the enrichment plants. The related R&D activities are:



▲ Interpreted Images - UF6 Cylinder Laser Identification System (L2IS)

- To complete or initiate tasks to improve the NDA technique based on tunable diode laser spectrometry (TDLS). A prototype is about to be tested before integration of new laser components developed under the task GER A 1658. Draft user requirements for operational units were issued and submitted to potential industrial suppliers. (Existing internal task, MSSP task GER A 1658);
- To select the most appropriate technology/equipment and to industrialise it (internal task).

3.6. *Develop or improve the techniques for attended and unattended assay aiming at estimating the enrichment of in process material (Objective 2.6.). The activities are:*

- To upgrade the CHEM system which is an attended system based on high resolution gamma spectrometry. A new design has been formulated internally by means of extensive Monte Carlo simulations. A prototype is currently under mechanical design and will be tested beginning of 2008. Upon successful testing of the prototype, production of a updated data acquisition and interpretation software will be initiated (MSSP task or contract);
- To upgrade the CEMO system which is an unattended system based on low resolution gamma spectrometry. Internal analysis of the capabilities and vulnerabilities of the CEMO system was carried out. Use of a short lived source (Cd-109) and monitoring of each cascade in a commercial size GCEP is not seen sustainable and other configurations are currently investigated. I-129 as a transmission source has been found a promising solution but faces difficulties of supply. An affordable architecture of the CEMO system to be used in conjunction with environmental sampling will be proposed for implementation (MSSP task or contract);
- To investigate other possible NDA methods applicable within the cascade area with emphasis on non-intrusive equipment (MSSP task);
- To investigate other possible non intrusive NDA methods applicable on cold traps or high pressure withdraw pipes emphasis (MSSP task);
- To capture and analyze the experience feedback of enrichment and flow monitoring systems being currently under field-testing (Internal Task).

3.7. *Select and develop the techniques for the verification of absence of operation at shutdown or decommissioned facilities (Objective 2.7.). The activities are:*

- To investigate the radiometric NDA methods supporting the verification of absence of operation like neutron background monitoring in the feed area (Internal Task);
- To continue developing the laser based technique for detection of fluoride acid in the atmosphere. A prototype has been successfully tested and user requirements were elaborated to be submitted to industrial suppliers (MSSP task or contract).

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

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

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| EC | E1697 | L2IS: Laser Item Identification System | Identification of $UF_6$ cylinders, Managed under project SGTS-03 |
| EC | A 1687 | State of the Art of NDA Techniques Applicable to UF6 Cylinders | Completion date end of 2008 (The task proposal is under consideration by other MSSP) |
| GER | A 1658 | Development of Tunable Diode Laser Spectroscopy for UF6 assay | Completion mid 2008 |

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| 07/TAU-003 | Field Test of Tunable Diode Laser System for HF Gas Monitoring | Accepted by France in December 2007 (FRA E 1714). |
| 07/TAU-004 | Development of Selected NDA Applicable to UF6 Cylinders | Accepted by European Commission Support Programme and under review by other MSSPs |
| Task 1 | Integration of Laser Identification Technology and NDA within the Measurement Station | |
| Task 2 | Engineering of the Centralized Measurement Stations | MSSP task or contract with third party companies |
| Task 3 | High Resolution Gamma Spectrometry for Attended Estimate of U Enrichment in Cascade Area | Upgrade of CHEM system |
| Task 4 | Low Resolution Gamma Spectrometry for Unattended Estimate of U Enrichment on Header Pipes | Upgrade of CEMO system |
| Task 5 | Neutron Distributed Source Analysis for Detection of HEU Production | |
| Task 6 | Development of Unattended Laser Based Detection of HF in Atmosphere | Continuation of current development |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

Tasks under this section will be carried out internally with assistance of third party commercial companies as necessary.

| Activity Designation | Activity Title |
|---|---|
| Task 1 | Assessment of GCEP Design Analysis for the Feasibility of Centralized Measurement Stations |
| Task 2 | User Requirement for Centralized Measurement Stations |
| Task 3 | Selection of NDA Methods for the Unattended Measurement Station |
| Task 4 | Integration of the Laser Identification into the Unattended Measurement Station |
| Task 5 | Capture Experience and Feedback of the Current Field-Testing of a Continuous Enrichment and Flow Monitor (Tenex). |
| Task 6 | To Investigate the Appropriateness of Radiation Monitoring for Verification of the Absence of Operation at Shutdown or Decommissioned Facilities |

# SGTS-13

## Universal NDA Data Acquisition Platform (UNAP)

**Project Manager: Mark Pickrell** **Division: SGTS**

### 1. Background

This document describes the plans for developing the Universal NDA Data Acquisition Platform (UNAP) within the Department of Safeguards for the period 2008–2009. The UNAP will be the next generation of data acquisition for NDA systems and is expected to replace the array of multiple instruments that is currently in use, including the JSR-12, JSR-14, miniGrand, AMSR, and the multi-channel analyzers used for unattended and remote monitoring. The UNAP will provide a more standard basis for NDA measurements, a common interface to the central data acquisition systems, and improved reliability from MIL-SPEC manufacturing standards. This plan has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011 and the Strategic Equipment and Technology Development Plan for 2006–2011 prepared by the Division of Technical Support, which specify that new NDA systems must achieve a level of standardization.


▲ UNAP Unit Front & Bottom Views

The UNAP is being developed to address a broad series of engineering problems that have plagued unattended monitoring systems. These problems manifest in both large unattended systems, such as for the J-MOX and RRP facilities, as well as smaller installations, where only a single measurement instrument is in place. Broadly, these problems fall under the rubric of unnecessary complexity. Part of this complexity is due to the large number of NDA data acquisition instruments available and in use by the Agency, each specific to a particular application. At present, there is little standardization. The Agency is then burdened by the concomitant supply-chain problems of purchasing, inventorying, maintaining, and training for these different instruments. More important, the data acquisition software is made much more complicated because it must accommodate so many different types of data acquisition modules. Indeed, the principal reason for cost over runs and schedule delays in the I3S software at Rokkasho Reprocessing Plant (RRP), was the difficulty in interfacing the I3S data acquisition software to the multiple, different instruments deployed in the plant. But, what is true of RRP in microcosm is also true for unattended systems generally. Multiple, application-specific modules have increased complexity and cost, and have delayed scheduled completion.

The UNAP system, which will be developed under the auspices of this development program, will address specifically the engineering problems caused by the current ensemble of instruments. Broadly, the two goals that we wish to achieve are:

- Simplification of the supply chain problem by replacing multiple, different units with a single variant, the UNAP.

- Simplification of the data acquisition software effort by providing only a principal NDA data acquisition interface, the UNAP, which will accommodate most of the NDA measurements required.

These two conditions drive the engineering specification for the UNAP. First, the requirement that a single module replace the current suite of modules demands that multiple different inputs are available on the UNAP, so that the broad spectrum of NDA measurements can be accommodated. The other engineering specifications for the UNAP were derived similarly. A summary list of the principle engineering requirements is provided, and is intended as an overview, not a complete specification. A complete, detailed set of specifications for the UNAP has been drafted and is attached to the task proposal sent to MSSPs. Subsequently, a conference of experts was convened at the Agency to evaluate and refine these specifications so that they were fully consistent with industry standards and modern engineering methods. The goal of that workshop was to ensure that the UNAP could be manufactured reliably and relatively inexpensively. The successful outcome of the UNAP workshop provides an added measure of confidence that the UNAP can be developed and placed into service quickly.

The overview requirements for the UNAP are:

- Multiple inputs to accommodate all of the NDA measurement types including: 2 low input current (fempto-amp) inputs, 2 full-up neutron multiplicity counters, 8 single channel analyzers (SCA) used as pulse counters, 8 digital pulse counters, a multiplicity counter that can sum any of the 8 SCAs and 8 digital scalers, an industrial 4 – 20 milliamp current loop, 4 digital outputs (contact closures), 4 digital inputs (looking for contact closure), 2 USB ports, 2 serial ports.
- MIL-SPEC specifications to ensure reliability and robust operation.
- Direct Ethernet connection to eliminate the need for a local collect computer, which has been a failure point and cause of significant reliability problems in the past.
- Direct communication between the data acquisition computer and the UNAP over Ethernet to allow for direct configuration control.
- Fiber optic Ethernet, on-board power supplies, and grounding control to solve the ground loop problems that many unattended systems suffer.
- An on-board processor and data storage to provide direct storage of data in the event of network failure.
- Data authentication and encryption built in to satisfy Agency Policy Paper 20 and general data security requirements.
- A skeletal operating system with minimum internet exposure to provide network security. Moreover, the on-board processing software will "own the IP stack" so that the UNAP can function as its own firewall.
- A composite video output so that future variants of the UNAP can be developed, with only upgrades to the software, to work as an attended unit as well as in unattended mode.

This development program is fully consistent with the SGTS strategy of modernizing and standardizing the instrumentation basis. For example, SGTS has implemented the upgrade of video systems with the Next Generation of Surveillance System (NGSS) project. Larger plants such as J-MOX are now moving towards modern blade processor, server farms that are based on current industry (telecommunications and Information Technology industry) best practices. Finally, as is implicit from the specifications, development of the UNAP will continue beyond the scope of this project to become an attended, as well as unattended instrument. The strategy is to standardize on a single (or just a very few) NDA instrument(s) for all NDA applications in the longer term.

## 2. Objectives

The objectives of this project are principally derived from the following goal and related key activities of the Department of Safeguards Strategic Objectives 2006–2011:

- Enhance detection capabilities through the development of new or improved safeguards approaches and techniques, and acquisition of more effective verification equipment

    - Optimize safeguards equipment and technology development with the view of further improving present detection capability, increasing reliability of equipment while ensuring the security of information transmission from the field and improving sustainability and timeliness.

    - Use where possible equipment and technology already available with the view of adapting it to departmental needs.

***The principal objective of this project is: To develop the Universal NDA Data Acquisition Platform (UNAP) as the basis of unattended monitoring systems for both large (e.g. J-MOX) and small deployed systems for the Agency.***

In particular the following specific objectives can be identified:

2.1. *Develop the full set of specifications for the UNAP system in consultation with NDA instrumentation experts from all principle developers and vendors. The UNAP should address all of the issues identified in the root cause analysis of objective 2.1.*

2.2. *Design and build a prototype of the UNAP system with basic operating software.*

2.3. *Test this prototype to demonstrate basic functionality and to select the final version.*

2.4. *Use several of the production prototypes of the UNAP as test modules to enable coding of the data acquisition system for J-MOX. These modules should be provided to the software vendor.*

2.5. *Use the processor design and software of the UNAP to develop and field a companion UNAP that provides a high resolution, Digital Signal Processor-based, multi-channel analyzer.*

2.6. *Integrate the UNAP into early J-MOX NDA systems.*

### 3. Activities

The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes.

3.1. *Develop the full set of specifications for the UNAP system in consultation with NDA instrumentation experts from all principle developers and vendors (Objective 2.1.)*

This activity is nearly complete. It was funded using multiple MSSP funds to pay for NDA experts from representative countries to attend a workshop at the Agency in Vienna. During this workshop, the draft specifications for the UNAP were reviewed and revised to ensure that the module can be build according to established industrial standards without undue expense. The workshop was quite successful and a full set of specification revisions have been developed.

3.2. *Design and build the production prototype UNAP system with a full software complement (Objective 2.2.)*

The design and production of the UNAP system will follow directly from the specifications, which

have already been reviewed by internal Agency experts and by instrumentation developers from all of the major NDA suppliers to the Agency. The design was selected that extensively used existing input circuits from proven measurement systems, so that the UNAP would be based on field-tested approaches to NDA data acquisition. For example, the neutron multiplicity input circuit is the same design that has been used for over 25 years, in facilities throughout the world, in literally tens of thousands of nuclear measurements. Moreover, the performance of these systems has been widely published in the open literature. Similarly, the Ethernet interface and control processor will be taken from existing designs, such as the Safeguards Core Component, which is part of the NGSS system. In this fashion, the UNAP design can be a process mostly of integrating existing, proven circuit elements.

The hardware design is also open and flexible. The essential functionality will be incorporated into the operating software. Therefore, many of the operating modes can be adjusted as we obtain operating experience, by changing the software. Equally important, the vision for the UNAP extends considerably beyond this implementation. There are several phases to the instrument development, leading to a system that can be used for both unattended and attended operation. The phases we have identified (both within and outside the scope of this research project), are:

- Develop the UNAP hardware platform, to include a composite video output and touch screen input port. Ensure that the processor has sufficient capability to run the entire suite of software envisioned for the UNAP. (In scope)
- Develop the initial software for the UNAP that will provide the basic functionality for the unattended application. (In scope)
- Develop the second variant of the UNAP that will have the DSP / MCA input capability. (In scope).
- Develop an auxiliary hardware to display a VGA (or similar) screen with touch-screen input capability that is compatible with the UNAP. (Out of present scope).
- Upgrade the UNAP software to display the last 20 data points of all channels that are operational on the display. This display should be similar to the AMSRWatcher program that is used with the MIC data acquisition software, and allows the user to monitor the entire NDA system performance. (Out of present scope, this will be addressed in a subsequent task).
- Upgrade the UNAP software to allow the display to present a touch screen panel that can configure the UNAP. The idea is to provide a virtual front panel of controls. The original UNAP will be configured using a Notebook computer connected through the USB port. This variant will remove the need for the Notebook and allow the UNAP to be operated and configured in a stand-alone configuration. Operating experience with systems such as the JSR-12 and the JSR-14 has shown that the local configuration is an important capability. (Out of present scope, this will be addressed in a subsequent task).

The specific schedule to develop the two variants of the UNAP for the unattended mode of operation is:

- Complete initial circuit design for the entire system. (5 months After Receipt of Funding [AROF]).
- Complete breadboard of UNAP with minimal software needed to test the hardware. (8 months AROF).
- Complete production prototype UNAP hardware with beta-level software. (12 months AROF).
- Complete final production unit of UNAP hardware with final phase 1 software. (15 months AROF).

*3.3. Test, evaluate, and select the UNAP system (Objective 2.3.)*

This task is separate from the development of the UNAP and will be conducted by an independent

laboratory and the Agency, to ensure that the results are fair and impartial. The test will be based on the final UNAP specifications. Several of the UNAP production prototypes will be delivered to the testing laboratory for final testing. Additionally, a 3rd party vulnerability assessment will be conducted. Scheduled completion for testing and evaluation: 15 months after funding of initial UNAP development (task 3.3). There are several components to this task.

- Development of the final version of the specifications and user requirements.
- Development of the test procedures based on the final user requirements. These test procedures will be written by the Agency with regular budget funds.
- Completion of the design, development, and manufacture of the UNAP prototypes.
- Testing the prototypes using the test procedures.

3.4. *Design and build the prototype second variant of the UNAP, which has the DSP-based multi-channel analyzer as an input. (Objective 2.5.)*

The UNAP design has inputs for all NDA measurements except for the digital signal processor-based multi-channel analyzer (DSP / MCA). The reason is that the DSP / MCA have been developed by several commercial companies, and the intellectual property is proprietary. Moreover, these DSP / MCAs are better performing than any of the non-DSP based MCAs available from the research labs. Although these MCAs are available as commercial products, they do not have the same software interface as the UNAP. One of the principles of the UNAP design is that all units must appear identical to the data acquisition system, so that the software coding is simplified. It was precisely the converse, multiple NDA data acquisition types that caused significant cost and schedule problems with the RRP I3S system.

This task will be a follow-on phase to the development of the first UNAP variant. It will use the identical processor and network interface as will have been developed for the UNAP. It will combine this processor with the proprietary DSP MCA to produce a second UNAP variant, the MCA input variant. Scheduled completion: 15 months after funding of initial UNAP development.

3.5. *Use the UNAP (both variants) as the building blocks for the J-MOX system (Objective 2.4 and 2.6). Regular budget funds*

This task will be implemented using regular budget funds under the auspices of the J-MOX project. The UNAP will be the foundation of the data acquisition system for the J-MOX plant. This implementation has both hardware and software implications. All of the NDA systems have to be designed to be compatible with the UNAP, which is relatively straight-forward because the UNAP input circuits are identical to the existing NDA systems. More importantly, the data acquisition software has to be coded to be consistent with the UNAP, which should provide a significant cost, schedule, and complexity savings.

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

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

There are no currently active or standby MSSP tasks.

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| 07/TAU-008 (Objective 2.3, 2.5) | Development of Universal NDA Data Acquisition Platform (UNAP) | Submitted October 2007 to EC, USA, GER, JAP, CAN, FRA |

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| New Task (Objective 2.4) | Independent Testing of the UNAP for Functionality and Specification Compliance. | |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

Staff support during the development process, testing and implementation are the activities supported through the regular budget.

# SGIM-01

## Integrated Safeguards Environment

### Project Manager: Remzi Kirkgoeze — Division: SGIM

#### 1. Background

This document describes the plans for the project SGIM-01 Integrated Safeguards Environment for the period 2008–2009. The Project seeks to enhance the integration, reliability and security of the information management computing systems within the Department of Safeguards. The plan has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011.

Information Management is at the heart of Safeguards activities. Safeguards are an information-driven business, and the knowledge workers of Safeguards Information Management endeavor to add value to this information through an integrated, secure approach. As the criticality and risks related to the information are ever-increasing, SGIM must elevate the integration, quality, security, integrity and availability of safeguards data throughout the Division.

Building on the enormous gains of previous and ongoing Member State Support Programme projects throughout SGIM, including the ISIS Re-engineering Project (IRP), the Communications Infrastructure Security Enhancements Tasks, the Public Key Cryptography Tasks as well as numerous internal initiatives, the SGIM-01 Project is positioned to deliver key new technologies, processes and procedures to create an integrated information processing environment for safeguards.

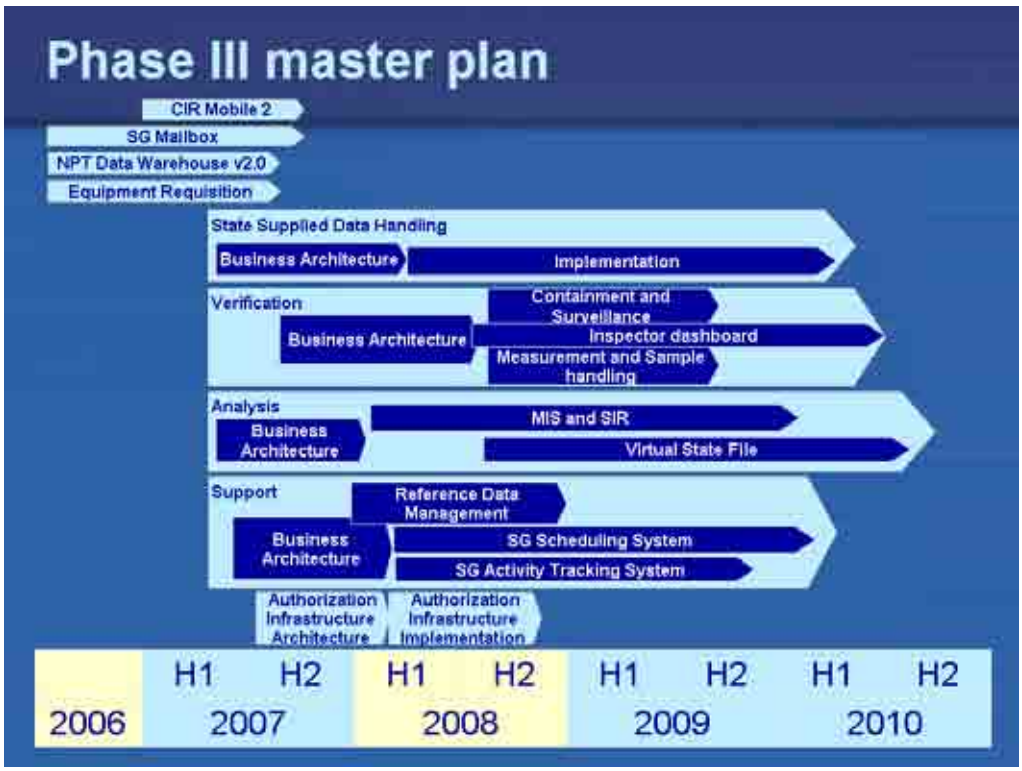
The Agency signed a contract with an external contractor to implement the IRP. It is planned to be implemented in three phases. The implementation of the Phase I & II started on 4 July 2005. The outcome of the implementation will be:

- Inspectors will have real-time access to all needed safeguards information via web-based applications at their desktops and via secure communications in the field.
- Analysts will be able to view integrated data from numerous safeguards applications to assist in the implementation of the strengthened safeguards programme.
- Savings in resources will be available to perform activities associated with the expanding role of the Department of Safeguards.
- Improved usability of applications will be achieved through the integration of all applications and information.
- Improved maintainability as a result of consistent database and application platforms.
- Improved resource utilization in the Department of Safeguards as a result of process and procedure re-engineering. The process and procedure re-engineering will be performed as part of the QMS activities.

As of October 2007 all Phase I & II projects of the IRP were implemented successfully and four Phase III projects were started.

The SGIM-01 Integrated Safeguards Environment project intends to align closely with initiatives throughout the Department, comprising not only the ISIS Re-engineering Project but other projects to ensure that safeguards information can be made available to appropriate users in a timely and secure manner, using an integrated standard computing environment. Most activities the division has identified for information technology infrastructure and services fulfill numerous of the department's objectives.

Member States can support the project in different ways, including, but not limited to, the following activities:




▲ IRP Phase III Master Plan

- To provide cost-free experts and consultants who can be included in the development project team;
- To provide cost-free experts and consultants to replace the SG resources reallocated to the IRP; and
- To provide training on the new technologies to be used in the new system.

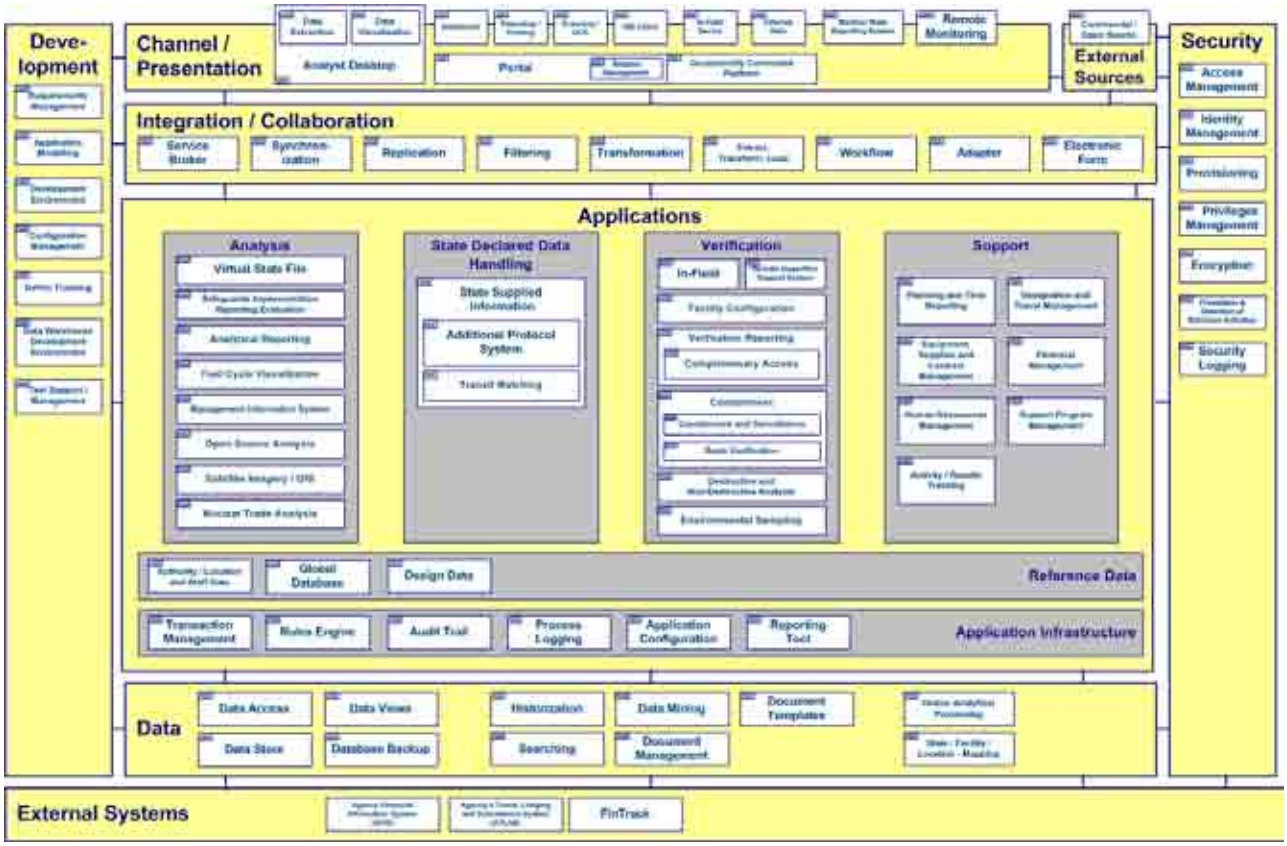
The end users of this project are the entire Department of Safeguards, Agency management and the Member States.

## 2. Objectives

The objectives of this project are principally derived from the following goals and related key activities of the Department of Safeguards Strategic Objectives 2006–2011:

As stated in the Department of Safeguards Strategic Objectives SG-MN-GNRL-PL-0001 2.3.1

- Enhance information acquisition, analysis and evaluation capabilities through:
    - The establishment of an integrated, service oriented, analysis-friendly information architecture, as an effective base to collect, evaluate, analyze, structure, secure and disseminate safeguards-relevant information;
    - The development, improvement and/or acquisition of more comprehensive information collection, analysis and evaluation tools to process relevant information; and
    - The constant improvement of the analytical processes within the department aimed at the optimization of the use of available expertise.
- Increase and intensify efforts related to the collection, analysis and evaluation of, and follow-up on, all available information on States' nuclear programmes, including extending evaluation capabilities for measurement data and information collected during inspection and visits, as well as on clandestine networks for the supply of nuclear items.




▲ IRP Planned Logical Information Systems

- Maintain an efficient safeguards information infrastructure.
- Enhance the Agency's present satellite imagery acquisition and analysis capabilities to support the verification work of the Agency
- Continue to develop processes and tools to maintain the knowledge required for the Department to produce credible conclusions
- Ensure that an effective Departmental security system, including staff awareness, and physical and electronic measures, is in place.

In particular the following specific objectives can be identified:

2.1. *Enhance information acquisition, analysis and evaluation capabilities*

2.2. *Maintain an efficient safeguards information infrastructure*

2.3. *Continue to develop processes and tools to maintain the knowledge required for the Department to produce credible conclusions*

2.4. *Ensure that an effective Departmental security system including staff awareness, physical and electronic measures is in place*

## 3. Activities

3.1. *Enhance information acquisition, analysis and evaluation capabilities (Objective 2.1.)*

The establishment of integrated, service oriented, analysis-friendly information architecture, as an effective base to collect, evaluate, analyze, structure, secure and disseminate safeguards-relevant

information.

- ISIS Re-engineering Project (Tasks CZ D 1512, FRA D 1676, GER D 1455, UK D 1449, USA D 461) The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes.

| Project Code | Project Name | Start | End |
|---|---|---|---|
| **State Supplied Data Handling** | | | |
| I.31 | State Supplied Data Handling (Requirements Gathering)<br>• Establish a detailed, complete and consistent understanding of the business activities, their sequence, business actors and business rules of the State Supplied Data Business Area.<br>• Reach a mutual agreement with the project stakeholders and key users if and how the business activities shall be supported by Information System services and which priority the implementation of these information services have.<br>• Derive detailed requirements from the identified information services and logical in-formation system components that allow for the subsequent beginning of parallel implementation streams without requiring to further detail the requirements. | 04/2007 | 04/2008 |
| I.32, I.44 | State Supplied Data Handling (Implementation)<br>• Implementation of the requirements collected in the State Supplied Data Handling (Requirements) project (I.31) | 05/2008 | 05/2008 |
| **Verification** | | | |
| I.43 | Verification (Requirements Gathering)<br>• Analysis and documentation of the business architecture;<br>• Update of the information systems architecture;<br>• Requirements analysis and specification for business processes that need information system support. | 09/2007 | 04/2008 |
| I.35 | Containment and Seals Verification<br>• Analysis and documentation of the business architecture and requirements analysis and specification for business processes that need information system support<br>• Implementation of the functionality to support containment and seals verification | 03/2008 | 12/2008 |
| I.36 | Measurement and Sample Handling<br>• Requirements analysis and specification for business processes that need information system support<br>• Implementation of the functionality to support measurement and sample handling. | 06/2008 | 02/2009 |
| **Analysis** | | | |
| I.37 | Analysis (Requirements Gathering)<br>• Requirements collection and business architecture documentation for the Analysis business area | 11/2007 | 06/2008 |

| | | | |
|---|---|---|---|
| I.38 | Management Information System (Implementation)<br><br>• Implementation of the functionality to support management information reporting. | 12/2008 | 07/2009 |
| I.39 | Virtual State File (Implementation)<br><br>• Implementation of the services and tools to support virtual state file within the Safeguards | 05/2008 | 02/2009 |
| I.40 | Safeguards Implementation Reporting (Implementation)<br><br>• Implementation of the functionality to support state evaluation and safeguards implementation report | 03/2008 | 05/2009 |
| **Support** | | | |
| I.41 | Safeguards Scheduling System (SLAPS, ISS, CAS, PLAIRE, Designation System) – (Requirements Gathering)<br><br>• Requirements gathering and prioritization for a departmental scheduling and planning system which is going to replace current functionality supported by different tools. | 11/2007 | 05/2008 |
| I.41 | Safeguards Scheduling System (SLAPS, ISS, CAS, PLAIRE, Designation System) – (Implementation)<br><br>• Implementation of the functionality defined in the project I.41 | 06/200 | 04/2009 |
| I.42 | Activity Tracking (DCAS, CATS, IDP Tracking)<br><br>• Requirements gathering and prioritization for a departmental activity tracking system<br><br>• Implementation of the functionality as defined in the requirements. | 11/2007 | 12/2008 |
| I.33 | Reference Data Management (Requirements Gathering)<br><br>• Analysis and documentation of the business architecture for reference data and update of the information systems architecture<br><br>• Requirements analysis and specification for business processes that need information system support for the reference data | 06/2007 | 02/2008 |
| I.34 | Reference Data (Implementation)<br><br>• Implementation of the functionality defined in the project I.34 | 03/2008 | 12/2008 |

- Tasks which are related to the IRP Implementation work-

- UK D 1412 Consultant - Assistance in ISIS Re-engineering Project (F1c)) (Target Date: December 2008). A consultant helped the IRP project team to put governance in place to run IRP and continuous support is provided during the project.
- USA D 1429 Quality Control Verification Software for Member States Nuclear Material Accounting Reports to the Agency (D.146) (Target Date: December 2007). A software has been developed to support Member States and the Agency for quality control verification for nuclear material accounting report. The software is currently tested by the Agency.
- USA D 1430 NPT – Accounting Enhancements (SP.62) (Target Date: December 2007) A software tool was developed to enhance NPT accounting reporting functionality. The tool is currently under test and will be released end of the year
- AUL D 1481 Agency Safeguards Information System Re-engineering Project (IRP) (Target Date: December 2007). The task is to support open source information collection activities in relation with the IRP and will be finished in 2008. This task closely linked to the SGIM-03 and SGIM-06 projects.

- USA D 1665 Junior Professional Officer - CIR-Mobile (Fayer) (D.164) (Target Date; December 2008)Mr. Fayer will help Computerized Inspection Reporting System project team to extend functionality for the in field activities.
- USA D 1638 State-level Follow-up Action System (D.162) (Target Date: December 2008). The task is currently on hold until end of the year. It will resume with the implementation of the Safeguards Scheduling System.

• SPRICS 2.0 (Tasks AUL D 1538, CAN D 1536, CZ D 1517, FIN D 1518, FRA D 1527, GER D 1522, JPN D 1546, ROK D 1528, SWE D 1537, UK D 1511, RSA D 1670, USA D 1617, HUN D 1592) Implementation of the SPRICS 2.0 system has started in March 2007. The system will be deployed to the Members States and within the Safeguards in April 2008.

*3.2. Maintain an efficient safeguards information infrastructure (Objective 2.2.)*

The establishment of integrated, service oriented, analysis-friendly information architecture, as an effective base to collect, evaluate, analyze, structure, secure and disseminate safeguards-relevant information.

• Platform Standardization and Consolidation (ISE)

SGIM seeks to inaugurate a platform virtualization and consolidation effort in which older hardware would be retired and the entirety of the Safeguards computing infrastructure would be standardized on the ISIS Re-Engineering Project-developed Integrated Safeguards Environment (ISE) platform. This task aligns with efforts underway throughout SGIM and would enhance the division to provision systems that are absolutely compliant with security and operational standards in a fraction of the time required today. Furthermore, support costs and complexity would decrease due to running a standardized hardware and software virtual platform which would still remain flexible enough to accommodate new development and the integration of future products. Virtualization would also enable the division to use, without risk, new technologies in isolated engineering environments that could be re-purposed quickly through virtual server management tools for any given testing task.

• Remote office architecture and platform development

SGIM seeks to standardize on a remote office hardware, software, network and communications platform that can be repeated whenever necessary and elevates the security and integrity levels of all remote office data and integrates more thoroughly the remote sites with Vienna and the Integrated Safeguards Environment. Additionally, SGIM wishes to pursue a strategy of distributing remote access gateways to the remote offices in efforts to vastly improve our remote personnel's abilities to deliver data into ISE. A business process analysis, followed by a technical architecture and platform development phase will precede the delivery of the new remote office technology platform.

• ITIL Compliance for Operations

Building on the gains of previous internal and Member State Support Programme tasks in the realm of quality management, SGIM will integrate an ITIL-compliant service management framework into the existing quality management framework (SSEP, the Safeguards Systems Engineering Process). An output of the process shall be the Safeguards IT Manual, which will include the operations guides for the Integrated Safeguards Environment. The activity will be comprised of two primary phases:

- Develop framework for integrating operations into the existing QMS system
- Populate the IT Manual

But more importantly, the outcome will be the assurance that IT services and operations can be provided in a documented and approved manner and that the quality of these services can be measured against this international standard and that eventual required improvements can be

planned and implemented against this standard.

- Achieve CMM Level 3 for SGIM/IAP

  The application development section for safeguards information management has achieved CMM Level 2 status. In efforts to verify and maintain this status, audits must be conducted on a periodic basis. After the attainment of CMM Level 3, audits would be necessary to retain and verify this status of process maturity.

3.3. *Continue to develop processes and tools to maintain the knowledge required for the Department to produce credible conclusion (Objective 2.3.)*

- Livelink integration into ISE

  The division shall integrate the Agency's official document repository into the Integrated Safeguards Environment, while ensuring that information stored through Livelink remains easily and securely accessible for analysis and other business purposes.

- Enhancement of the Material Balance Evaluation reporting system:
  The main objective is to implement document and knowledge management in the current Material Balance Evaluation reporting system in accordance with the Department's document management principles and standards. The enhancements include incorporation of IT security guidelines in the system, migration of the system to the new integrated safeguards IT environment, expansion and standardization of the workflow ability and tools, and inclusion of functional upgrades requested by the users. This activity is targeted for completion by September 2009.

3.4. *Ensure that an effective Departmental security system, including staff awarenes, physical and electronic measures is in place (Objective 2.4.)*

- Public Key Cryptology Deployment in Safeguards

  The Agency-wide Public Key Infrastructure (PKI) is slated for production in December 2007. Follow-on projects will seek to enhance the delivery methods of security certificates and tokens, to distribute components to Agency users, to leverage the platform for secure communication with member states and business partners, and to utilize certificates from PKI throughout the Agency's and safeguards' computing infrastructure to strengthen encryption and authentication.

- Safeguards secure desktop and mobile computers

  Leverage the advantage of the standardized safeguards computing environment to further enhance security of all desktop and laptop computers. Numerous regular budget and MSSP-funded tasks are foreseen related to this critical activity. SGIM intends specifically to investigate the feasibility of using technology for 'virtual computing' for desktop and laptop computers in order to further minimize residual risks.

- Strong authentication in safeguards

  SGIM plans to undertake a market survey and selection of a strong authentication solution for safeguards, and deploy strong authentication throughout the department. Strong authentication is defined as requiring a second factor (something one has in one's possession, such as a secure token or certificate) with something one knows (a password) to gain access to systems. The authentication shall serve as the gateway to the Integrated Safeguards Environment and will be required in 2008.

- Digital Rights Management

  The division wishes to investigate the use of encryption and digital signatures as well as

embedded attributes of documents to ensure that the viewing, editing, copying and printing of documents is allowed on a controlled manner.

- Advanced Network Security

The safeguards network is the backbone for all information collection and analysis in the department. As more information of increasing sensitivity is integrated and made available to appropriate people, it remains imperative that stronger controls are put in place to ensure that only approved traffic is on the network and that any intrusion attempts can be detected and stopped. There are several activities planned and underway in this area, including:

- Network Access Control
  A project is already underway to deliver this technology, which shall identify all devices on the safeguards network and deny access to unauthorized devices. It is scheduled to go into full production in 2008.
- Quarantine of return equipment
  Safeguards operational and technical staff members frequently work off-site and in environments of higher security risk to the mobile safeguards computing components such as laptop computers. SGIM wishes to investigate and then initiate a process and method for securing laptops for travel and then re-attaching the devices to the safeguards network only after a thorough security and operational status check of the equipment.
- Core firewall upgrades
  The network firewall that isolates users from applications and serves as the central firewall is nearing its capacity and may require an upgrade or replacement sometime during the 2008-2009 period.
- Secure information flow (controlled in/out
  Safeguards shall 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, SGIM shall develop a means of secure data interchange between trusted and not trusted networks either through the use of commercial products, custom-developed solutions or both. This capacity must be in place and integrated by the end of 2009.
- Integrated Network Architecture
  The first and fundamental task involving secure network integration shall be a business process and feasibility study to determine the level of secure network environment isolation possible while still maintaining the ability to conduct safeguards work. After the intensive security efforts recently undertaken by SGIM related to network and application security, SGIM should conduct ongoing series of risk and threat assessments, vulnerability tests and risk mitigation strategy sessions.
- Next generation intrusion detection systems (IDS) for the Integrated Safeguards Environment
  Safeguards IM deployed network intrusion throughout the network as part of the umbrella network security task. These intrusion detection systems (IDS) are ending their support life and are candidates for replacement sometime in 2008 or 2009.

- Business continuity and disaster recovery

There is a need for the Department of Safeguards to be able to continue the normal working in the event of a major disaster in the facility at VIC, thereby access to the data and infrastructure is not possible or not available to use. The data and a similar infrastructure shall be available elsewhere for Safeguards operations to resume in the shortest possible time. The SGIM Crisis Recovery Plan and the overall Agency business continuity also mandate the establishment of disaster recovery facilities built using appropriate infrastructure and technology, to save and secure the data and make it available for SG purposes. SGIM intends to study the use of virtual server technologies for disaster recovery and remote disaster recovery infrastructure.

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

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

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| AUL | D 1538 | SPRICS 2.0 | Target date 05/2008 |
| AUL | D 1481 | IAEA Safeguards Information System Re-engineering Project (IRP) | Target date 12/2007 |
| CAN | D 1536 | SPRICS 2.0 | Target date 05/2008 |
| CAN | D 1576 | Public Key Infrastructure Deployment in Safeguards | PKI Infrastructure scheduled to go into production in November 2007 |
| CZ | D 1517 | SPRICS 2.0 | Target date 05/2008 |
| CZ | D 1512 | IAEA Safeguards Information System Re-engineering Project (IRP) | Target date 10/2008 |
| FIN | D 1518 | SPRICS 2.0 | Target date 05/2008 |
| FRA | D 1527 | SPRICS 2.0 | Target date 05/2008 |
| FRA | D 1676 | IAEA Safeguards Information System Re-engineering Project (IRP) | Target date 12/2009 |
| GER | D 1522 | SPRICS 2.0 (B.18) | Target date 05/2008 |
| GER | D 1455 | IAEA Safeguards Information System Re-engineering Project (IRP) (B.15) | Target date 09/2007 |
| HUN | D 1592 | SPRICS 2.0 | Target date 05/2008 |
| JPN | D 1546 | SPRICS 2.0 | Target date 05/2008 |
| ROK | D 1528 | SPRICS 2.0 | Target date 05/2008 |
| RSA | D 1670 | SPRICS 2.0 | Target date 05/2008 |
| SWE | D 1537 | SPRICS 2.0 | Target date 05/2008 |
| UK | D 1412 | Consultant - Assistance in ISIS Re-engineering Project (F1c)) | Target date 12/2008 |
| UK | D 1511 | SPRICS 2.0 | Target date 05/2008 |
| UK | D 1449 | IAEA Safeguards Information System Re-engineering Project (IRP) | Target date 08/2007 |
| USA | D 1429 | Quality Control Verification Software for Member States Nuclear Material Accounting Reports to the Agency (D.146) | Target date 12/2007, Testing in progress |
| USA | D 1430 | NPT – Accounting Enhancements (SP.62) | Target date 12/2007 |
| USA | D 1665 | Junior Professional Officer - CIR-Mobile (Fayer) (D.164) | Target date 12/2008 |
| USA | D 1638 | State-level Follow-up Action System (D.162) | Target date 12/2009, currently on hold will be integrated into a larger project within the IRP. |
| USA | D 1617 | SPRICS 2.0 (D.160) | Target date 05/2008 |
| USA | D 1461 | IAEA Safeguards Information System Re-engineering Project (IRP) (D.151) | Target date 11/2007 |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| USA | D 1158 | Implementation of Systems Engineering Process for the Division of Safeguards Information Technology (D.122) | Target Completion date 2007 |
| USA | D 1548 | Windows XP/Office 2003 Migration for Safeguards (E.127) | Target completion December 2007 |

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| 03/ISH-001 | IAEA Safeguards Information System Re-engineering Project (IRP) | Under consideration with some MSSPs |
| 07/ICO-002 | Enhanced Material Balance Evaluation and Reporting System | Spanish Support Programme |
| 06/ISH-001 | Junior Professional Officer - I3S | Under consideration |
| 06/ISI-001 Objective 2.2. | Integration of ITIL Relevant Best Practices into the SEI-CMMI Based Safeguards Systems Engineering Process (SSEP) for ICO | Initiate in 2008 |
| New Task 1 Objectives 2.1., 2.4. | Business Process Analysis for Secure Network Integration | Initiate in 2008 as fundamental basis of work under umbrella task of secure network integration |
| New Task 2 Objectives 2.1., 2.4. | Consultancy to update SGIM Disaster Recovery Plan | Initiate in 2008 |
| New Task 3 Objective 2.1. | Ensuring Scalable and Reliable Remote Monitoring Systems (RMS) | Initiate in 2008 |
| New Task 4 Objective 2.2. | Achieving CMM level 3 in SGIM/IAP | Initiate in 2008 |
| New Task 5 Objective 2.2. | CMM audit of SGIM/IAP | Will be needed 1 year after New Task 4 and will happen every 2 years. |
| New Task 6 Objective 2.2. | Achieving CMM level 3 in SGIM/IAP | Initiate in 2008 |
| New Task 7 Objective 2.2. | Achieving ITIL Compliance for the Safeguards Information Management IT Operations Group | Initiate in 2008 |
| New Task 8 Objectives 2.1, 2.4. | Virtual Client Security Architecture and Deployment | Initiate in 2008 |
| New Task 9 Objectives 2.1., 2.4. | Develop the Next Generation Remote Office Platform | Initiate in 2008 for completion and roll out in 2009. |
| New Task 10 Objective 2.3. | Consultancy to Integrate Livelink with ISE | Initiate in 2008 |
| New Task 11 Objectives 2.1., 2.2., 2.4. | Develop a Capacity for Highly-controlled Information Flow in Safeguards through the use of bastion product, custom-developed solutions or both | Initiate in 2008 |
| New Task 12 Objective 2.4. | Risk and Threat Assessment and Residual Risk Mitigation Study after the completion of the previous network security tasks | Initiate in 2008 |
| New Task 13 Objective 2.3., 2.4. | Local Virtual Private Network(VPN) Gateways for Remote Offices | Initiate in 2008 |

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| New Task 14<br>Objectives 2.2., 2.3., 2.4. | Virtual Platforms for Safeguards Computing | Investigate, design and deploy virtual platforms for use in server consolidation and disaster recovery scenarios. Initiate and complete in 2008 |
| New Task 15<br>2.2 | Wide Area Network Acceleration for Remote Offices | Initiate in 2008 |
| New Task 16<br>2.1, 2.2, 2.4. | Disaster Recovery Infrastructure Design and Deployment for Tertiary Business Continuity Site. | Initiate in 2008, complete by end of 2009 if feasible |
| New Task 17<br>2.1., 2.4. | Feasibility and Design Study for Secure Network Integration | Building on the business process analysis (New Task 1), IRP and ISE Phase One, study and design the architecture for secure network integration. Initiate and complete in 2008 |

### 5. Current Active and Planned R&D Activities Supported Through Regular Budget

| Activity Designation | Activity Title | Comments |
|---|---|---|
| 3.3 | Enhancement of the Material Balance Evaluation Reporting System | Active, ongoing |
| 3.4 | Network Access Control | Project serves as a follow-up to the improvements from the communications infrastructure task carried out in 2006-2007 and will serve to identify and control access for every device on the safeguards network. Scheduled for full production in March, 2008. |
| 3.4 | Safeguards Secure Desktop Engineering Work | Improve the security of the safeguards computers |
| 3.4 | Securing the Network Operating System Policy and Directory Services. | |

# SGIM-02

## Commercial Satellite Imagery

### Project Manager: Karen Steinmaus

### Division: SGIM

#### 1. Background

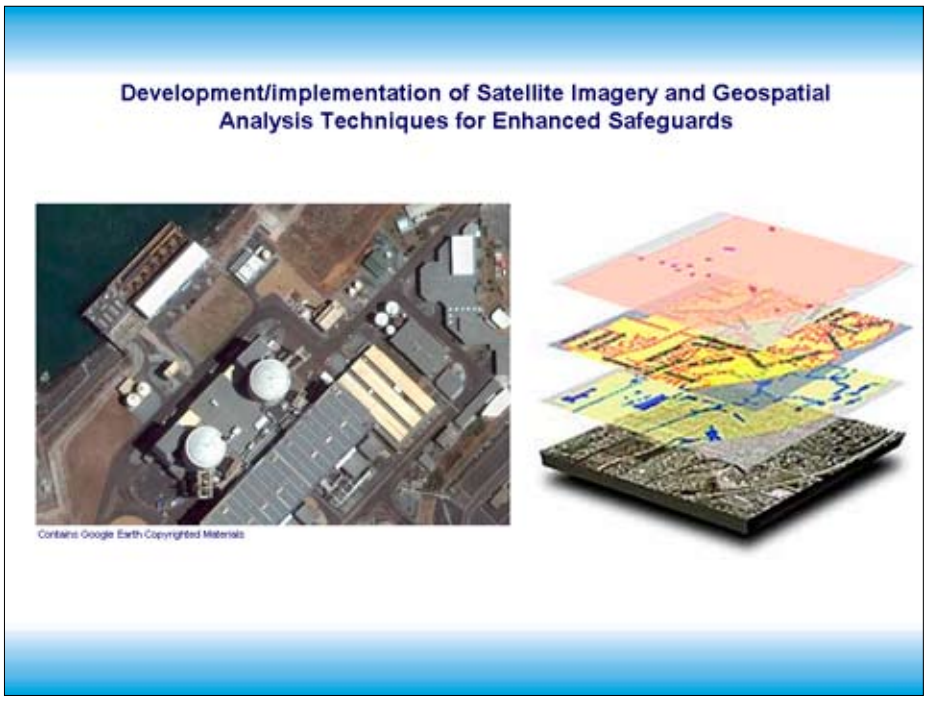
During the 2006 through 2007 reporting period, satellite imagery analysis capabilities have been significantly consolidated and most of the R&D objectives have been reached with the support of Member States. These activities are reported in the 2006–2007 Biennial Report on the R&D Program. It should be mentioned that commercial satellite imagery was extensively used to:

- Support the evaluation of newly revealed and alleged clandestine programs and activities,
- Monitor on-going development at critical nuclear fuel cycle facilities
- Support the verification of States' declarations with special attention given to newly implemented additional protocol agreements.

▲ Imagery Analyst at Work

During this intensive period, the Satellite Imagery Analysis Unit (SIAU) demonstrated how currently available commercial satellite imagery could be used as a valuable monitoring tool, and also where there were limitations for its use. These operational limitations include the identification of small scale undeclared activities and the difficulties associated with implementing an efficient monitoring program over some areas. Some solutions might come from future systems which promise higher spatial and spectral resolutions, while others are related to access to cutting-edge sensor technologies (e.g. thermal imagery). The use of geospatial information combined with imagery has also demonstrated its potential in many instances. Relevant projects have been implemented within SIAU to test and demonstrate the integration of these technologies on a prototype basis. Now proven, such geospatial solutions should be consolidated and expanded with a Departmental vision of a geospatial information service. The enhancement of expertise of Agency imagery analysts on advanced imaging technologies and the nuclear fuel cycle was pursued intensively through training courses, visits to international nuclear facilities, and participation on inspections. Such efforts will be continued in 2008–2009, as they are a critical component of developing and maintaining knowledge of the nuclear fuel cycle. A new state-of-the-art imagery exploitation system was deployed in 2007 (Carterra Analyst V6.0). This will significantly improve the Department of Safeguards' capability to collect, evaluate, analyze, structure, secure, and disseminate commercial satellite imagery and imagery-derived products.

Several new satellite-based sensor systems have been launched that have significant implications for SIAU. One is an optical sensor with very high spatial resolution (<50cm in panchromatic mode) and dramatically enhanced agility. The second will be the first commercial high-resolution radar sensor in the world (1m). The




▲ Satellite Imagery and Geospatial Analysis Techniques for Safeguards

exploitation of radar technology represents a challenge for the Department as the visual interpretation of high resolution radar imagery and the complex analysis of its signal requires a totally new skill-set for SIAU imagery analysts.

This following R&D project plan was prepared taking into consideration the Department of Safeguard's Strategic Objectives for 2006–2011, and in accordance with the Agency's Medium Term Strategy (MTS).

## 2. Objectives

The Department's overall objective is to maintain and further develop an effective and efficient verification system in order to draw independent, impartial and timely safeguards conclusions, thus providing credible assurances to the international community that States are in compliance with their safeguards obligations. The 2008–2009 objectives for the SGIM-02 Commercial Satellite Imagery project focus on enhanced information acquisition, analysis, and evaluation capabilities. Key activities include:

2.1. *The establishment of an integrated, service oriented, analysis-friendly information architecture as an effective base to collect, evaluate, analyze, structure, secure, and disseminate safeguards-relevant information;*

2.2. *The development, improvement, and/or acquisition of more comprehensive information collection, analysis, and evaluation tools;*

2.3. *The constant improvement of analytical processes;*

2.4. *Enhance the Agency's present satellite imagery acquisition and analysis capabilities to support the verification work of the Agency.*

***The primary objective of this project is to enhance the Agency's ability to acquire, analyze and exploit satellite imagery and geospatial information to support verification activities.***

## 3. Activities

3.1. *The establishment of an integrated, service oriented, analysis-friendly information architecture as an effective base to collect, evaluate, analyze, structure, secure, and disseminate safeguards-relevant information.*

- Evaluate a Department-wide geospatial information service in the context of ongoing IT architecture improvement efforts (IRP and/or n-Vision) (2008).
- Identify "next generation" enhancements to SIAU's imagery exploitation system (2009).

3.2. *The development, improvement, and/or acquisition of more comprehensive information collection, analysis, and evaluation tools.*

- Evaluate capabilities to enhance imagery analysis and automate geospatial processing techniques to increase the productivity and the timely provision of imagery and imagery-derived products (e.g., updating AP site maps) (2008).
- Develop relationships with relevant organizations that would permit the Agency to be involved at the conceptual stage of new civil Earth Observation programs, to provide operational feedback and technical requirements to developers and future providers (2008–2009).

3.3. *The constant improvement of analytical processes.*

- Organize, with the support of Member States, a workshop with national experts on the identification, detection, and characterization of undeclared activities using commercial satellite imagery. The focus will not only be on the next generation of very high spatial resolution sensors, but also on the exploitation of thermal, radar and hyperspectral imagery and the implications for safeguards activities (2008).
- Request support from Member States to organize a workshop or training courses on all-source analysis for safeguards activities, focusing on integrated analysis using a combination of imagery and open source information. This task will be conducted in concert with SGIM/ICA TTA and IAU (2008).
- Discuss with Member States the existence and conditions of access to next generation and experimental sensors relevant to safeguards activities (2008–2009).

3.4. *Enhance the Agency's present satellite imagery acquisition and analysis capabilities to support the verification work of the Agency;*

- Request support from Member States in organizing training courses on satellite imagery analysis for safeguards applications. This is in support of both new SIAU analysts as well as more in-depth studies on the nuclear fuel cycle for existing image analysts (2008–2009).
- Request support from Member States in organizing in-depth training courses on the processing and analysis of high-resolution radar imagery for SIAU imagery analysts. These training courses will be based on newly launched sensors providing high-resolution SAR imagery (2008).
- Request support from Member States to provide case studies and recommendations on the use of high-resolution radar imagery for nuclear facilities monitoring within SIAU (2008).
- Evaluate the use of commercial satellite imagery for monitoring geological repositories (2008).
- Request support from Member States for evaluating the application of 3D visualization in a GIS environment for safeguards monitoring activities (2008).
- Request support from Member States to provide access and host visits to nuclear facilities for training and familiarity with observables associated with the nuclear fuel cycle (2008–2009).
- Request support from Member States to populate a comprehensive database of imagery indicators/signatures for all nuclear fuel cycle processes (New SP-1).

- Initiate the creation of a handbook on radar signatures for nuclear and industrial facilities with the support of Member States (New SP-1).

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

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

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| FRA | D 1296 | Investigation of the potential applications of commercial satellite imagery | Expected completion date: end of 2009. |
| GER | D 1686 | Junior Professional Officer – SIAU | Candidate to begin with SIAU in 11/2007 |
| USA | D 1694 | Junior Professional Officer – SIAU | Candidate to begin with SIAU in 2007/early 2008 |
| UK | B 1655 | Consultant: Training on Satellite Imagery Analysis for Safeguards Applications (F1(d)) | Expected completion date: end of 2008; request extension 2009. |
| RUS<br>GER<br>UK | D 1413<br>D 1313<br>D 1329 | Commercial Satellite Imagery Analysis and Photo Interpretation Support | Expected completion date: end of 2008. RUS task on stand-by. |
| CAN<br>SWE | B 1483<br>B 1373 | Satellite Imagery Training Program | Expected completion date: end of 2008. Managed in project SGCP-102. |
| EC<br>JPN | D 1664<br>D 1586 | | Expected completion date: end of 2008. |
| GER<br>USA<br>FRA<br>CAN | D 1457<br>D 1477<br>D 1440<br>D 1486 | Software, Hardware and Database Provision for Satellite Imagery Analysis Support | |
| CAN<br>EC<br>FRA<br>GER<br>JPN<br>AUL | JNT D 01657 | Signatures of Nuclear Fuel Cycle Related Processes (Satellite Imagery/Space Borne Remote Sensing Data) (AUL, CAN, EC, FRA, GER, JPN) | Expected completion date: end of 2008. |
| GER<br>FIN<br>CAN | D 1632<br>D 1614<br>D 1675 | Use of Satellite Imagery Data for Geological Repositories Monitoring | Expected completion date: end of 2009 |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| SWE | B 1504 | Specialist Training for Agency's Imagery Analysts | Expected completion date: end of 2009 |
| UK | B 1495 | | |
| JPN | B 1585 | | |
| USA | B 1442 | | |
| GER | B 1456 | | |
| FRA | B 1439 | | |
| CAN | B 1484 | | |

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| 03/IIS-003 | Investigation of the Potential Applications of Commercial Satellite Imagery | US outstanding |
| 05/IIS-004 | Use of Satellite Imagery Data for Geological Repositories Monitoring | EC, SWE and US outstanding |
| 06/IIS-002 | Signatures of Nuclear Fuel Cycle Processes | US, UK, and RUS outstanding |
| New task | Organization of a workshop on geospatial information for safeguards applications | SP-1 to be submitted |
| New task | Organization of a workshop on the identification of undeclared nuclear facilities | SP-1 to be submitted |
| New task | Development of a comprehensive list of imagery indicators for all processes identified in the Agency physical mode | SP-1 to be submitted |
| New task | Organization of a workshop/training on all-source analysis | SP-1 to be submitted |
| New task | Support on development/population of a database of imagery indicators/signatures for the NFC | SP-1 to be submitted |
| New task | Populate a Comprehensive Database of Imagery Indicators/Signatures for all Nuclear Fuel Cycle Processes | SP-1 to be submitted |
| New task | Initiate the Creation of a Handbook on Radar Signatures for Nuclear and Industrial Facilities | SP-1 to be submitted |

# SGIM-03

## Information from Open Sources

### Project Manager: John Lepingwell — Division: SGIM

### 1. Background

This document describes the plan for developing and implementing processes and technologies for the collection, processing, analysis and dissemination of open source information within the Department of Safeguards for the period 2008–2009. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011.

Since 1996, the collection and analysis of open source information has become a central element in the state evaluation process. All state evaluation reports (SERs) incorporate open source research, while the provision of open source analysis has also become an essential element in the detection of undeclared nuclear facilities and materials, evaluation of Additional Protocols, support for complementary accesses, and in the investigation of nuclear trade. The rapid pace of change in information technology and the growing amount of open source information available pose challenges and opportunities. Meeting these challenges requires ongoing development and investment in technology and tools that effectively collect information, filter out "noise," and present valuable information in a clear and accessible manner. The development of human resources is equally important as staff must receive training in the effective use of technology, in analytical techniques, and in substantive matters related to proliferation and the fuel cycle. This project aims to enhance these aspects of information collection, processing, analysis and dissemination.

Most of the funding for developments in open source collection is expected to come from the regular budget. MSSP support will be requested to focus on specific areas, including technology and tool development (SGIM-06), assistance in diversifying sources, and development of analytical capabilities.

While SGIM is responsible for developing open source processes all Divisions within the Department are end users of the information, with a significant proportion of the information being used by the Operations Divisions in the State Evaluation process.

### 2. Objectives

The objectives of this project are derived from the following goals and related key activities of the Department of Safeguards Strategic Objectives 2006–2011 (section 2.3):

- Enhance information acquisition, analysis and evaluation capabilities through:
  - The establishment of an integrated, service oriented, analysis-friendly information architecture, as an effective base to collect, evaluate, analyze, structure, secure and disseminate safeguards-relevant information;
  - The development, improvement and/or acquisition of more comprehensive information collection, analysis and evaluation tools to process relevant information; and
  - The constant improvement of the analytical processes within the department aimed at the optimization of the use of available expertise.
- Increase and intensify efforts related to the collection, analysis and evaluation of, and follow-up on, all available information on States' nuclear programmes, including extending evaluation capabilities for measurement data and information collected during inspection and visits, as well as on clandestine networks for the supply of nuclear items.

- Continue to develop processes and tools to maintain the knowledge required for the Department to produce credible conclusions.

***The principal objective of the project is to enhance the Agency's ability to collect and analyze open source information in support of the Agency's verification mission, in particular with respect to the state evaluation process and the detection of undeclared nuclear material or facilities.***

The following specific objectives can be identified:

2.1. *Increasing Efficiency*

The challenges for 2008-2009 are qualitatively similar to those of 2006-2007. The increasing volume of information available makes it essential to continue to increase the efficiency of the collection and distribution process. Improved information collection and processing tools are required, as are streamlined systems for building State Files and supporting the State Evaluation process. New technologies investigated and tested under the last Plan are expected to be ready for implementation in 2008-2009 in collaboration with SGIM-06.

2.2. *Expanding and Diversifying Sources*

There is an ongoing need to acquire information on a global basis, 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.

2.3. *Enhancing Evaluation and Analysis*

The provision and analysis of open source information is essential to the state evaluation process. Given the large quantity of information that must be reviewed, the development of analytical methods and tools is an ongoing process. This will be done both by internal reviews of processes and by external reviews. Inputs from specialized technical consultants can also play a role in enhancing the Department's capability to evaluate new technologies and complex issues. Ongoing training in information collection and analysis (in cooperation with SGCP-102) is also required.

2.4. *Developing Capabilities to Enhance Detection of Undeclared Activities*

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 open source indicators and the means of detecting them

## 3. Activities

Enhance information collection by introducing new sources of data and collection tools. (Objective 2.1)

- Regional Information Collection. The support of Member States in the provision of open source information, particularly regional information, will continue to be of great importance. It is expected that existing programmes for supply of regional information by Member State Support Programmes

will continue. A new aspect for 2008–2009 is an increased emphasis on access to regional scientific and technical information, including additional translations of relevant non-English language information. It is planned to issue a new task for support of regional scientific and technical information collection. Ongoing tasks include: AUL D 1088, BEL D 1478, GER D 1487, ROK D 1213, RUS D 1414, RSA D 1489, and UK D 1366. (Target Date: Ongoing)

- Monitoring Scientific and Technical Information. The large volume of scientific and technical publications in nuclear-related fields makes regular monitoring for potential Safeguards relevant items a complex problem. This task will develop a scientific and technical literature monitoring system. It will generate search strategies optimized to identify Safeguards-relevant articles and to disseminate them to staff members responsible for their evaluation. Coordination with the Agency library and INIS will be an integral part of this task. This will require a new task request with initial work to start in 2008. Launch of the new service in a trial mode would be expected in late 2008 with full system implementation in 2009.
- Identification of New Sources. Rapid changes in the information marketplace require continuous monitoring and review of information sources. This is particularly the case with respect to business, commercial, trade, and industrial databases for use in State Evaluation and to support trade analysis in SGIM ICA TTA. This work has been ongoing during 2006–2007 with regular budget funding and will be continued in 2008–2009. Member state support requested would include assistance in the identification and evaluation of sources, possibly through a limited number of consultancies. [New Task 1]
- Consultants on Open Source Analysis. Provision by member states of consultants with extensive experience in open source analysis has allowed SGIM to provide a broader and deeper range of analytical products. In addition, the opportunity to interact with outside experts has enabled 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's capability in this area. This is proposed as an ongoing task for the duration of the project plan.
- Development of Open Source Capabilities for Detection of Undeclared Activities. This activity will focus on developing open source indicators of undeclared activities, both technical and non-technical, and will be closely coordinated with the scientific and technical literature monitoring task. It will also complement related work taking place in SGIM-02, SGIM-06, SGIM-09, and the Novel Technologies Project. Initial work has been done in a related task, FRA D 1417. It is planned to hold internal meetings to develop joint approaches to this issue, and to develop a workplan that would include input from Member State experts and organizations with experience in the field in early 2009. This input would be used to implement new research and analysis strategies in 2009. (Target Date: May 2009).
- Training to Support Open Source Collection and Analysis. Training in open source information collection is necessary to identify new sources, tools and methods for efficiently collecting and disseminating information. Analysts and open source collection assistants also require training in nuclear fuel cycle activities in order to be able to identify relevant indicators and issues in the open source collection process. Support for open source training has been provided under SWE D 1380, and for fuel cycle training under FRA B 1427 (Training Project SGTS-101, Proposal 02/TTR-011). A new task is proposed that would focus on specific open source training activities in collaboration with the satellite imagery project (SGIM-02) and the trade analysis project (SGIM-09). This task may be proposed under the Training Project. Activities would include workshops in 2008 and 2009 as part of SWE D 1380 and FRA B 1427.
- Introduction of Collaborative Information Systems. During 2006–2007 a project was started to explore the potential use of collaborative software (e.g. blogs, wikis, bulletin boards) to SGIM information collection and dissemination procedures. Initial work was supported by the Canadian SP under SGIM-06, and proved successful. The introduction of collaborative software tools and Web 2.0 technology will be a central theme in the Research Plan for 2008–2009, and will be fully integrated with the Microsoft Sharepoint deployment planned under IRP. Additional support for this task is to be synchronized

with the Departmental rollout of Sharepoint software. (Target Date: July 2009) [CAN D 1485]

- Development of a Virtual State File. The development of a Virtual State File is a component of IRP that would complement the activities being undertaken in the deployment of collaborative software. The initial focus would be on the storage of all SGIM information for use in the State Evaluation process. This would be a joint task with SGIM-01, SGIM-02, SGIM-06, and SGIM-09.

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

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

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| ARG | D 1228 | Provision of Open Source Information | No Activity. Pending Review. |
| AUL | D 1378 | Open Source Information Collection | |
| BEL | D 1478 | Open Source Information Collection | |
| FRA | B 1427 | Training for Information Collection and Analysis for Additional Protocol Verification | Training Project SGTS-101<br>Proposal 02/TTR-011<br>2004/12 |
| FRA | D 1417 | Open Source Information Collection | |
| GER | D 1487 | Open Source Information Collection (B.17) | |
| JPN | D 1282 | Provision of Open Source Information | |
| ROK | D 1213 | Provision of Open Source Information | |
| RSA | D 1489 | Open Source Information Collection | |
| RUS | D 1414 | Open Source Information Collection | |
| SWE | D 1380 | Open Source Information Collection | |
| USA | D 1126 | Consultant - Assistance on Information Collection and Information Systems (D.137) | |
| USA | D 1672 | Junior Professional Officer - Open Source Information Analysis (Tatavosian) (D.166) | |
| BRZ | D 1603 | Assistance in Open Source Information Collection | |
| UK | D 1569 | Support for Regional Open Source Information Collection (A8(d)) | |
| USA | D 1674 | Junior Professional Officer - Open Source Information Collection () (D.165) | JPO candidate declined post, new recruitment underway |
| USA | D 1673 | Junior Professional Officer - Open Source Information Collection (Feldmann)((D.167) | |

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| New Task | Acquisition of Regional Scientific and Technical Information | |
| New Task | Development of a Monitoring Capability for Scientific and Technical Information | |

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| New Task | Training in Support of Open Source Information Collection and Analysis | Joint with SGCP-102, SGIM-02, SGIM-09. |
| New Task | Revision of State File Structure and Process | Joint with SGIM-06, |
| New Task | Development of Open Source Capabilities for Detection of Undeclared Activities | Joint with SGIM-02, SGIM-06, SGIM-09 |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

| Activity Designation | Activity Title | Comments |
|---|---|---|
| Virtual State File | Development of a framework for information collection in a Virtual State File | Joint with SGIM-06, SGIM-02, SGIM-09 |
| Topic Tree Development | Development of Topic Trees for Autonomy search engine | Joint task with SGIM-06 |
| Indicator Development | Development of open source search terms and indicators based on the Physical Model. | Combined with above task. |
| Scientific Literature Monitoring | Development of a regular review and alert service for scientific and technical literature. | Supported in part by US JPO. |
| Undeclared activities indicators | Research on identification and search strategies for indicators of undeclared activities. | Joint with SIAU and TTA. |
| Open Source Tool Identification | Identification and evaluation of new open source information collection and analysis tools | Joint with SGIM-06 and SGIM- |
| Review of New Open Sources | Identification and Evaluation of new databases and other sources of open source information | |
| Open Source Training | Training in use of databases, new sources of information, and tools | Joint with Agency Library, SGIM-06. |

# SGIM-06

## Enhanced Information Analysis Architecture

### Project Manager: John Hilliard — Division: SGIM

### 1. Background

This document describes the plans for developing and implementing all functional areas of Project SGIM-06 "Enhanced Information Analysis Architecture" prepared by SGIM-IAP **w**ithin the Department of Safeguards for the period 2008–2009. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011 and 2006–2011 Strategic Plan for Information and Communication Technology produced by the Division of Safeguards Information Management.

The implementation of "information-driven safeguards" requires the deployment of an array of advanced information technologies to support the collection and evaluation of information about States nuclear activities.

These technologies are essential for managing the extremely large and growing volume of information utilised for evaluation purposes. In part, this large size has arisen because in-depth evaluation reports have to be prepared annually for about a hundred States. And this number of States will continue to increase. It is also because large volumes of relevant information are readily accessible.

To convert even a fraction of this information into knowledge is usually a time-intensive and manual process for analysts. The limitation of human resources available within the Agency for State-evaluations imposes a significant constraint on the amount of information that can be effectively scrutinised. This limits the extent to which the knowledge 'signal' can be extracted from the vast information 'noise'. Therefore, useful inter-relationships and patterns that may exist within large volumes of information may be not identified within the short deadlines to which analysts typically work.

This two year project will be a key component supporting a larger Safeguards project – the ISIS Re-engineering Project (IRP) – which will create the information environment for all-source analysis in Safeguards, particularly the fusion of all key data sources. It is aimed at providing an analysis portal which will provide access to all relevant high value open sources for not only Information and Safeguards Analysts but to users across the entire Department.

Member State research and development activities in all functional areas of the project have been essential and will help in reaching a larger Departmental goal of fostering an analytical culture within the Department of Safeguards.

### 2. Objectives

The objectives of this project are principally derived from the following goals and related key activities of the Department of Safeguards Strategic Objectives 2006–2011:

Enhance information acquisition, analysis and evaluation. Information acquisition and its analysis are fundamental elements of effective safeguards. Therefore, the Agency needs to continue to enhance its capabilities in that regard.

Key activities:

- Enhance information acquisition, analysis and evaluation capabilities through:
  - the establishment of an integrated, service oriented, analysis-friendly information architecture,

as an effective base to collect, evaluate, analyze, structure, secure and disseminate safeguards-relevant information;

- the development, improvement and/or acquisition of more comprehensive information collection, analysis and evaluation tools to process relevant information; and

- the constant improvement of the analytical processes within the department aimed at the optimization of the use of available expertise.

- Increase and intensify efforts related to the collection, analysis and evaluation of, and follow-up on, all available information on States' nuclear programmes, including extending evaluation capabilities for measurement data and information collected during inspection and visits, as well as on clandestine networks for the supply of nuclear items.
- Continue to develop processes and tools to maintain the knowledge required for the Department to produce credible conclusions.

***The principal objective of the project is to: Enhance all aspects of our information collection, analysis and evaluation capabilities through the development, improvement and utilization of advanced analysis tools. This would contribute to the broader and long term goal of fostering a more comprehensive analytical culture within the Department of Safeguards.***

The specific objectives of the project are:

2.1. *To design and define an Enhanced Information Analysis Architecture.*

2.2. *To automatically extract structure and semantics from information that is unstructured.*

2.3. *To automatically illustrate links, inter-connections, patterns and other associations between "entities" of information from a nuclear proliferation perspective*

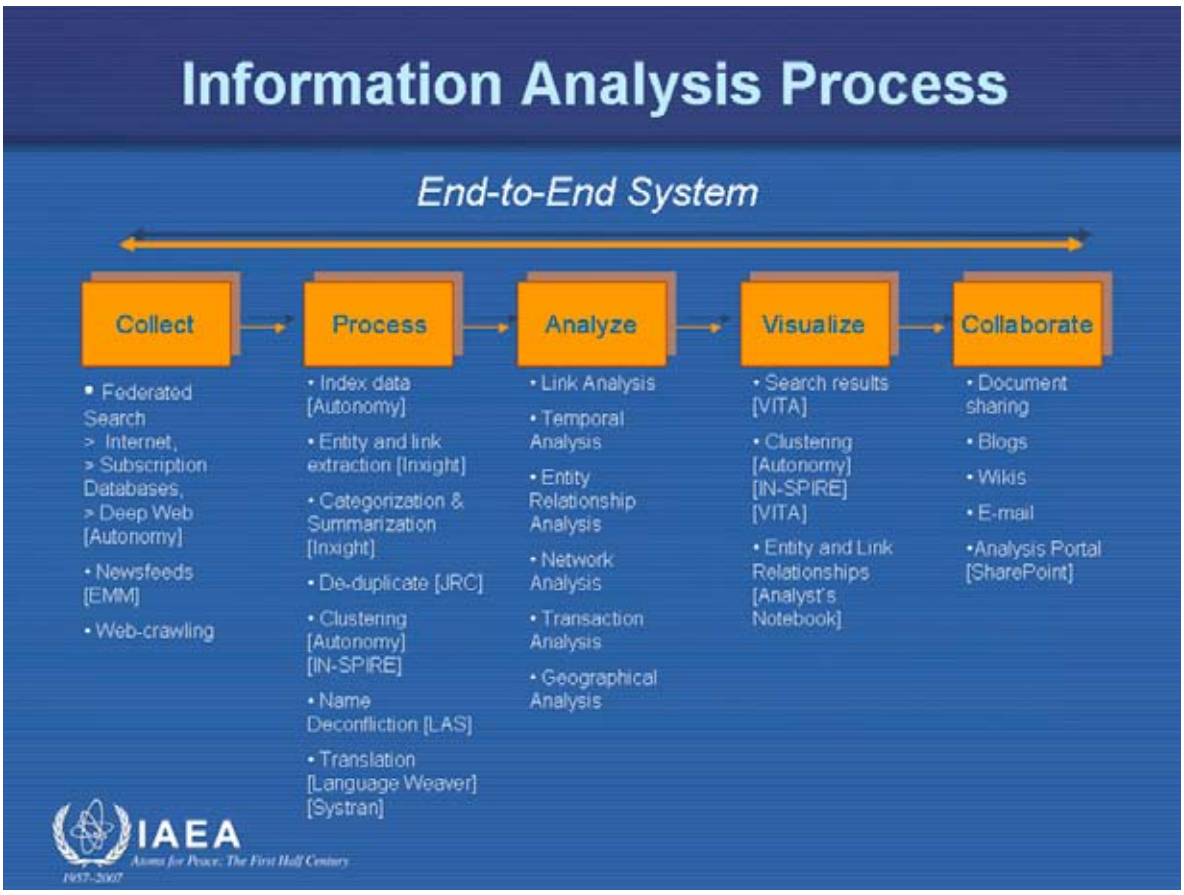
2.4. *To improve access to relevant information and sources to allow for more sources, faster querying, and more effective use of non-English information through the implementation of transliteration software.*

2.5. *To minimize duplicate/near duplicate documents in the Agency's Open Source Information System and ad-hoc searches.*

2.6. *To provide for overall system integration and 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.*

2.7. *To ensure information is appropriately classified and secure.*

The system will be utilized in support of the Department of Safeguards evaluations of States' nuclear activities and ad-hoc tasks such as the identification of potential international proliferation networks.




▲ SGIM-06 Information Analysis Process

## 3. Activities

The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes.

*3.1. To design and define an Enhanced Information Analysis Architecture*

An Application Architect and Integration Specialist (CFE) will arrive and take the lead on all aspects of the design, requirements analysis, functional specifications, development, deployment and quality assurance of our information analysis architecture. This will include documenting use cases and mapping our analytical processes. Member State consultants and expert will continue to be involved in this activity including European Commission., U.K., U.S. Canadian, Swedish and Australian Support Programmes (Target Date: December 2008)

*3.2. To automatically extract structure and semantics from information that is unstructured.*

Define rule sets for extraction of entities, (people, places, organizations, etc.) and facts from unstructured open source data and internal data. This would include the system design, development, testing and deployment (Target Date: June 2008).

*3.3. To automatically illustrate links, inter-connections, patterns and other associations between "entities" of information from a nuclear proliferation perspective*

To work with commercial software tools designed for visualizing links and patterns between various entities and facts. This would include system design, development, testing and deployment and working with other data visualization tools to aid analyst in seeing relationships that otherwise

may not have been known. (Target Date: Ongoing)

3.4. *To improve access to relevant information and sources to allow for more sources, faster querying and more effective use of non-English information through the implementation of transliteration software (Target Date: December 2008)*

To enhance and extend our departmental search engine to include federated search capabilities, name variant recognition, non-English translation of source documents and access to more high value global data sources. This would include the system design, development, testing, deployment and integration into a user friendly interface. (Target Date: December 2008)

3.5. *To minimize duplicate/near duplicate documents in the Agency's Open Source Information System and ad-hoc searches*


▲ nVISON Portal

To fine tune and finish developing a duplication identification and extraction system for our Open Source Information System (OSIS) This is follow on work under to EC D 1610. (Target Date: June 2008).

3.6. *To provide for overall system integration and 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.*

To design, develop, test and deploy an analysis web portal which would be a single point of access to high value sources, internal databases, and a variety of software tools. (Target Date: December 2008)

*3.7. To ensure information is appropriately classified and secure*

To provide a secure search capability for information analysts especially when using internet services. Information security needs to be addressed regarding the use of collaboration tools. MSSP consultants and internal security officials will provide advice and best practices as part of the Departmental Information Security plan. (Target Date: Ongoing)

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

*4.1. 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 | Ongoing |
| CAN | D 1651 | Design and Definition for an Enhanced Information Analysis Architecture | Ongoing |
| CAN | D 1623 | Further Development of VITA to Support Nuclear Trade Analysis<br>(Joint Task with SGIM-09) | Ongoing |
| CAN | D 1485 | Open Source Information Collection<br>Joint Task with SGIM-03 | Collaborative Software Tool Development (Wiki) |
| EC | D 1610 | Open Source Information Collection | Ongoing |
| SWE | D 1579 | Design and Definition for an Enhanced Information Analysis Architecture | Ongoing |
| USA | D 1564 | Design and Definition for an Enhanced Information Analysis Architecture | Ongoing |

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| New Task 1 | Fuel Cycle Analysis Tool | Will be under consideration by USSP |
| 05/IIS-001 | Design and Definition for an Enhanced Information Analysis Architecture | Under consideration with EC, FRA, and UK |
| New Task 2 | Delivery of Regional Information in XML Formats – Joint Task with SGIM-03 | U.K. Support Programme |
| New Task 3 | Machine Language Customization and Tuning for Multiple Language Pairs | Australia, U.S., and other Support Programmes |
| New Task 4 | Geographic Information Support<br>Joint Task with SGIM-02 | Not Known |
| New Task 5 | Supervised Clustering of Open Source Data | Will be under consideration by USSP |
| New Task 6 | Search Engine Extension work for Summarization and categorization | Will be under consideration by US and UK Support Programmes |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

| Activity Designation | Activity Title | Comments |
|---|---|---|
| 1 | Taxonomy and Topic Tree Formulation for Use with Departmental Search Engine | Australian Consultant funded by Regular Budget |

# SGIM-07

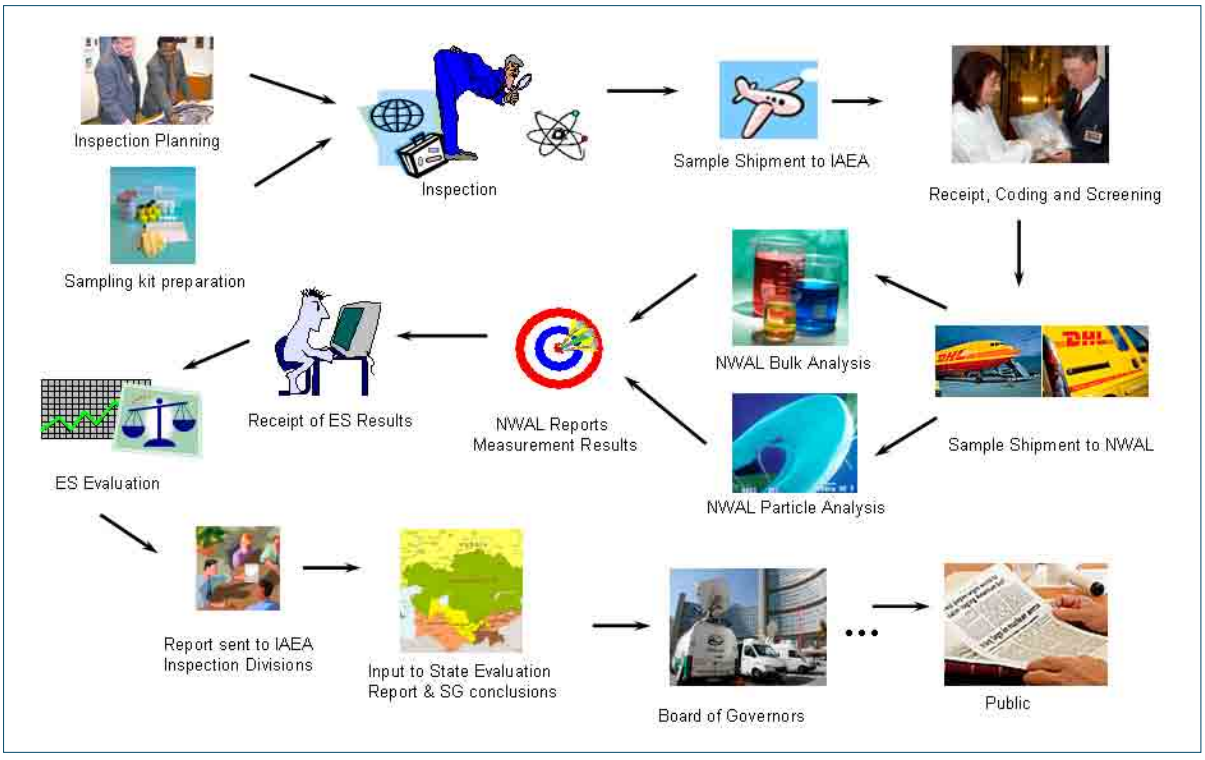
## Environmental Sampling for Safeguards

**Project Manager: William Fuhr** **Division: SGIM**

### 1. Background

This document describes the plans for developing and implementing improvements and enhancements to the environmental sampling programme within the Department of Safeguards for the period 2008–2009. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011.

This project covers the research and development of new analytical capabilities for environmental sampling and an assessment of environmental sampling under complementary and managed access. The environmental sampling programme directly meets the Department's overall objective: "To maintain and further develop an effective and efficient verification system, in order to draw independent, impartial and timely safeguards conclusions, thus providing credible assurances to the international community that States are in compliance with their safeguards obligations." The results from the analysis and evaluation of environmental samples are used by the Divisions of Operations in implementing a strengthened safeguards system. The conclusions from environmental sampling have a major impact on the drawing of sound safeguards conclusions.



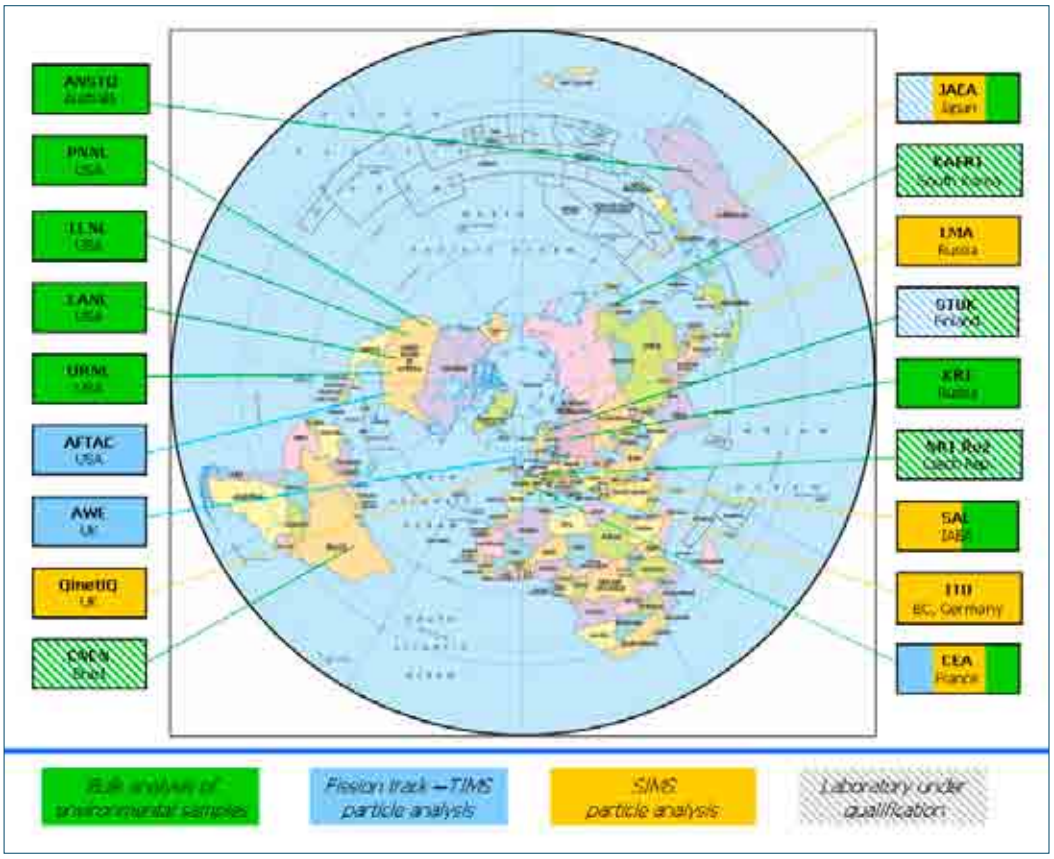

▲ Environmental Sample Life Cycle

All aspects of the environmental sampling programme need continual research and development to improve the Agency's capability and reliability. This includes investigating sampling strategies, analytical techniques, and data evaluations that are applicable to both location specific and wide-area environmental sampling. It also includes elements of sample collection, sample processing, laboratory quality control, and data evaluation. The resources that come to bear in accomplishing the tasks supported by the MSSPs for this project are unique and invaluable sources of expertise that are otherwise unavailable to the Agency to further the development of an effective and efficient safeguards verification system.

## 2. Objectives

The objectives of this project are principally derived from the following goals and related key activities of the Department of Safeguards Strategic Objectives 2006–2011, which has as its overall objective:

"To maintain and further develop an effective and efficient verification system, in order to draw independent, impartial and timely safeguards conclusions, thus providing credible assurances to the international community that States are in compliance with their safeguards obligations."




▲ Network Laboratories

Goal 1:

Enhance detection capabilities through the development of new or improved safeguards approaches and techniques, and acquisition of more effective verification equipment

- Enhance capabilities in the area of environmental sampling by:
  - expanding the capacity and capability to process and analyse environmental samples at SAL; and
  - expanding the capacity and capability of the network of analytical laboratories (NWAL) through the qualification of additional environmental sampling laboratories as part of the NWAL and/or by enhancing the capability of current network laboratories.

Goal 2:

Enhance information acquisition, analysis and evaluation capabilities.

- Enhance information acquisition, analysis and evaluation capabilities through:

- The development, improvement and/or acquisition of more comprehensive information collection, analysis and evaluation tools to process relevant information;

- The constant improvement of the analytical processes within the department aimed at the optimization of the use of available expertise.

- Increase and intensify efforts related to the collection, analysis and evaluation of, and follow-up on, all available information on States' nuclear programmes, including extending evaluation capabilities for measurement data and information collected during inspection and visits, as well as on clandestine networks for the supply of nuclear items.
- Continue to develop processes and tools to maintain the knowledge required for the Department to produce credible conclusions.

***The principle, overall objective of the project is to improve the confidence level of conclusions regarding the absence of undeclared nuclear material and activities, and improve the security of nuclear and other radioactive material.***

In particular the following specific ongoing objectives can be identified:

2.1. *Identify and qualify additional laboratories that will expand the analytical capacity of our network of analytical laboratories (NWAL).*

2.2. *Improve and develop SAL and NWAL analytical capabilities and data evaluation.*

2.3. *Prepare and deliver reference materials appropriate for environmental sampling.*

2.4. *Improve and develop sampling techniques and associated analytical methods.*

2.5. *Provide the necessary support to SAL and NWAL.*

## 3. Activities

The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes.

3.1. *Identify and qualify additional laboratories (Objective 2.1.)*

Laboratories interested in becoming participating members of the Agency's Network of Analytical Laboratories (NWAL) must demonstrate their ability to analyze environmental samples in a timely manner and have a documented quality control programme. Fifteen laboratories with the capability to analyze environmental samples are presently part of the NWAL. Member States are encouraged to explore the possibility of having candidate laboratories in their country seek qualification in the NWAL. The Agency can make available documented procedures which clarify and codify the qualification process for such candidates for NWAL membership. At present, Argentina, Brazil, China, Czech Republic, Malaysia, Republic of Korea, South Africa, and Spain have expressed interest in having analytical laboratories in their respective countries become part of the NWAL and are now in various stages of exploring laboratory qualification.

### 3.2. *Improve and develop SAL and NWAL measurement capabilities and data evaluation (Objective 2.2.)*

SGIM and SAL are continually looking for methods and techniques that will improve the overall effectiveness and efficiency of the analysis and evaluation of environmental samples. These include, inter alia, efforts to improve laboratory instrument sensitivity, lower detection limits, and reduce the time for analysis and evaluation. Present and proposed tasks of the project targeting this objective include:

- RUS A 1652, JPN A 1679, EC A 1605 – Age Determination of Uranium and Plutonium Particles. Task has been recently accepted by the above MSSPs. Coordinated work plan to be discussed at Technical Meeting on Particle Analysis in November 2007.
- UK A 1656, EC A 1650 – Study of Chemical Changes in Uranium Oxyfluoride Particles. This task involves collaboration between the EC's Institute for Reference Materials and Measurements and QinetiQ in the UK. The work plan calls for IRMM to produce "standard" UO2F2 particles on a graphite substrate and to "age" them under various conditions of temperature, humidity and light exposure. QinetiQ will then measure the U/F ratio in particles by SIMS. Expected completion December 2008.
- USA A 1619 – Improvement of NWAL Capability in Gamma Spectrometric Analysis for U/Pu and Fission and Activation Products. The goal of the task is to compare the performance of the new BeGe detector with traditional coaxial HPGe detectors and assess capability for measurement of U and Pu isotopes, as well as fission and activation products. Expected completion April 2008.
- JPN A 1500 – Support for the Development of Analytical Techniques for the Environmental Programme of the Network of Analytical Laboratories. A strong collaboration has been established between CLEAR and SAL staff to investigate enhancements to laboratory techniques through improvements in environmental bulk analysis, sensitivity of single particle detection, SIMS sample preparation, and materials suitable for swipe sampling. Expected completion December 2007.
- USA A 1498 – Environmental Sampling Evaluation Support. This task has continues to be of particular value to SGIM/IDS in that it is the only task devoted entirely to ES evaluation support and improvement. In addition to providing core support and expertise for more effective and efficient ES data evaluation, this task has resulted in the publication of extremely useful and relevant reference guides to assist in the evaluation process, namely: STR-348, Environmental Sampling for Safeguards, September 2005 and "Uses and Characteristics of Depleted Uranium for Environmental Sampling", (ORNL TM/2007-21), April 2007. Additional work under this task is required in the areas of enhancements to reactor and enrichment codes and modelling, development of integrated data evaluation software, and further investigations into Delayed Neutron Activation Analysis for safeguards applications. Expected completion December 2008.
- UK A 1459 – Improved Particle Analysis Methods. This task is exploring the vacuum-impactor technique for particle removal from swipe samples and deposition on a substrate (planchette) for measurement by SIMS. This method was developed first at the Japanese CLEAR facility and further refined at SAL. QinetiQ is evaluating the vacuum-impactor technique and comparing it with the heptane extraction method. This method promises to be a faster and less expensive method to prepare QC swipes with a well characterized loading of particles. Expected completion December 2008.
- EC A 1140 – Particle Analysis Techniques for Environmental Samples. This task involves the preparation of mono-disperse particles containing known mixtures of U and Pu or pure Pu, only. The mixed U/Pu particles will be used to calibrate SEM/EDAX measurements and to estimate the sensitivity for Pu by direct TIMS measurements of particles. Pu particles containing known amounts of Am would be useful for testing new methods of age-dating particles (resonance ionization mass spectrometry, for instance). These particles will also be used to prepare quality control swipes for distribution to the network laboratories. The task also involves a SIMS particle

recovery round-robin exercise. These activities should be reported to the Agency during the Technical Meeting on Particle Analysis for Safeguards in November 2007. Expected completion December 2007.

3.3. *The following are improvements and/or enhancements tasks underway that are outside the MSSP support activities:*

- Enhanced Analysis of Uranium Samples – Currently the Agency uses established procedures for analysis of uranium-containing materials for U content and U isotopic composition. The analysis results are compared with declared values. The analysis results are used routinely to draw safeguards conclusions about the correctness of the declaration. Uranium-containing materials have numerous characteristics other than U content and enrichment. They include chemical composition, trace elements, detailed isotopic composition of uranium and elements other than U, physical properties, etc. This task will investigate the likelihood that some of these characteristics or their combination might constitute a unique signature for U materials and identify their origin and the chemical process used for their production. This task is aimed at enhancement of the safeguards verification activities performed under additional protocols as applied to facilities with mining and milling operations and uranium concentration plants.
- Web-based Environmental Sampling - Based on Oracle technology, an Environmental Sampling (ES) client server information system has been developed to facilitate the statistical analysis of analytical data from environmental samples. The conclusions of the analyses are part of reports which are generated by analysts in SGIM/IDS using the ES system. The new Web-based Environmental Sampling (WES) information system is the proposal for moving the client-server system to a fully web-based and open-architected solution. The project covers the full life-cycle phases: analysis, redesign of the data model, web development and implementation. In support of the development effort, a prototype has already been developed in the house. The system features an interactive graphical function that plots the measurement data and permits on-screen changes to data points and plot parameters. Besides assisting in sample data analysis, the system also aids the user in evaluating quality control data and comparing sample measurement data to known standards and reference materials. The information in the database also allows the user to monitor analysis progress and generate laboratory performance metrics. Lastly, the user can produce various reports and documents such as analytical instruction letters, status reports, data tables, and plots.

3.4. *The following are analytical enhancements currently under consideration for possible future formal task proposals:*

- Measurement of Americium by thermal ionization and inductively-coupled plasma mass spectrometry. Studies are needed to improve the sensitivity and isotopic accuracy of these methods, as well as chemical separation methods for extracting Am from environmental samples. This measurement will support age-dating of plutonium in environmental samples.
- Development of Ultra-high resolution gamma spectrometry into a routine measurement tool. This is based on superconducting detectors and offers the ability to separate spectral interferences and to improve identification accuracy for isotopes in complex mixtures. The efficiency and sensitivity of the method needs to be improved before it can be applied for routine analysis of environmental samples.
- Age-dating of Pu-containing particles. This involves the identification, manipulation and analysis of individual micrometer-sized Pu particles using a combination of scanning electron microscopy and X-ray fluorescence followed by chemical separation of Am and Pu and their measurement by TIMS or ICP-MS. Work is needed to develop the measurement protocols and to evaluate the sensitivity and accuracy of the measurements.
- Age-dating of high-enriched uranium (HEU) particles. This is needed to help deduce the origin of HEU particles found in environmental samples, but at the present time, no method is

sensitive enough to measure the Pa-231 and Th-230 daughter isotopes. Candidate methods are accelerator mass spectrometry and resonance ionization mass spectrometry.

*3.5. Prepare and deliver reference materials appropriate for environmental sampling (Objective 2.3.)*

Particulate reference materials have to be developed because certified materials that simulate the particulate characteristics of environmental samples are not available. Using certified materials to obtain alternative reference material is a recurring development task often highlighted in the CGMs and TMs on particulate and bulk analysis of environmental samples. Current or planned activities include:

- FIN A 1543 – Production of Particles for Quality Control of Environmental Analysis. This task is currently on standby due to lack of funding. The task was to result in the production of particles of a given composition and size containing natural and enriched U and also mixtures of U and Pu for quality control checks of the NWAL. The particle production apparatus has been acquired but funding was not sufficient for routine production of particles.
- USA A 0909 – Separation of Plutonium Isotopes for the Production of High Purity Spike Reference Materials. The Memorandum of Understanding (MOU) between the US DOE and the Agency was signed by both sides in April 2005 and a Steering Committee Meeting was held in Vienna on 27 May, 2005. The meeting agreed on a schedule of activities, starting with the shipment of the test portion of FP33 to Arzamas. The contract between the Agency and VNIIEF for the separation of Pu-244 from US starting material FP-33 has been amended by the Agency to bring it into agreement with the Memorandum of Understanding with the US Department of Energy. The amended contract is still under consideration by the Russian Authorities. The test portion of FP-33 (0.5 g) has been received by the Agency and is in storage at SAL. The separation work for this test portion can therefore begin immediately once the amended contract has been signed. Expected completion December 2012.

*3.6. Improve and develop sampling techniques and associated analytical methods (Objective 2.4.)*

Maintenance of an effective environmental sampling programme requires continual research and development to improve safeguards capabilities and reliability. This includes identifying new approaches and techniques applicable to location specific and wide-area environmental sampling programmes, as well as illicit trafficking analytical support. Current or planned activities include:

- RUS A 1390 – Air Sampling Field Trials at the Saint Petersburg Nuclear Physics Institute in the Russian Federation. This task and one recently completed (UK A 1346, Air Sampling Field Trials in the United Kingdom) involve air sampling particulate field trials aimed at detecting possible undeclared enrichment or reprocessing activities. The results of these tasks are very useful in assessing the utility of Wide-Area Environmental Sampling (WAES) and in particular air sampling for the detection of clandestine nuclear facilities. Important conclusions can be drawn from this work, including the most promising sampling techniques, sampling media, analytical techniques, as well as conclusions concerning the strength of signatures which one detects outside of facilities and how to interpret these signatures. These activities should be reported to the Agency during the Technical Meeting on Particle Analysis for Safeguards in November 2007. Expected completion December 2007.

*3.7. Provide the necessary support to SAL and NWAL (Objective 2.5.)*

Support and Implementation tasks (X-tasks and technical support tasks) are planned to continue. The Agency requires participation of a Network of Analytical Laboratories (NWAL) in the analysis of environmental safeguards samples. To cover the costs of these analyses, the Agency pays a fixed amount for each type of sample and analysis. As this amount of funding does not fully cover the actual costs, other sources of funds must be made available.

- UK X 1045, RUS X 1515 – Analysis of Environmental Samples Supplied by Agency. Both the

UK and Russian Support Programmes support these extremely valuable on-going tasks that provide for the analysis of environmental samples supplied by Agency. This support has been particularly critical to the Agency during a recent long period of down time for the SIMS instrument at SAL.

- USA A 1639 – Expert, SAL SIMS. Progress continues in the repair and re-qualification of the Cameca 4f SIMS instrument at the Safeguards Analytical Laboratory. Despite continued breakdowns of the SIMS instrument, quality assurance, quality control, process blanks, and archived samples have been analyzed. Quality control samples and archived samples have been analyzed and agree well with independent FT/TIMS analyses. Reporting of the revalidation activities and results will be presented during the Technical Meeting on Particle Analysis for Safeguards in November 2007. Expected completion April 2008.

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

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

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| ARG | A 1154 | Qualification of Environmental Network Laboratories | On standby at the request of the Argentinean Support Programme. |
| AUL | A 0859 | Analytical Services for Environmental Sampling | Expected completion 09/09 |
| BRZ | A 1602 | Qualification of Environmental Network Laboratories | Expected completion 09/08 |
| CZ | A 1631 | Qualification of Environmental Network Laboratories | Expected completion 09/08 |
| EC | A 1140 | Particle Analysis Techniques for Environmental Samples | Expected completion 12/07 |
| EC | A 1650 | Study of Chemical Changes in Uranium Oxyfluoride Particles | Expected completion 12/08 |
| EC | A 1605 | Age Determination of Uranium and Plutonium Particles | Expected completion 12/08 |
| FIN | A 1543 | Production of Particles for Quality Control of Environmental Analysis | Task should be placed on standby |
| JPN | A 1500 | Support for the Development of Analytical Techniques for the Environmental Programme of the Network of Analytical Laboratories | Expected completion 12/07 |
| JPN | A 1679 | Age Determination of Uranium and Plutonium Particles | Expected completion 12/08 |
| RUS | A 1390 | Air Sampling Field Trials at the Saint Petersburg Nuclear Physics Institute in the Russian Federation | Expected completion 12/07 |
| RUS | X 1515 | Analysis of Environmental Samples Supplied by Agency | Ongoing task |
| RUS | A 1652 | Age Determination of Uranium and Plutonium Particles | Expected completion 12/08 |
| UK | A 1459 | Improved Particle Analysis Methods (B1(n)) | Expected completion 12/08 |
| UK | X 1045 | Analysis of Environmental Samples Supplied by Agency (A5(b)) | Ongoing task |
| UK | A 1656 | Study of Chemical Changes in Uranium Oxyfluoride Particles (B1(s)) | Acceptance of a formal report will complete the task. Expected 12/07. |
| USA | A 0909 | Separation of Plutonium Isotopes for the Production of High Purity Spike Reference Materials | Expected completion 12/12 |
| USA | A 1498 | Environmental Sampling Evaluation Support (A.265) | Expected completion 12/08 |

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| USA | A 1619 | Improvement of NWAL Capability in Gamma Spectrometric Analysis for U/Pu and Fission and Activation Products (A.268) | Expected completion 12/07 |

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| 05/PSA-001 (Objective 2.1 and 2.5.) | Qualification of Environmental Network Laboratories | Pending ROK Support Programme and Spanish Support Programme... |
| 07/TTS-004 (Objective 2.1. and 2.5.) | Qualification of Environmental Network laboratories | Pending Chinese Support Programme. |
| 07/SAL-003 (Objective 2.2. and 2.5) | Mass Spectrometry Training | Pending European Commission Support Programme. |
| New task 1 (Objective 2.2.) | Development of New Methods for Sample Processing or Particle Recovery | Partially covered by EC A 1140 and JPN A 1500. Depending on outcome of present tasks, additional work may be required. |
| New task 2 (Objective 2.2.) | Develop Capability to Identify Elemental and Compound Characteristics on Particles | Partially covered by UK A 1459. Depending on outcome of this task, additional work may be required. |
| New task 3 (Objective 2.2.) | Develop SAL Capability to Perform Isotopic Measurements via ICP-MS. | SAL's expertise in this area has increased. A new SP-1 is still under consideration. |
| New task 4 (Objective 2.2.) | Study and Test Alternate Environmental Swipe Material | Partially covered by JPN A 1500. Under discussion in Bulk and Particle TMs. No new SP-1 planned. |
| New task 5 (Objective 2.2.) | Investigate and improve methods for TIMS analyses of environmental samples | USA A 1432 completed. Follow-up SP-1 planned in 2008 to include multi-ion counters. |
| New task 6 (Objective 2.2.) | Evaluate and Monitor QC/QA Measures for all Aspects of Environmental Sampling Process. | Partially covered by UK A 1459, EC A 1140, and USA A 1498. Depending on the outcome of these tasks, new SP-1s may be submitted after consultation on possible proposals. |
| New task 7 (Objective 2.3.) | Develop Particulate and bulk Reference Materials with Alternate U or Pu Abundance | Partially covered by UK A 1459, EC A 1140, and FIN A 1543. There will be a continuing need for the development of reference materials as environmental sampling and analysis techniques advance. New SP-1s will be considered/submitted in response to analytical advances. |
| New task 8 (Objective 2.2.) | Improve SIMS Particulate Analysis Applications; in Particular, Evaluate the Use of High Resolution SIMS on Environmental Samples. | A new SP-1 will be submitted in 2008. |
| Proposed task 1 (Objective 2.2.) | Measurement of Americium by TIMS and ICPMS | In exploratory stages. Possible proposal for task in late 2009. |
| Proposed task 2 (Objective 2.2.) | Development of Ultra-High Resolution Gamma Spectrometry | In exploratory stages. Possible proposal for task in late 2009. |
| Proposed task 3 (Objective 2.2.) | Alternative Techniques to Age Date Pu Containing Particles Utilizing Multiple Instruments | In exploratory stages. Possible proposal for task in late 2009. |
| Proposed task 4 (Objective 2.2.) | Alternative Analytical Approaches to Age-Dating of Highly Enriched Uranium. | In exploratory stages. Possible proposal for task in late 2009. |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

| Activity Designation | Activity Title | Comments |
|---|---|---|
| Impurity Analysis | Enhanced Analysis of Uranium Samples | Active |
| Software/Database Development | Web-based Environmental Sampling | Active |

# SGIM-08

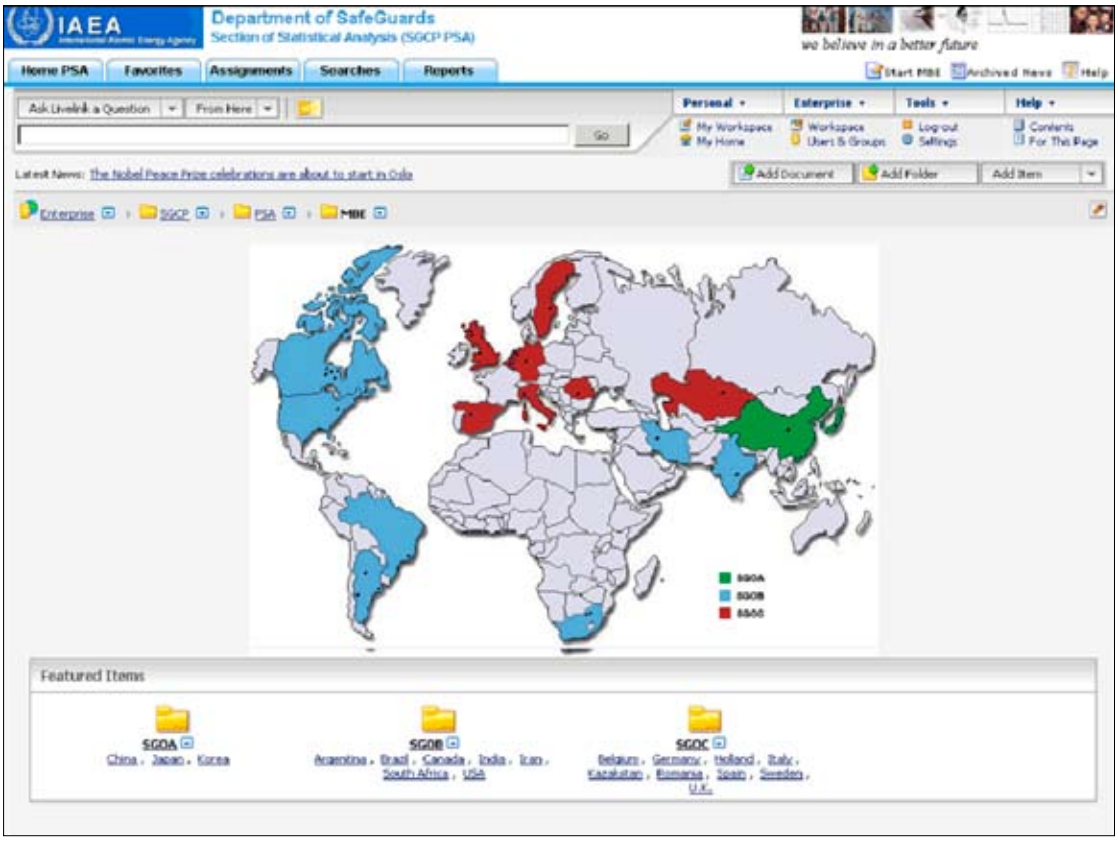
## R&D for Statistical Analysis

### Project Manager: Manuel Marinas de Miguel — Division: SGIM

### 1. Background

This document describes the plans for developing and implementing new statistical analysis tools needed for improving the evaluation of safeguards accountancy and verification data and for supporting various safeguards activities involving statistical concepts, during the period 2008–2009. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011.

The end users are the Operation Divisions, the Section for Effectiveness Evaluation, the Division of Information Management and the Deputy Director General Office.




▲ Material Balance Evaluation Reporting System (MBERS)

### 2. Objectives

The objectives of this project are principally derived from the following goals and related key activities of the Department of Safeguards Strategic Objectives 2006–2011:

In general: "To maintain and further develop an effective and efficient verification system, in order to draw independent, impartial and timely safeguards conclusions, thus providing credible assurances to the international community that States are in compliance with their safeguards obligations".

In particular:

- Develop, implement and revise, as appropriate, safeguards approaches for new safeguards situations (e.g. integrated safeguards), facility types and operating conditions, taking into account experiences, conceptual and technological developments and on-going needs for effectiveness and cost-efficiency.
- Use where possible technology already available with the view of adapting it to departmental needs.
- The continued development of processes and tools to maintain the knowledge required for the Department to produce credible conclusions.

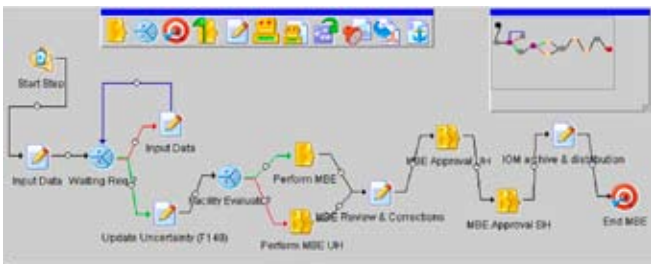
***The primary objective of the SGIM-08 project is to strengthen the statistical analysis capabilities through the continuous improvement of the statistical tools and methods used in the Department.***

The following specific project objectives are identified:

2.1. *Development of Near Real Time Accountancy (NRTA) systems for Pu Bulk Handling facilities: In some facilities, like large reprocessing plants, a higher detection sensitivity based on accurate material accountancy measures as well as on-site evaluation capabilities for immediate follow-up are needed. They can be provided by implementing a NRTA system. This has been requested by the SGOA Operation Division .Proliferation resistance of facilities and fuel cycles (whole period). Target completion date: September 2009.*

2.2. *Enhancement of the Material Balance Evaluation reporting system: The main objective is to implement document and knowledge management in the current Material Balance Evaluation reporting system in accordance with the Department's document management principles and standards. This is a proposal made by SGIM Section for Declared and Statistical Analysis. This point has been transferred to the 2.3. objective of the SGIM-01 project. Target completion date: September 2009.*

2.3. *Development of an upgraded sampling plan code incorporating 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. This is a proposal made by IDS. Target completion date: November 2009.*



▲ The Material Balance Evaluation Workflow

2.4. *Simulation of the nuclear material balance for Bulk Handling Facilities: The objective of this activity is to develop a generic software system capable of simulating the material flows and inventories for Pu reprocessing plants and MOX and LEU fabrication plants. Such a system can be used to compare safeguards implementation schemes and test the detection probability and the sensitivity of different statistics for different diversion scenarios. Target completion date: November 2009.*

## 3. Activities

The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes.

*3.1. Development of NRTA systems. (Objective 2.1.)*

The first version of the NRTA system for RRP is expected to be ready by the beginning of 2008. In a second phase, the NRTA Mathematica Engines will be completed with two additional statistical tests. Furthermore, a fine tuning will have to be done for the whole software package. A NRTA system for JMOX is under development and is expected to be ready by 2009.

*3.2. Enhancement of the Material Balance Evaluation reporting system. (Objective 2.2.): R&D uranium enrichment installations*

This point has been transferred to the 3.3. activity of the SGIM-01 project.

*3.3. Upgrade of existing sampling plan code (Objective 2.3.)*

The current sampling plan code does not include the calculation of the achieved detection probability, two-stage sampling and follow-up inspection sample sizes. This activity needs to be coordinated with SGIM in order to update other safeguards applications which are using the SGIM-IDS standard sampling plan code. An upgrade of the existing code requires the following tasks:

- Implement the existing methodology to include these features in the sampling plan code. Target date: Dependent upon the availability of resources.
- Document the upgraded system. Target date: Dependent upon the availability of resources.

*3.4. Simulation of the nuclear material balances for Bulk Handling Facilities (Objective 2.4.)*

- Review the scientific literature in order to acquire knowledge of existing nuclear process simulation systems. (Target date: June 2008).
- Provide specification of the software (Target date: December 2008).
- Test the functionality of the provided software using one reference plant as an example for configuration (Target date: July 2009).
- Demonstrate its use in comparing safeguards approaches and developing new evaluation methodologies (Target date: November 2009).

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

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

There are no Current Active or Standby MSSP tasks

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| 07/ICO-002 | Enhancement of the Material Balance Evaluation reporting system. | Spanish Support Program. This task has been transferred to the SGIM-01 project. |
| New Task 1 Objective 2.3 | Simulation of Nuclear Material Balances for Bulk Handling Facilities. | Proposed |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

| Activity Designation | Activity Title | Comments |
|---|---|---|
| 1.0 | Development of NRTA systems. | Active, ongoing |
| 2.0 | Upgrade of Existing Sampling Plan Code | Under consideration pending available resources |

# SGIM-09

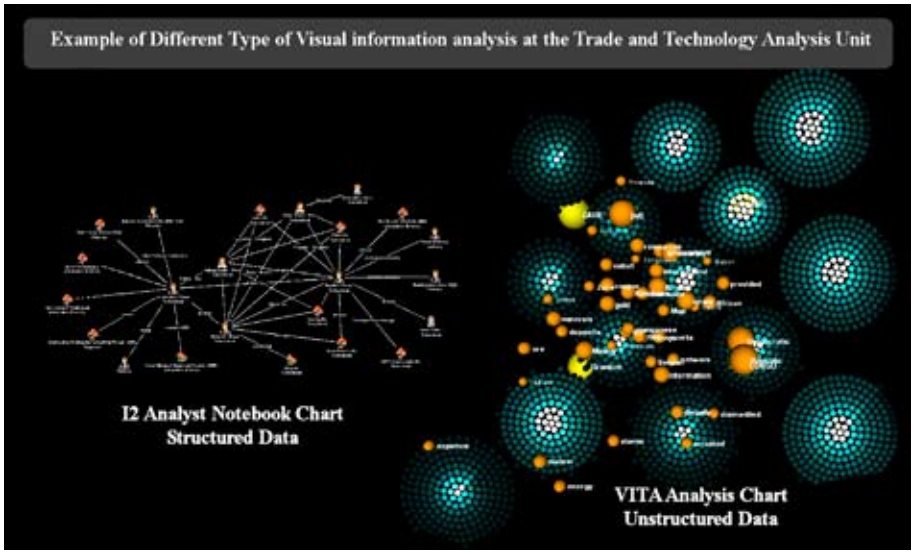
## Understanding Nuclear Trade Mechanisms

### Project Manager: Matti Tarvainen Division: SGIM

### 1. Background

This document describes the plans for further developing and implementing the acquisition and analysis of information on trade in sensitive nuclear technology by the Department of Safeguards for the period 2008–2009. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011. The goal is to further improve the understanding of covert trade in nuclear related goods, materials, services and technology, contribute to on-going State evaluations and maintaining nuclear trade related institutional memory. The analysis of nuclear trade related activities provides the Department with information that supports the development of our understanding, especially on the completeness of State declarations.

SGIM-09 was established to satisfy a Department need to further strengthen its ability to obtain a full picture of nuclear programmes, activities and plans in States and provide assurance that States are complying with their obligations under safeguards agreements. This need is continuous in nature. Proliferation networks pose one of the biggest challenges to nuclear non-proliferation. The project plan emphasizes the further development of approaches, methods and skills necessary to detect undeclared nuclear material and activities related to covert nuclear trade.




▲ Visual Information Analysis

### 2. Objectives

The objectives of this project are principally derived from the following goals and related key activities of the Department of Safeguards Strategic Objectives 2006-2011 (section 2.3) including:

- Enhance information acquisition, analysis and evaluation capabilities through:
  - the development, improvement and/or acquisition of more comprehensive information collection, analysis and evaluation tools to process relevant information; and
  - the constant improvement of the analytical processes within the Department aimed at the optimization of the use of available expertise.

- Increase and intensify efforts related to the collection, analysis and evaluation of, and follow-up on, all available information on States' nuclear programmes, including extending evaluation capabilities for measurement data and information collected during inspections and visits, as well as on clandestine networks for the supply of nuclear items.
- Continue to develop processes and tools to maintain the knowledge required for the Department to produce credible conclusions.
- Have the best management practices in place to optimize delivery of the nuclear verification programme (Objective 2.4.). Key activity:
  - Maintain a unified approach to address preservation of institutional memory and the promotion of knowledge management, while maintaining competence in the Department of Safeguards (ref. MTS E).
- Have adequate and uniform legal authority in place to conduct credible safeguards verification (Objective 2.5.). Key activity:
  - Support Member States' efforts to strengthen the safeguards system including:
  - proposing amendments to the annexes of the additional protocol to include additional activities related to new advanced technologies and possibly dual-use items, as well as potential nuclear weapons related activities and items.
- Improve external and internal communication and reporting. Key activities:
  - Seek a closer cooperation with Member States in order to jointly address current and future non-proliferation issues and challenges.
  - Establish partnerships with selected international and intergovernmental organizations, to address the trends of non-proliferation.

The principal objective(s) of the project are:

***Enhance nuclear trade related information acquisition, analysis and evaluation.***

***Increase and intensify efforts related to the collection, analysis and evaluation of, and follow-up on, all available information on clandestine networks for the supply of nuclear related items.***

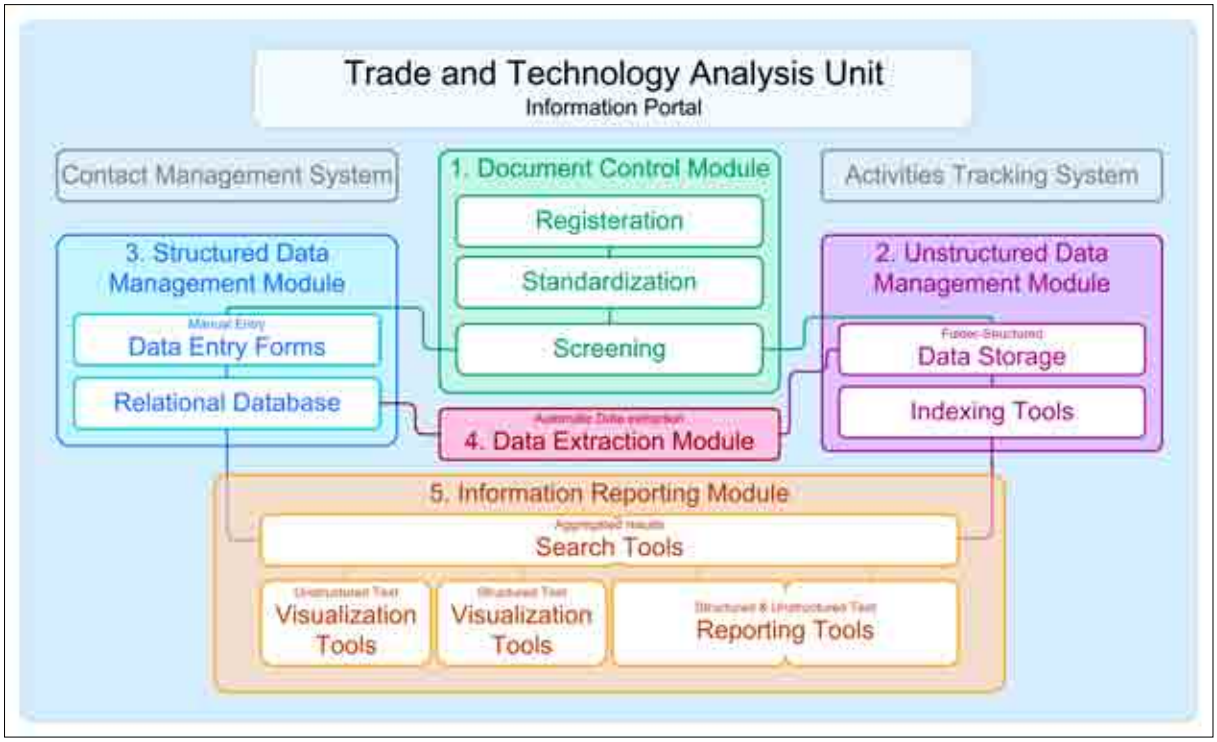
***Seek a closer cooperation with Member States in order to jointly address current and future non-proliferation issues and challenges.***

In particular the following specific objectives can be identified:

2.1. *Examine and make use of best practice methods used in acquiring, processing, combining, analysing, storing and disseminating information and knowledge created of the trade in sensitive nuclear technology and safeguards related relevant non-technical indicators.*

2.2. *Improve awareness of sensitive nuclear related technology and proliferation issues with regard to trade and export controls.*

2.3. *Improve awareness of the market related to proliferation sensitive equipment, materials and technologies including knowledge of manufacturers, market structures and non-sensitive applications. Identify relevant parties and conduct joint studies on nuclear related trade and technology R&D uranium enrichment installations (until end 2006).*




▲ Information Portal

2.4. *Improve access to information by diversifying reliable information sources. Commercial enrichment plants (whole period).*

2.5. *Further refine the existing specially designed software (Procurement Tracking System, PTS) used for tracking, analysing, combining, storing and visualizing proliferation networks and maintaining Agency's institutional memory for nuclear trade activities.*

2.6. *Further develop the existing Technical Cooperation Review System (TCRS) used for reviewing TC procurements and projects to identify items of safeguards relevance.*

## 3. Activities

The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes (MSSP).

3.1. *Examine and make use of best practice methods used in acquiring, processing, combining, analysing, storing and disseminating information and knowledge created of the trade in sensitive nuclear technology and safeguards related relevant non-technical indicators (Objective 2.1.)*

- A task proposal 'Develop capabilities to improve the recognition of non-declared activities through the assessment of social, demographic and other non-technical issues' has been drafted

to cover the need for better understanding safeguards relevant non-technical indicators of a covert nuclear programme (Target date: December 2008) [MSSP]

- Identify suitable Member State partners and develop mechanisms to learn from best practices and apply them, mutatis mutandis, in the trade and technology analysis activities of the Agency (Target date: December 2008) [MSSP].
- Develop mechanisms to better understand and further improve creation and managing knowledge of covert nuclear related trade (Target date: On-going activity).

3.2. *Improve awareness of sensitive nuclear related technology and proliferation issues with regard to trade and export controls (Objective 2.2.)*

- Conduct a nuclear trade analysis related workshop with help of a MSSP. Focus on clandestine nuclear procurement/supply networks and practical analytical aspects. Provide some background and theory for information analysis relevant for the Agency needs (Target date: December 2008) [GER B 1560].
- Plan and conduct a best practice workshop relevant to the analysis of covert nuclear trade in response to the identified needs (Target date: December 2009) [UK B 1524].
- Identify suitable Member State partners to conduct studies on proliferation relevant aspects of global trade and trade/trading trends focusing on free-trade zones (Target date: December 2008) [MSSP].

3.3. *Improve awareness of the market related to proliferation sensitive goods, materials, services and technologies including knowledge of manufacturers, market structures and non-sensitive applications. Identify relevant parties and conduct joint studies on nuclear related trade and technology (Objective 2.3.)*

- Identify suitable Member State partners to conduct studies on the markets of nuclear related goods and other safeguards relevant topics (Target date: December 2008) [MSSP].

3.4. *Improve access to information by diversifying reliable information sources (Objective 2.4.)*

- Continue the programme 'procurement outreach to nuclear related industries'. The programme is on-going in nature and joining is voluntary for Member States as recommended by appropriate Agency General Conference resolutions since 2005 (Target date: On-going activity).
- Continue and complete activities aimed at identifying new information sources suitable and available for the Agency in tracking safeguards relevant shipments (Target date: January 2009) [EC D 1662].
- Outreach Member States to encourage and arrange sharing of export denials data with the Agency on a voluntary and bilateral basis (Target date: On-going activity).

3.5. *Further refine the existing specially designed software (Procurement Tracking System, PTS) used for tracking, analysing, combining, storing and visualizing proliferation networks and maintaining Agency's institutional memory for nuclear trade activities (Objective 2.5.)*

- Finalize modifying and optimizing the VITA software tool for the handling and analyzing unstructured nuclear related trade and other safeguards relevant data (Target date: August 2008) [CAN D 1623]. Related activity: Project SGIM-06, Task CAN D 1651.
- Identify the need for additional tailoring, adjusting and development of VITA to fully optimize the tool for the intended use. (Target date: December 2008) [CAN D 1623]. Related activity: Project SGIM-06, Task CAN D 1651.
- Develop mechanisms to better understand and further improve generating and maintaining institutional memory of nuclear trade related activities (Target date: On-going activity).

- Develop mechanisms to formalize the document processing and tracking features of the system to ensure that new data is routinely prioritized and presented to the analysts for screening and analysis in a timely and consistent form (Target date: On-going activity).
- Review the existing data model, including document and information tracking – updating to comply with Agency standards (Target date: On-going activity).

3.6. *Further develop the existing Technical Cooperation Review System (TCRS) used for reviewing TC procurements and projects to identify items of safeguards relevance.*

- Improve the review process and associated software features to enhance the efficiency, effectiveness and quality of the process. This including the enhancement of electronic interfaces and, wherever possible, integration with TC and other safeguards databases (Target date: On-going activity).

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

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

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| EC | D 1662 | Improving Analysis of Covert Nuclear Trade | Expected completion date: 1/2009 |
| CAN | D 1623 | Further Development of VITA to Support Nuclear Trade Analysis | Expected completion date: 12/2008 |
| GER | B 1560 | Nuclear Trade Analysis Related Support and Training for NUTRAN Unit (B.20) | Expected completion date: 12/2008 |
| UK | B 1524 | Support and Training for NUTRAN Unit (C1(s)) | Standby |

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| 06/DDG-001 | Nuclear Trade Analysis-Support and Training | Proposal under review by one MSSP, consider termination if not accepted |
| 07/TTR-001 | Training on export control concepts and standards from international perspective | Proposed in 2007 to one MSSP, not yet accepted |
| New Task 1 Objective 3.1. | Develop capabilities to improve the recognition of non-declared activities through the assessment of social, demographic and other non-technical issues | MSSP task proposal under drafting |
| New Task 2 Objective 3.1. | Best practice methods for nuclear trade and technology analysis | MSSP task proposal under consideration |
| New Task 3 Objective 3.2. | Understanding free-trade zones and their influence on nuclear proliferation and procurement networks | MSSP task topic introduced in 2006 to two MSSPs, no feed-back received |
| New Task 4 Objective 3.3. | Markets and market trends of nuclear proliferation sensitive goods, materials, services and technologies | MSSP task topic 'Nuclear related multi-use goods and their alternative uses' presented in 2006 to one MSSP, no feed-back received |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| New Task 5 Objective 3.5. | Further Development of PTS Processing and Tracking | Work started in 2007 and proceeding in accordance with the availability of development resources |
| New Task 6 Objective 3.5. | Upgrade PTS to Latest Agency Standards | Task scheduled for 2008 |
| New Task 7 Objective 3.6. | Improve TCRS Features to Improve Efficiency and Accessibility | Work started in 2007 and proceeding in accordance with the availability of development resources |

# SGOA-01

## Safeguards System for Rokkasho Reprocessing Plant (RRP)

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

▲ Rokkasho Reprocessing Plant

### 1. Background

This document describes the plans for completion of the development and implementation of the Safeguards systems for the Rokkasho Reprocessing Plant (RRP) within the Department of Safeguards for the period 2008–2009. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011.

The safeguards approach for RRP incorporates continuing design information examination and verification (DIE/DIV), conventional and near real time accountancy (NRTA), short-notice random inspections of other strategic points, containment and surveillance (C/S) measures, solution and radiation monitoring, sampling for destructive and non-destructive analyses, and in-situ unattended and attended non-destructive assay (NDA) methods. The Integrated Inspector Information System (I3S) collect and evaluate operator and inspector data in automatic and interactive modes. In addition, an On-Site Laboratory (OSL) has been established.

The activities related to this project have been transferred under the responsibility of SGOA2 section head as of 1 April 2006. An inspection regime has been implemented at RRP from the beginning of the active commissioning that occurred on 31 March 2006. The active commissioning phase is expected to be completed end 2007 while the commercial start-up is expected to occur in the first half of 2008.

During 2008–2009, remaining activities will mainly focus with the finalization of the Safeguards Approach and inspection procedures, completion of the development of the I3S, improvement of the reliability of the SG systems in place, development of the DIV procedures during the operational phase and continuous training of inspectors.

### 2. Objectives

The objectives of this project are principally derived from the following goal of the Department of Safeguards Strategic Objectives 2006–2011:

- Implement safeguards in an effective and efficient manner in States with safeguards agreements in force, including those with additional protocols.

***The principal objective of the project is to complete the SG systems implementation for the RRP facility in Japan.***

In particular the following specific objectives can be identified:

2.1. *Refine the Safeguards Approach that provides effective and adequate safeguards measures; finalize and refine inspection procedures.*

2.2. *Complete the development of the I3S software.*

2.3. *Finalize implementation of the SG systems and improve the reliability of those systems.*

2.4. *Complete the DIE/DIV procedures for the lifetime of the facility, which will provide assurance that the facility continues to be constructed and operate as declared.*

2.5. *Consolidate the continuing training programme for inspectors and support staff.*

2.6. *Consolidate/complete the qualification of the On Site Laboratory analytical techniques and procedures.*

## 3. Activities

The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes. The number of remaining active tasks for this project is expected to decrease in the near future since RRP is moving in commercial start-up in 2008 and that most of the work has been completed in 2006–2007. A number of other R&D projects within the Safeguards Department will potentially contribute to the objectives of the RRP R&D project for 2008–2009 like SGTS-03 (Next Generation Surveillance System), SGTS-11 (Unattended and Remote Monitoring systems) and SGTS-13 (Universal NDA Data Acquisition Platform).

3.1. *Refine the Safeguards Approach that provides effective and adequate safeguards measures; finalize and refine inspection procedures (Objective 2.1.)*

Transition of all inspection activities to routine use will be completed during the stat up of commercial operations in 2008. Modifications and adjustments will be made as necessary. In parallel, the Integrated Safeguard Approach for the JNFL-1 site (including RRP, J-MOX and other facilities on site) and interrelated facilities, will be develop in accordance with the development of the Integrated Safeguard Approach at the state level.

3.2. *Complete the development of the I3S software (Objective 2.2.)*

The goal of the I3S is to provide on-site computing capabilities which can interrogate inspector and operator data from a large central data base, calculate the data as required, evaluate the data as specified and provide reports. The I3S integrate a various software packages while providing a single interface to the inspector. The release 1.6 is currently operated at RRP with limited applications. Stand alone software are also available for specific systems and as back up systems for I3S. The release 2 of I3S including most of the software packages will be installed beginning 2008 prior the start-up of RRP commercial operations. A couple of software packages will need

some further development and testing and will be deployed at RRP in 2008. This will complete the development phase of I3S with the exception of on going contracts for bug fixes and enhancements. The following tasks are contributing to this overall objective:

USA A 1351 Support for Development of the Safeguards Systems at RRP (Target Date: December 2007 but might be extended)

EC A 1661 Consultation for improvement, evaluation and testing of the Solution Monitoring Software (Target Date: First half 2009)

3.3. *Finalize implementation of the SG systems and improve the reliability of those systems (Objective 2.3.)*

Most of the SG systems have been implemented, tested and authorized for inspection use with the exception of the Vitrified Canister Assay System (VCAS) which will be tested once the vitrification process will start at RRP (expected end 2007 or beginning 2008). A number of actions contribute to the improvement of the reliability of the RRP SG systems. A number of other R&D projects within the Safeguards Department will also potentially contribute to those objectives like SGTS-03 (Next Generation Surveillance System), SGTS-11 (Unattended and Remote Monitoring systems) and SGTS-13 (Universal NDA Data Aquisition Platform).

USA A 1351 Support for Development of the Safeguards Systems at RRP (Target Date: December 2007 but might be extended)

JPN E 1281 Safeguards Equipment for the RRP MOX Storage Area (Target date December 2007 but might be extended)

EC A 1363 Support for Specification of Instruments and Procedures for RRP (Target date: first half 2008)

3.4. *Complete the DIE/DIV procedures for the lifetime of the facility, which will provide assurance that the facility continues to be constructed and operate as declared (Objective 2.4.)*

The DIE/DIV plan for the lifetime of the facility will be updated as required, and the DIV procedures for the operational phase of RRP will be drafted in 2008.

3.5. *Consolidate the continuing training programme for inspectors and support staff (Objective 2.5.)*

The RRP training programme and training manual will be consolidated based on the experience gained during the active commissioning. New inspectors assigned to RRP will be trained as required. The following tasks may contribute to this overall objective:

USA A 1351 Support for Development of the Safeguards Systems at RRP (Target Date: December 2007 but might be extended)

FRA B 1562 Familiarization Visit to La Hague for RRP inspectors (Target date: October 2007)

3.6. *Consolidate/complete the qualification of the On Site Laboratory analytical techniques and procedures (Objective 2.6.)*

Continuous cooperation with Support Programmes is foreseen for 2008–2009 while RRP will move to commercial operation.

EC A1391 Support for the Rokkasho On-Site Analytical Laboratory

JPN A1345 Technical Support for the Joint Agency/Japan On-site Analytical Laboratory at the

Rokkasho Reprocessing Plant (JU-01)

USA A1369 Enhanced ANM Capability for HKED Software at SAL

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

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

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| EC | A 1363 | Support for Specification of Instruments and Procedures for RRP | Completion June 2008 |
| EC | A 1391 | Support for the Rokkasho On-Site Analytical Laboratory | Completion expected in 2009 |
| EC | E 1425 | 3D Laser Range Finder for Design Verification in RRP | Managed under SGTS-03, Completion Dec. 2007 |
| EC | B 0620 | Nuclear Material Solution Accountancy and Verification Training | Managed under SGTS-101 Completion Dec. 2007 |
| EC | A 1661 | Consultation for improvement, evaluation and testing of the Solution Monitoring Software | Completion expected in 2009 |
| FRA | B 1562 | Familiarization Visit to La Hague for RRP Inspectors | Managed under SGCP-102, expected completion Oct. 2007 |
| JPN | A 1345 | Technical Support for the Joint Agency/Japan On-site Analytical Laboratory at the Rokkasho Reprocessing Plant (JU-01) | Completion expected in 2009 |
| JPN | E 1281 | Safeguards Equipment for the RRP MOX Storage Area (JD-22) | Completion Dec 2007, but might be extended |
| UK | B 1550 | Advanced Training in Nuclear Fuel Cycle Facilities | Managed under SGTS-101 Completion Sept. 2009 |
| USA | A 1238 | Development of Integrated Review Software for UMS (A.241) | Managed under SGTS-011, Expected completion Dec. 2007 |
| USA | A 1351 | Support for Development of the Safeguards System at Rokkasho Reprocessing Plant (RRP)(A.247) | Completion Dec 2007, but might be extended |
| USA | A 1369 | Enhanced ANM Capability for HKED Software at SAL (A.250.01) | Managed under SGTS-06 |
| USA | E 1249 | Upgrading of GARS Review Software and Software Factory Support (E.119) | Managed under SGTS-03 |

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

There are no new MSSP tasks planned or proposed.

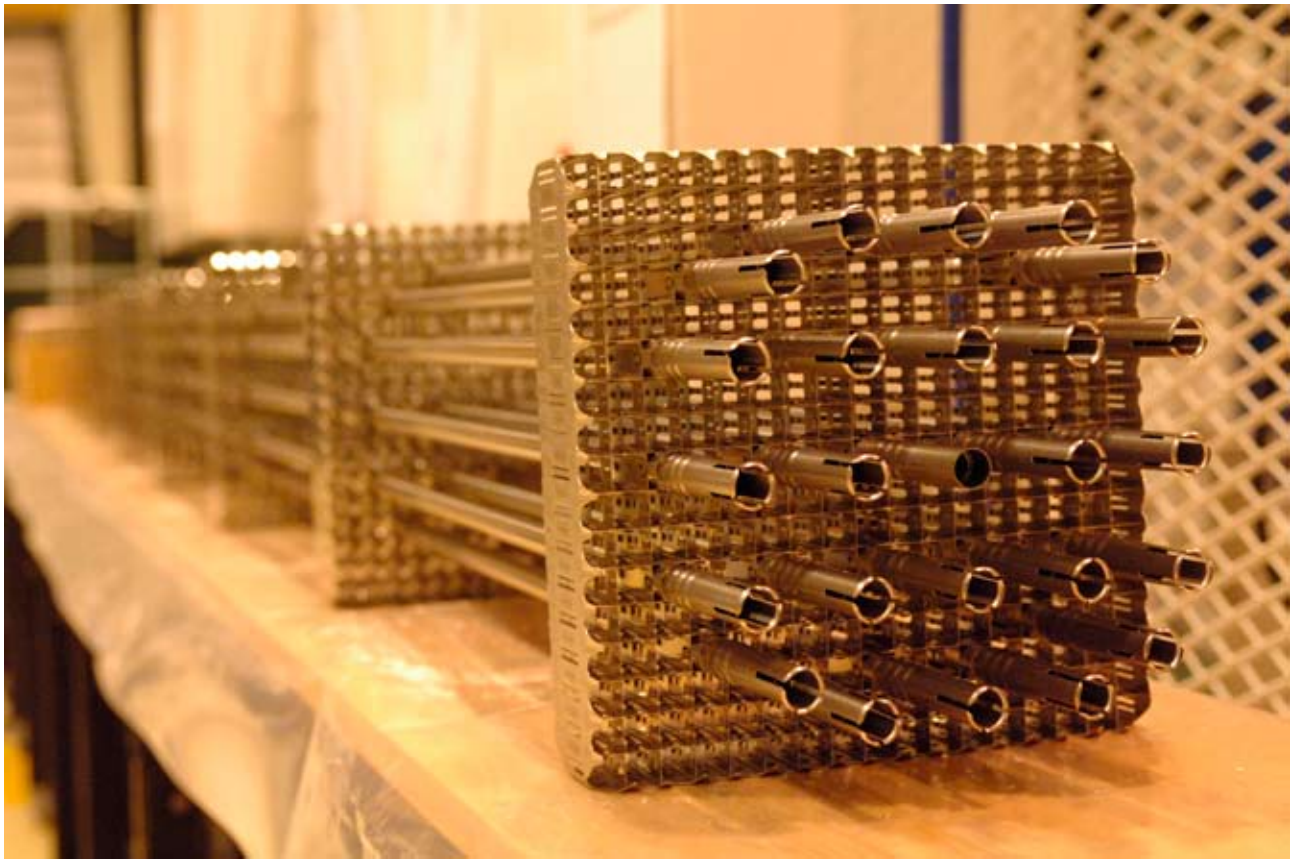
## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

All R&D activities have been supported through MSSP tasks.

# SGOA-02

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

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



▲ Fuel Element Fabrication (example)

### 1. Background

This document describes the plans associated with the development and implementation of effective and efficient Safeguards Systems for the J-MOX Fuel Fabrication Plant in Japan within the Department of Safeguards for the period 2008–2009. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011.

The JNFL-1 site located at Rokkasho at 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 MOX fuel fabrication plant (J-MOX), additional UO3 storages and various low level waste treatment and storage facilities.

The preliminary Design Information was submitted in June 2005 when the project was started. The construction phase of the plant will probably start beginning of 2008 and the start of commercial operation is foreseen for 2012/2013. J-MOX Safeguards Approach will include 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, and in-situ unattended and attended non-destructive assay (NDA) methods.

During 2008–2009, activities will focus mainly on the continuation of the development of an integrated

safeguards approach, design information examination and verification (DIE/DIV) activities, specification, development and preliminary testing of nuclear accountancy methods involving DA, NDA and C/S equipment as well as an integrated data evaluation system. In addition, the cost share between the SSAC, the operator and the Agency will be consolidated.

## 2. Objectives

The objectives of this project are principally derived from the following goal of the Department of Safeguards Strategic Objectives 2006–2011:

- Implement safeguards in an effective and efficient manner in States with safeguards agreements in force, including those with additional protocols.

***The principal objective of the project is to develop and implement effective and efficient safeguards systems for the J-MOX facility in Japan.***

In particular the following specific objectives can be identified:

*2.1. Development of an integrated Safeguards Approach for J-MOX based on the basic elements approved with Japan and start of the preparation of procedures for implementation.*

*2.2. Consolidate cost share between SSAC, JNFL and the Agency.*

*2.3. Design, test and installation of SG equipment (NDA, C/S) that provide high quality, independent and reliable results.*

*2.4. Design, test and implementation of an integrated data collection and evaluation software for J-MOX, using synergies with RRP I3S.*

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

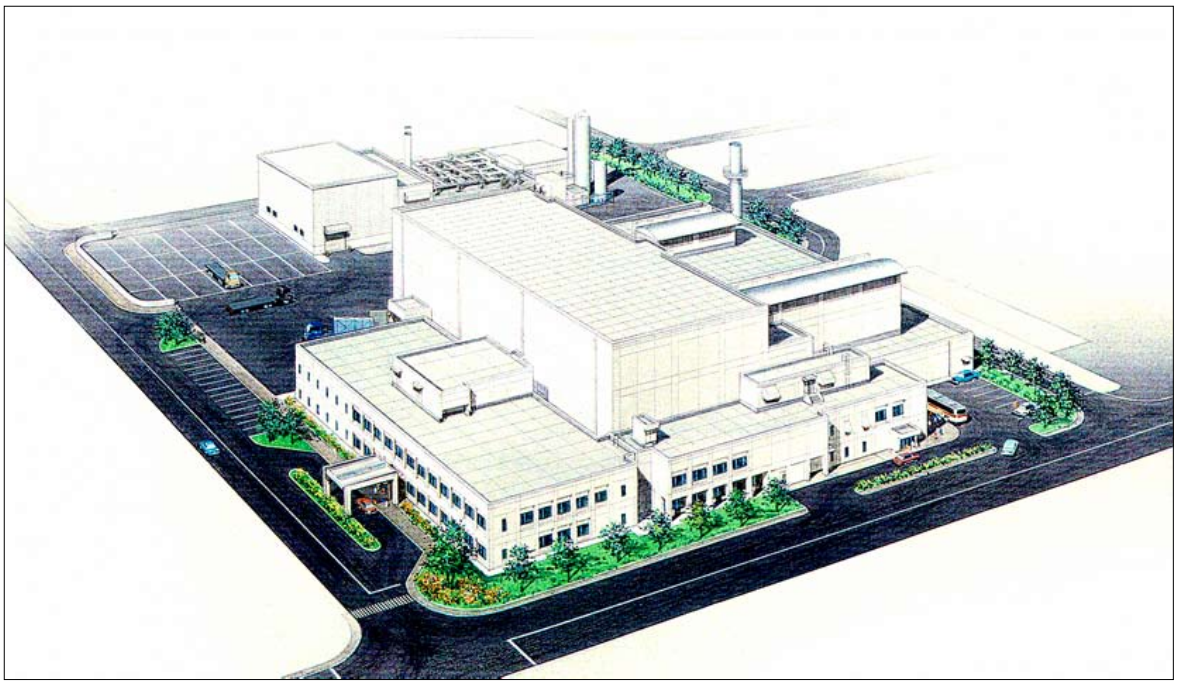
## 3. Activities

The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes. At the moment there are no active tasks but possibly a number of new tasks foreseen in the future will contribute to the design of the safeguards systems for J-MOX. In addition, a number of other R&D projects within the Safeguards Department will potentially contribute to the development of the J-MOX systems like SGTS-03 (Next Generation Surveillance System), SGTS-11 (Unattended and Remote Monitoring systems) and SGTS-13 (Universal NDA Data Acquisition Platform).

*3.1. Development of an integrated Safeguards Approach for J-MOX based on the basic elements approved with Japan and start of the preparation of procedures for implementation (Objective 2.1.)*

In order to pursue the development of an integrated approach for J-MOX, a number of steps need to be pursued:

- The sectors for verification activities in consistency with the site integrated safeguard approach will be confirmed (Target: mid 2008);



▲ J-MOX Facility Rendering

- The inspection regime, based on short notice random interim inspections (RII) will be further developed. The procedures for RII will be developed for each sector (Target: end 2008);
- The type and number of SG equipment will be updated, if needed (On going);
- NRTA concept for J-MOX to be developed (Target: Mid 2008);
- The operators' accountancy system and procedures will be analyzed and reviewed (On going in 2008/2009);
- DA sampling and analyses arrangements will be specified (Target: Mid 2008);
- Operators Data required for inspection activities (RII, PIV, and NRTA) will be confirmed (Target: Mid 2008).

3.2. *Consolidation of cost share between SSAC, JNFL and the Agency (Objective 2.2.)*

The cost sharing principles between the SSAC, the operator and the Agency have been approved in 2007. This cost share will be discussed as the need arises.

3.3. *Design, test and installation of SG equipment (NDA, C/S) that provide high quality, independent and reliable results (Objective 2.3.)*

The development, testing and installation of SG 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 homogeneity of equipment and software and for the implementation coordination of those. A number of milestones within the development and testing phase of the systems has 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 (mostly carried out in 2007);
- Detailed Technical Specifications (2007/2008);
- Continuous design review (2008/2009);
- Manufacturing and factory acceptance tests (2008/2010);

- Installation and cold tests (2010/2011);
- Tests with U and MOX (2011/2012).

3.4. *Design, test and implementation of an integrated data collection and evaluation software for J-MOX, using synergies with RRP I3S (Objective 2.4.)*

In the same way than for the SG equipment, the development and implementation of an integrated data collection and evaluation system for J-MOX will be coordinated through the J-MOX Joint Technical Committee. The main steps are:

- High level requirements (2007/2008);
- Requirements specifications (2008);
- IT architecture design (2008);
- Software development and testing (2008/2010);
- Software deployment and test at J-MOX (2011/2012).

3.5. *Establish and implement DIE/DIV procedures that assure that the facility is constructed and will operate as declared. Carry out DIE/DIV activities from construction to MOX commissioning phases (Objective 2.5.)*

Initial DIE/DIV activities will be performed during the construction and commissioning phases of the plant (from 2008 to 2012). 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 (1st half 2008);
- Continuous DIE to assess the validity of SG systems to be implemented (On going);
- Detailed procedures for DIV during construction and commissioning phases (2008/2010);
- Development of tools to manage DI documentation and track the DIV activities (2008).

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

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

There are currently no active and standby tasks.

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| 07/OA2-001 | Support for Development of J-MOX SG Systems | Umbrella task- Japan |
| New Task 1 | Support for development of DA sample treatment, analysis and transportation procedures. | To be submitted as need arises. |
| New Task 2 | Support for development of hardware and software associated with measurement, monitoring and C/S systems. | To be submitted as need arises. |
| New Task 3 | Support for development of a collection and evaluation software system for J-MOX and integration with the I3S developed for RRP. | To be submitted as need arises. |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

None.

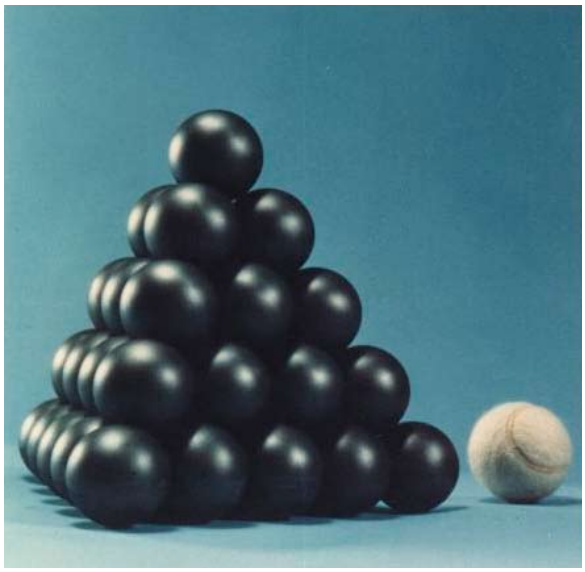
# SGOB-01

## R & D for Safeguarding Pebble Bed Reactors and Supporting Facilities

**Project Manager: Glen Horton** **Division: SGOB**

### 1. Background

An integrated safeguards approach for Pebble Bed Reactor systems is being developed by the Department of Safeguards, Division of Operations B. Where appropriate technical support projects are to be employed to assist in the development of new technologies and techniques to be applied at Pebble Bed Reactor facilities. This document describes the plans for developing and implementing the project SGOB-01, "Development of Safeguards Technology for Pebble Bed Reactors[1] and Supporting Facilities" within the Department of Safeguards for the period 2008–2009. It has been produced consistent with the Department of Safeguards Strategic Objectives 2006–2011



▲ Laser Surface Mapping

The document describes the plans for the development of the safeguards technology and systems which will be applied to the Pebble Bed Modular Reactor (PBMR) system being developed in South Africa.

The PBMR system includes fresh fuel fabrication, the on-line refueling reactor itself and the storage of spent fuel at the reactor site. The first PBMR Fuel Fabrication Plant is expected to have design and construction completed in 2009 and to be operational in 2012. The first reactor is expected to be operational in 2013. Because of the unique design of process and plant and the continuous online refueling of the reactor unique technologies and systems must be developed in order to apply safeguards.

The two year plan covers the period where system studies of plant and process are to be finalized and the design of specific technologies is to be commenced. The safeguards approach is planned to utilize in-process monitoring data. It is therefore essential to identify relevant equipment and complete system validation during the construction and commissioning period of the PBMR facilities.

There are currently two active MSSP activities and two activities in the planning stage. These activities are concerned with operational modeling of the reactor, the development of integrated fuel flow verification techniques, the development of safeguards technology for spent fuel measurement at the PBMR and the development of technology for design information verification at the PBMR.

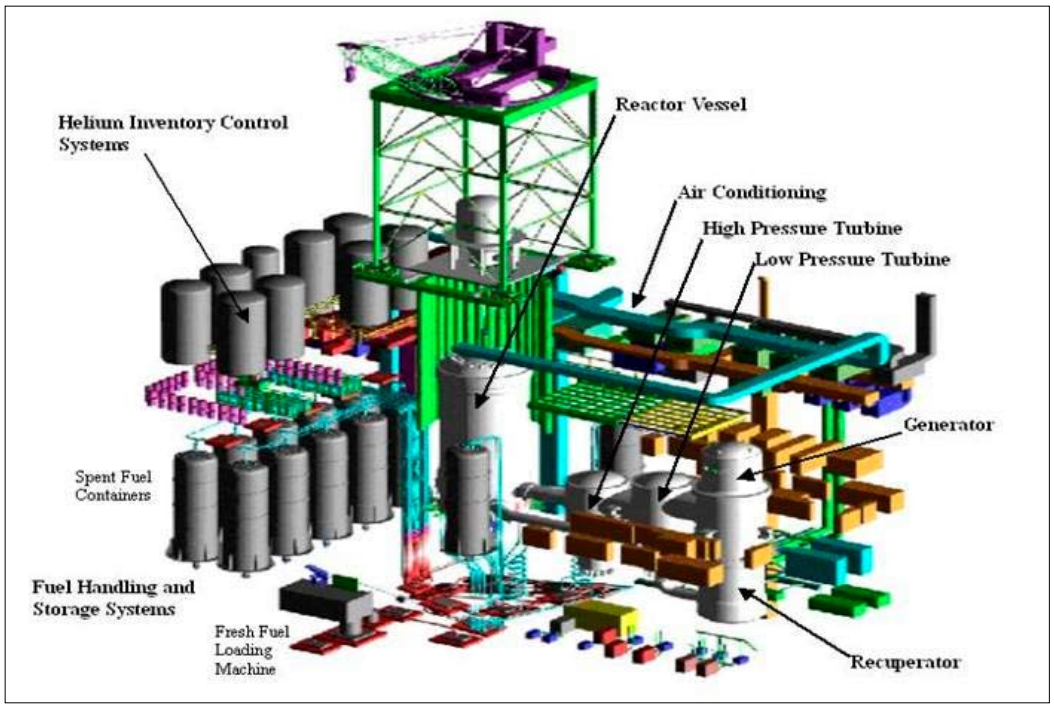
The end users of the results from this project in the near term will be the Agency once the developments are applied at installations in South Africa and elsewhere. Additional end users will be the operators of the facilities and the vendors of the PBMR system. In the longer term the development of the safeguards approaches and techniques may be applied generically to future PBR systems.

As the safeguards approach is developed it is expected that there will be the need for further technical support for the development of technologies and equipment. It is envisaged that there will need to be research and development in the following fields:

[1] "Pebble Bed Reactors" or PBR refers to the generic pebble based reactor system, "Pebble Bed Modular Reactor" or PBMR refers to the pebble reactor system being developed in South Africa.

- Computerized accounting and data sharing strategies and techniques at the Fuel Fabrication Plant.
- Equipment for verification of fresh fuel and flow monitoring during production.
- Integrated process monitoring equipment or validation of operator's reactor process data.
- Automated accountancy and reporting systems for application at the reactor.
- NDA equipment for verification of spent fuel on discharge from the reactor.

Specific support projects will be proposed by Division of Operations B as the details of the safeguards approach are developed.




▲ Pebble Bed Reactor Schema

## 2. Objectives

The objectives of this project are principally derived from the following goals and related key activities of the Department of Safeguards Strategic Objectives 2006–2011:

- Enhance detection capabilities through the development of new or improved safeguards approaches and techniques, and acquisition of more effective verification equipment.
- Develop, implement and revise, as appropriate, safeguards approaches for new safeguards situations (e.g. integrated safeguards), facility types and operating conditions, taking into account experiences, conceptual and technological developments and on-going needs for effectiveness and cost-efficiency.
- Use where possible equipment and technology already available with the view of adapting it to departmental needs.

***The principal objective of the project is to: Complete system studies of the Pebble Bed Reactor, supporting facilities and processes and to design specific technologies to support the implementation of safeguards at these facilities.***

In particular the following specific objectives can be identified:

2.1. *Develop and test SG equipment for PBR Fuel Fabrication Plant – June 2009*

2.2. *Assess numerical and NDA techniques for application to PBR spent fuel measurements and verification – September 2008*

2.3. *Development of Operational Model for PBR with proliferation indicators and possible diversion scenarios – September 2009*

## 3. Activities

The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes.

3.1. *Develop and test SG equipment for PBR Fuel Fabrication Plant (Objective 2.1.)*

- Define SG equipment functions and locations for application in PBR Fuel Fabrication Plant – March 2008;
- Review integration of process monitoring equipment – June 2008;
- Design, construct and test prototype equipment – December 2008;
- Construct equipment for application at PBMR Fuel Fabrication plant – June 2009.

3.2. *Assess numerical and NDA techniques for application to PBR spent fuel measurements and verification (Objective 2.2.)*

- Develop the appropriate neutron cross section libraries to perform the fuel depletion calculations. Those calculations will be run to establish the neutron-Pu correlations necessary for the interpretation of the NDA measurements;
- Based on design details, review potential of neutron and gamma scanning measurements along spent fuel tank verification tubes by means of Monte Carlo simulations of the transport of neutrons and gammas from the fuel to the verification detectors;
- R&D activities supported through task RSA A 1488, Safeguards Technology for Spent Fuel Measurement at the PBMR.

3.3. *Development of DIV technologies for PBR (Objective 2.3.)*

- Development of Design Information Verification Plan (DIVP) technologies for application at PBMR. Extension for general PBR installations;
- R&D activities supported through AUL task C 1567, Safeguards Technology for Design Information Verification at the PBMR.

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

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

| MSSP | Task No. | Task Title | Comments |
|---|---|---|---|
| AUL | C 1567 | Safeguards Technology for Design Information Verification at the PBMR | Target Completion:2009 |
| RSA | A 1488 | Safeguards Technology for Spent Fuel Measurement at the PBMR | Target Completion:2008-2009<br>Managed under SGTS-07 |
| USA | C 1547 | Develop a PBMR Operational Model to Identify and Quantify Proliferation Indicators and Possible Diversion Scenarios (C.114) | Target Completion: 2007-2012. Spent fuel analysis conducted by US Support Programme. Operational modeling required.<br><br>Managed under SGCP-03 |

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

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| 02/OB2-003 | Integrated Monitoring Technology for Fuel Flow Verification using Authenticated Process Data | Inactive |

# SGOC-01

## Chernobyl

### Project Manager: Goeran af Ekenstam

### Division: SGOC

#### 1. Background

This document describes the plans for the development and implementation of Safeguards systems for the decommissioning of Chernobyl NPP and for the stabilization of the Unit 4 "Shelter". It has been produced consistent with the Agency Department of Safeguards Strategic Objectives 2006–2011.

The Chernobyl nuclear power plant in the Ukraine was closed in December 2000. The decommissioning of the plant is expected to cover activities related to decontamination of buildings, soil, and water and to the removal of spent nuclear fuel from the wet storage and from the three units of the RBMK type reactors. The spent fuel transfer and conditioning campaign will be completed in about a decade. The spent fuel will be conditioned at a special processing facility, i.e. cut, canned and will then be transferred to an interim dry storage facility. Construction of the conditioning facility and dry storage started in 2001, but it has been delayed due to technical problems. Preliminary information from the Chernobyl NPP indicates that the facility will be completed by 2012. The transfer of some 22000 spent fuel assemblies is expected to commence thereafter.


▲ Spent Fuel Conditioning Facility

Another issue at Chernobyl deals with the sarcophagus, or "Shelter", encasing the fourth Chernobyl unit, which was destroyed in the 1986 accident. The "Shelter" that was constructed around the destroyed reactor unit 4 contains about 200 tons of uranium in various forms including melted reactor core material. The initial inventory of nuclear material in the "Shelter" declared by the Ukraine as of the date before the accident has been provisionally accepted by the Agency with the understanding that more accurate accounting and

verification of the material might be possible at some future date.

The "Shelter" has survived almost 20 years; however its stability and the quality of its confinement are in doubt. Necessary measures required to stabilize the existing "Shelter" are ongoing and the construction of a new safe containment is planned. At the same time, some removal of the nuclear material (e.g. for characterization) may take place.

Project work over the next two years will mainly consist of the finalizing of safeguards approaches, meetings and preparations for safeguards equipment installation. Significant design, development and safeguards implementation activities are not expected to start until 2010 because of the delay of the construction of the new facilities at the Chernobyl site.

SGOC, in consultation with SGCP has formulated a safeguards approach regarding application of safeguards to the nuclear material in the now existing "Shelter", which was approved by the DDG in 2005.

There are currently three U.S. Support Programme active tasks regarding the safeguards system for the spent fuel transfer and conditioning campaign and one U.S. Support Programme active task related to the safeguards system for Chernobyl Unit 4 ("Shelter").

This project is needed in order to fulfill the commitments of the Agency to ensure the Member States of the non-diversion of nuclear material placed under safeguards in Ukraine.


▲ Spent Fuel Storage

## 2. Objectives

The objectives of this project are principally derived from the following goal and related key activities of the Department of Safeguards Strategic Objectives 2006–2011:

Enhance detection capabilities through the development of new or improved safeguards approaches and techniques, and acquisition of more efficient verification equipment.

Key activities include:

- Develop, implement and revise, as appropriate, safeguards approaches for new safeguards situations

(e.g. integrated safeguards), facility types and operating conditions, taking into account experiences, conceptual and technological developments and on-going needs for effectiveness and cost-efficiency;

- Optimize safeguards equipment and technology development with the view of further improving present detection capability, increasing reliability of equipment while ensuring the security of information transmission from the field and improving sustainability and timeliness;
- Use where possible equipment and technology already available with the view of adapting it to departmental needs.

The primary objectives of this project are to:

***Develop and implement safeguards approaches for the Conditioning facility and the Shelter;***

***Develop and optimize equipment and technologies for use at the facilities at the Chernobyl site;***

***Enhance information acquisition by establishing a network for collection of safeguards data.***

In particular the following specific project objectives for the 2008–2009 timeframe can be identified:

2.1. *Revise the safeguards approach for the new conditioning facility, including the transfer of SF to the facility and conditioned material to the dry storage.*

2.2. *Develop a safeguards approach for the New Safe Confinement.*

2.3. *Finalise the installation of safeguards equipment in the Chernobyl Reactor no 4.*

2.4. *Upgrade of the safeguards equipment to be used during the transport of spent fuel (MMCT.)*

2.5. *Site integration of safeguards media for collection of data and also evaluate possible future remote monitoring.*

## 3. Activities

The following projected activities include those funded by the regular budget and those expected to be funded by Member State Support Programmes.

3.1. *Revise the safeguards approach for the new conditioning facility, including the transfer of SF to the facility and conditioned material to the dry storage. Develop an effective and cost-efficient safeguards system to be installed prior to the start of spent fuel transfers. The Holtec Company signed a contract in August 2007 for the re-construction of the conditioning facility. The licensing work estimated to be completed within approximately 2 years. Revised design data for the updated approach is expected to be available at the end of 2008.*

3.2. *Develop a safeguards approach for the New Safe Confinement as soon as design information is available.*

3.3. *Finalise the installation of safeguards equipment in the Chernobyl Reactor no 4. During 2006, safeguards equipment was installed at the main access points of the existing Shelter. 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.*

3.4. *Upgrade the safeguards equipment to be used during the transport of spent fuel (MMCT). 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 upgraded and the installation of a second unit is required. This equipment will be used later for confirmation of the spent fuel transports to the conditioning facility.*

3.5. *Site integration of Safeguards media for collection of data. The objective of this task is to integrate the safeguards data acquisition at the site. The possibility for remote monitoring at a later stage is also included.*

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

4.1. *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) | Standby |
| USA | E 1375 | Mobile Safeguard System for SF Transport from Chernobyl NPP to the Conditioning Facility (Part 1/3 of Chernobyl Transfer and Conditioning Campaign) | Active |
| USA | E 1376 | Safeguard Systems for Chernobyl SF Long Term Dry Storage (Part 3/3 of Chernobyl Transfer and Conditioning Campaign). | Standby |
| USA<br>RUS | JNT E 1445 | Safeguards System for Chernobyl Unit 4 ("Shelter") (C.111-USA) | Active |

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

There are no new task proposals planned to be initiated in 2008–2009. However, a remote monitoring system may be considered to be used during the planned 10-years shipment of spent fuel to the Conditioning Facility and Dry Storage. A first step into this direction is already taken by the planned site data integration activities.

| Task Proposal ID | Task Title | Comments |
|---|---|---|
| New Task | Remote monitoring | May be considered |

## 5. Current Active and Planned R&D Activities Supported Through Regular Budget

There are no R&D tasks activities active or planned that are supported through the regular budget.

# ANNEX I

## Strategic Objectives

## 2006–2011

## (SG-MN-GNRL-PL-0001)

## 1 Purpose and scope

Purpose: The Strategic Objectives determine the overall goals of the Department in accordance with the Agency's mandate and the Medium Term Strategy (MTS).

Scope: The DDG-SG, in consultation with MCM, determines the overall departmental strategic objectives in accordance with the Agency's mandate and Medium Term Strategy.

The strategic objectives are used as a basis for the development of the Planning Document to identify programmes needed for the implementation of the strategy before the development of the details of the Agency's Programme & Budget 2008-2009/2010-2011. They are reviewed on a regular basis to ensure that the objectives of the Department are in line with a changing environment and programme requirements.

## 2 Policy

The Strategic Objectives determine the overall goals of the Department in accordance with the Agency's mandate and the Medium Term Strategy (MTS). Whilst the vision embodied in Article II[1] of the Statute remains valid, the environment in which the Agency seeks to realize that vision is constantly changing; therefore, the path to achieving the strategic objectives is, by definition, dynamic and needs to be responsive to changing times and circumstances.

The present document defines the objectives of the Department of Safeguards for the period 2006-2011, the actions required to achieve those objectives, and how the Department expects to be perceived at the end of the given timeframe. Some of the objectives are interrelated; therefore, a single activity may address more than one objective. These objectives and the Planning Document for 2008-2009 and 2010-2011 provide a bridge between the Medium Term Strategy GOV/2005/8 and the Programme and Budget documents. Objectives, which are being implemented in close cooperation between the Department of Safeguards, EXPO and OLA, are cross-referenced to those in the MTS.

**The Medium Term Strategy, as approved by the Board, foresees that in 2011 the Agency will, inter alia:**

- have an effective and efficient verification system in place which will make full use of appropriate technological advances and which will operate around the backbone of a re-engineered Agency Safeguards Information System (ISIS);
- be playing a major role internationally in formulating improved approaches to challenges posed to the nuclear non-proliferation regime;
- have enhanced its reputation as a professional, innovative, impartial and transparent entity which is capable of anticipating new developments and responding promptly to new challenges;
- continue to foster well-motivated, dedicated staff, of highest competence and integrity, representing a wide geographical distribution and gender balance.

### *2.0 Overall objective*

In order to achieve the above, the Departmental strategy will be targeted on the following:

[1] **ARTICLE II:** Objectives

The Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world. It shall ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose.

*Overall objective*

***To maintain and further develop an effective and efficient verification system, in order to draw independent, impartial and timely safeguards conclusions, thus providing credible assurances to the international community that States are in compliance with their safeguards obligations.***

The Strategy outlines six main strategic areas around which the Department's action will develop over the next 6 years, namely:

***2.1 Implement safeguards in an effective and efficient manner in States with safeguards agreements in force, including those with additional protocols***

*2.1.1 Key activities:*

i. Implement safeguards strengthening measures for all States, including SQP States in light of the amendments approved by the Board in 2005.

ii. Implement integrated safeguards in States for which the Agency has drawn a conclusion on the non-diversion of nuclear material placed under safeguards and on the absence of undeclared nuclear material and activities.

iii. Intensify cooperation between the Agency and Member States to strengthen arrangements for safeguards implementation, including support the development/improvement of State Systems of Accounting for and Control of Nuclear Material (SSACs) capabilities where appropriate and other relevant infrastructure with the view of ensuring more efficient and effective safeguards.

iv. Effectively and efficiently apply safeguards to components of the nuclear fuel cycle of non-NPT States, upon request.

v. Contribute, as appropriate, to effective verification of nuclear arms control and reduction agreements, including nuclear disarmament (ref . MTS C.2).

***2.2 Enhance detection capabilities through the development of new or improved safeguards approaches and techniques, and acquisition of more effective verification equipment (ref. MTS C.1)***

*2.2.1 Key activities:*

i. Develop, implement and revise, as appropriate, safeguards approaches for new safeguards situations (e.g. integrated safeguards), facility types and operating conditions, taking into account experiences, conceptual and technological developments and on-going needs for effectiveness and cost-efficiency.

ii. Optimize safeguards equipment and technology development with the view of further improving present detection capability, increasing reliability of equipment while ensuring the security of information transmission from the field and improving sustainability and timeliness.

iii. Use where possible equipment and technology already available with the view of adapting it to departmental needs.

iv. Pursue R&D activities in the development of novel technologies for detection of undeclared activities using, inter alia, Member States Support Programme mechanisms as well as internal resources and expertise.

v. Enhance capabilities in the area of environmental sampling by:

- expanding the capacity and capability to process and analyse environmental samples at SAL; and
- expanding the capacity and capability of the network of analytical laboratories (NWAL) through the qualification of additional environmental sampling laboratories as part of the NWAL and/or by enhancing the capability of current network laboratories.

### *2.3 Enhance information acquisition, analysis and evaluation capabilities. (ref. MTS C.1)*

Information acquisition and its analysis are fundamental elements of effective safeguards. Therefore, the Agency needs to continue to enhance its capabilities in that regard.

*2.3.1 Key activities:*

i. Enhance information acquisition, analysis and evaluation capabilities through:

- the establishment of an integrated, service oriented, analysis-friendly information architecture, as an effective base to collect, evaluate, analyze, structure, secure and disseminate safeguards-relevant information;
- the development, improvement and/or acquisition of more comprehensive information collection, analysis and evaluation tools to process relevant information; and
- the constant improvement of the analytical processes within the department aimed at the optimization of the use of available expertise.

ii. Increase and intensify efforts related to the collection, analysis and evaluation of, and follow-up on, all available information on States' nuclear programmes, including extending evaluation capabilities for measurement data and information collected during inspection and visits, as well as on clandestine networks for the supply of nuclear items.

iii. Maintain an efficient safeguards information infrastructure.

iv. Enhance the Agency's present satellite imagery acquisition and analysis capabilities to support the verification work of the Agency.

v. Continue to develop processes and tools to maintain the knowledge required for the Department to produce credible conclusions.

vi. Ensure that an effective Departmental security system, including staff awareness, and physical and electronic measures, is in place.

### *2.4 Have the best management practices in place to optimize delivery of the nuclear verification programme (ref.MTS E.2)*

*2.4.1 Key activities:*

i. Implement a Quality Management System (QMS) that ensures soundly based safeguards conclusions and supports efficient implementation of safeguards verification and evaluation activities (ref.MTS C.1 & E.3).

ii. Continue to improve the organizational capability to more effectively carry out the mission of the Agency by:

- analyzing and, where needed, improving processes and practices within the Department with the view of optimizing the use of resources, thereby implementing organizational and operational changes when needed;
- seeking adequate and predictable funding for core statutory activities, ensuring that this is used efficiently by promoting cost consciousness and reinforcing programme priorities;
- aligning departmental structure and human resources closely to programmatic needs, and ensuring that the Department has at all times the appropriate human resources required to carry out its mandate by seeking and maintaining expertise in a wider range of needed disciplines; and
- implementing best practices for the management of projects, in particular for cross-departmental activities.

iii. Implement the departmental action plan developed to address the issues identified in the staff surveys with a view to fostering an open management style so that staff will be motivated and developed to ensure the best support to the department's mission.

iv. Ensure that the training programme fully meets staff needs and current and future organizational requirements.

v. Maintain a unified approach to address preservation of institutional memory and the promotion of knowledge management, while maintaining competence in the Department of Safeguards (ref. MTS E).

### *2.5 Have adequate and uniform legal authority in place to conduct credible safeguards verification (ref. MTS C.1)*

*2.5.1 Key activities:*

i. Pursue the conclusion of outstanding safeguards agreements and the universalization of the additional protocol.

ii. Enhance mechanisms within the scope of the Agency's mandate for dealing with non-compliance, including reporting.

iii. Support Member States' efforts to strengthen the safeguards system including:

- assessing whether the Agency is fully exercising all legal authority available to verify the non-diversion of nuclear material and/or the absence of undeclared nuclear materials and activities
- proposing amendments to the annexes of the Additional Protocol to include additional activities related to new advanced technologies and possibly dual-use items, as well as potential nuclear weapons related activities and items.

iv. Promote the application of safeguards in non-NPT States beyond the current obligations.

### *2.6 Improve external and internal Communication and Reporting (ref. MTS D.3)*

*2.6.1 Key activities:*

i. Enhance current reporting mechanisms to systematically compile, analyse and share safeguards information

ii. Seek a closer cooperation with Member States in order to jointly address current and future non-proliferation issues and challenges.

iii. Establish partnerships with selected international and intergovernmental organizations, to address the trends of non-proliferation.

iv. Maintain and develop stronger internal communication, and contribute to expand outreach activities and public awareness on verification activities by seeking to improve the quality and timely availability of information.

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