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Nuclear safeguards and security research in collaboration with JRC – RF

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Abstract

10 years of successful co-operation between JRC and RF in the area of training in safeguards methodology and the development of accounting and monitoring systems has led to improved nuclear safeguards and security, that is a non-proliferation issue (i.e. the control on materials) and a response to illicit trafficking of nuclear and radioactive material.

While the US DoE Safeguards support focused on the removal and physical protection of weapon grade material, the EC strategy aimed at a sustainable development of a safeguards accountancy and control methodology with Nuclear Material (NM) measurements according to international standards and with internationally accepted reference materials.

The EC-CIS relationship has evolved over the last 10 years from a demand-driven to a discussion-driven strategy in areas of mutual interest and benefit. The new program responds to a slightly shifted problem, away from the classical Nuclear Material Accountancy & Control (NMAC) towards combating of illicit trafficking while sustaining past initiatives within an enlarged international cooperation. In particular, the three classical pillars in the area of NMAC will be combined into one, addressing the identified bottlenecks in the Soviet nuclear fuel cycle. A new second and third pillar will provide support in nuclear security issues and in environmental monitoring by focusing on the safeguards aspects of downblending NM and respectively by addressing the fight against illicit trafficking.

Firstly, an enhanced surveillance for the accessibility of nuclear material undermines the chances for use of a nuclear device in terrorist attacks. Secondly, a further strengthening of the Nuclear Material Accountancy and Control will increase our protection against nuclear terrorist threats.

In that view, future projects will be oriented taking into account the new situation where objectives will stick with international updated context.

This paper presents the results of past collaboration and gives an overview of the JRC expertise which can be utilized in a new nuclear safeguards and security program.

Keywords: nuclear security, illicit trafficking

1 – Introduction

Following the breakdown of the Soviet Union, the international community realized the importance of nuclear safety and security issues in the Commonwealth of Independent States (CIS). The 1992 G7 summit in Munich decided to give the leadership to the European Union to address the corresponding problems. Upon request of the Member States the Commission created the TACIS (Technical Assistance to the Commonwealth of Independent States) program.

In a first step, projects tackled the most urgent problems related to safety of Soviet-Design Nuclear Power Plants. Feedbacks on the national situation and improved communication lead to point out major weaknesses in the system:

- Independent regulatory authority was inexistent
- The Nuclear Material Accountancy & Control (NMAC) didn't match the international standards
- There was no separation between civil and military cycles
- Weapon grade material was dispatched between 4 members of the Commonwealth of Independent States (CIS).

Consequently, in September 1994, the European Commission (EC) decided to include in the TACIS program projects for establishing more reliable safeguards systems. The decision was endorsed by the European Council, which requested the JRC to establish a coherent program for such a technical co-operation.

While the United States Safeguards support focused on the removal and physical protection of weapon grade material (1), the EC approach was based on the following three pillars for a sustainable improvement of nuclear safety and security (see fig 1):

- Training on safeguards methodology
- nuclear analytical capabilities serving for NMAC, nuclear forensics and reference material
- development of instrumentation in co-operation with the RF industry.

One of the major missions of the Joint Research Center (JRC) is to provide support to other Commission Directorate General in particular for the present case to the External Relation, DG RELEX, and Europe Aid Co-operation Office, DG AidCo.

The scientific support to the TACIS nuclear safety and security projects is based on:

- The recognition of JRC as a centre of excellence
- The institutes unique infrastructure and facilities deploying up-to-date techniques and state-of-the-art methodologies
- The implementation of safeguards activities in a neutral way, i.e. independent from national or private interests
- The long experience, support and collaboration with DG TREN for the implementation of the EURATOM treaty as well as the IAEA under the Non-proliferation Treaty (NPT).

In particular, the JRC is well recognised by the international scientific community for:

- the development of techniques, equipment and methodologies;

- the on-site assistance;
- the provision of training;
- the evaluation and qualification of safeguards equipment.

2 – TACIS Safeguards support program 1994 – 2004

In 1995, the Memorandum of Understanding signed between the Minister of Nuclear Energy of the Russian Federation (RF), Mr. Mikhailov and the Commissioner Mr. van der Bröck in charge of External Relations was the starting point of the co-operation. The RF introduced, based on the Federal Law on the Use of Nuclear Energy, enacted in November 1995, a new State System of accountancy and control (SSAC), which contains elements of International Safeguards and constitutes the basis for NMAC. The Joint Research Center (JRC), with a long-year experience in Safeguards R&D and with a Safeguards methodology that meets the international standards, was directly involved via a collaboration agreement signed by Mr. Egorov and Mr. Contzen. A first TACIS project on training in safeguards methodology started in December 1995 in Obninsk and was followed by other important milestones as the first Joint Steering Committee in 1996 or the Tripartite seminar in 1997.

Since 1994, 9 projects have been implemented in 3 beneficiary countries (Russian Federation, Kazakhstan, Ukraine) by two JRC Institutes: the Institute for Systems Information and Safety ISIS that was later renamed the Institute for the Protection and Security of the Citizen - IPSC- Ispra (Italy) and Institute for TransUranium Elements – ITU - Karlsruhe (Germany).

A summary of each project with its main focus is listed below:

- Support to the creation of dedicated training centers for nuclear safeguards and Material Control and Accounting (MC&A):
 - Russian Methodological and Training Center (RMTC) in Obninsk, in collaboration with US DoE;
 - Ural Siberian Methodological and Training Center (UrSiMTC) in Snezhinsk;
- Establishment of production strategy of instrumentation for the State System of Accountancy and Control (SSAC) of Nuclear Materials in Russia with VNIIA;
- Design and set up of three laboratories at the Bochvar All Russian Institute of Inorganic Materials VNIIMN;
- Pilot project on enhancement of the safeguards system at two nuclear power plants, Kursk and Kalinin;
- Modernisation and enhancement of Nuclear Material Accountancy and Control (NMAC) at the Mayak RT-1 plant
- Pilot project on combating illicit trafficking of nuclear materials with the Institute for Nuclear Research in Kiev.
- Enhancement of facilities Mass/Volume, Containment/Surveillance and Training at Ulba Metallurgical Plant (UMP);
- Enhancement of safeguards at the Ulba fabrication plant, the Almaty VVER reactor and the Kurchatov reactor in Kazakhstan.

EC STRATEGY for Technical Assistance and Support to CIS countries in nuclear safeguards *

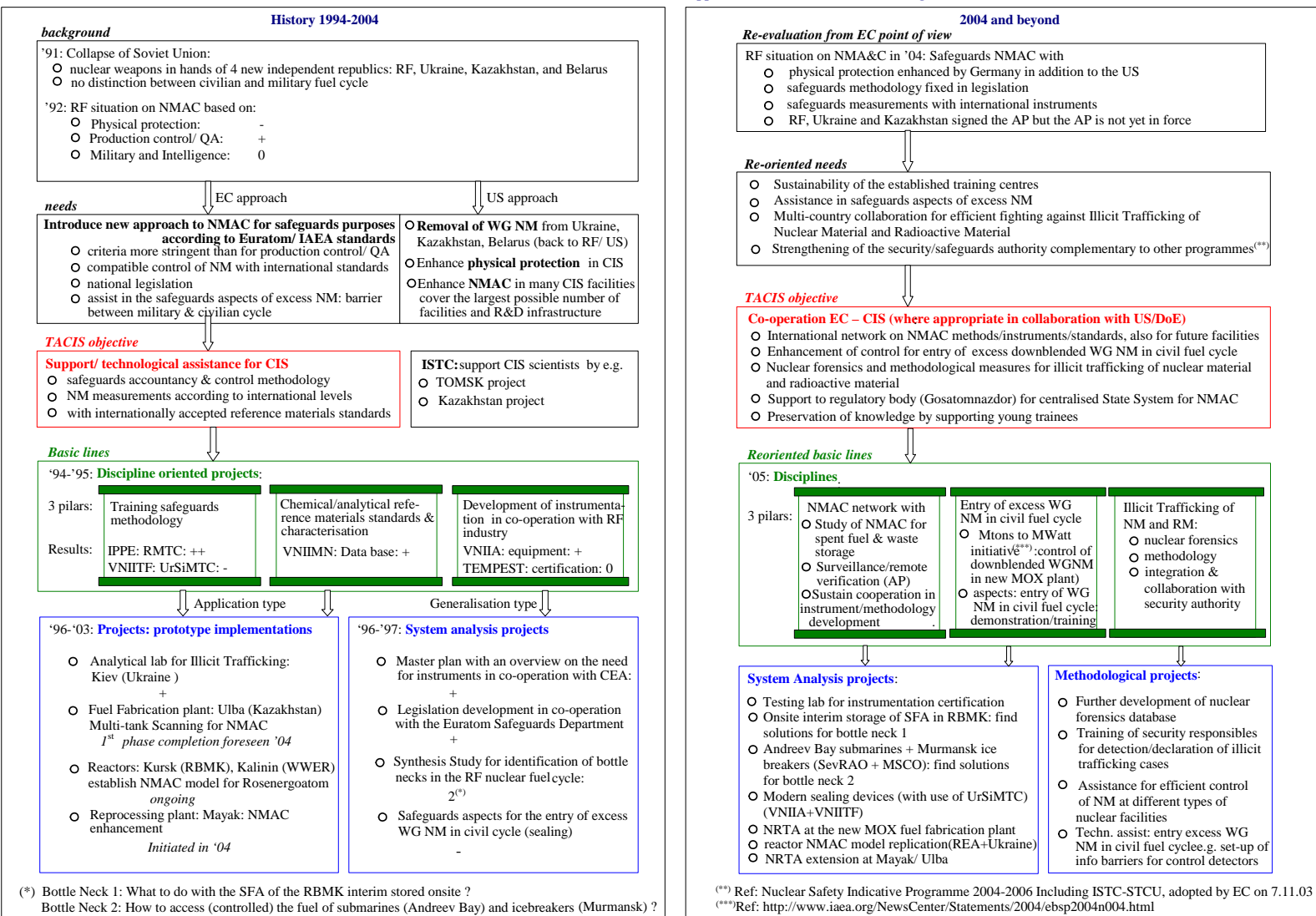


Fig. 1 Overview of the EC strategy with the three pillars for the past projects and the three pillars for the new projects.

The 10 years of successful cooperation has been celebrated by the involved EC and RF representatives, in presence of a US DoE National Nuclear Security Administration (NNSA) delegation and press (2,3).

3 - Current Situation and Needs

3.1 Russian Federation

President Putin has recently restructured the Federal Government and this affected as well the nuclear government bodies Minatom (today FAEA: Federal Atomic Energy Agency) and the newly created Environmental, Technological and Nuclear Oversight Service (which incorporates former Gozatomnadzor).

Some prospective studies by RAS Institute of Power Research pointed out a possible a strong increase of the nuclear power production. This has implications on the whole fuel cycle in the RF and the CIS, especially in fuel assembly fabrication (standard and MOX option) and reprocessing (cf. RF decree on the possibility to reprocess foreign fuel elements, completion of the RT-1 plant reconstruction, enlargement of Spent Nuclear Fuel (SNF) storage facilities at the RT-2 plant). Moreover, very important plans are under discussion in the RF, in particular about the disposal and/or re-utilization of nuclear material flows from military accountancy (front-end of weapons-grade plutonium utilization in Russian reactors and reprocessing of spent fuels from naval nuclear propulsion). The Safeguards system will have to be upgraded accordingly.

General Safeguards aspects will be extended to the fight against illicit trafficking of nuclear and radioactive materials, following detected past cases and new terrorist threats after the tragic events of September 11, 2001 and March 11, 2003. JRC had a pioneering experience in the field as the EC illicit trafficking combat program started in the mid-nineties and was jointly developed with IAEA.

3.2 Ukraine

Ukraine inherited most of the Soviet Union's NM. As a consequence, the EU's co-operation objectives as set out in the PCA (Partnership and Co-operation Agreement) with Ukraine focussed also on the establishment of a NMAC based on international EURATOM and IAEA standards.

Because of its infrastructures (ports, pipeline networks) and strategic geographical position, Ukraine has an important role as a transit route with EU countries. Moreover, after the enlargement it has a long border with the EU. The EU has therefore a particular interest in combating illicit trafficking in the frame of a multi-country co-operation project in order to protect the new outer border of enlarged Europe.

3.3 Kazakhstan

Kazakhstan which inherited Nuclear Weapons of Mass Destruction (NWMD) of the former Soviet Union on the one hand and the contaminated Semipalatinsk nuclear weapon test site on the other hand had to undergo an important transition phase towards Non Nuclear Weapon State with the Non-Proliferation Treaty (NPT) in force and the Additional Protocol (AP) signed. Kazakhstan transferred all nuclear warheads to Russia by April 1995 and destroyed the nuclear testing infrastructure at Semipalatinsk by July 2000.

The ULBA nuclear fuel conversion and fabrication plant in Ust-Kamenogorsk is one of the largest in the world and includes two separate facilities one for production of RBMK fuel pellets and one for production of pellets for WWER 1000.

Beside Ulba, Kazakhstan is housing also the NNC reactors (3 research reactors at Kurchatov and Alatau) and the Mangyschalk fast breeder reactor (at Aktau and which is now permanently closed down).

This important fuel cycle, and the related international transports (UMP is providing fuel pellets for WWER which are processed by Electro Stahl, near Moscow, for the fabrication of Fuel Assemblies) calls upon the strengthening of Safeguards.

Moreover, several cases of Nuclear Materials and several tenths of cases of Radioactive Materials Illicit Trafficking (IT) have been detected leading to a very high concern for IT risks. This issue will be addressed in the context of a multi-country project.

3.4 Multi-country approach

The safe operation of nuclear facilities, have been efficiently solved at many important nuclear facilities with the large support of nuclear industry. The 9 projects of the JRC, the large US support in Safeguards and some additional support of Member States have considerably enhanced the situation. The international community recognises the current need for strengthening nuclear security, a general international problem. A corresponding multi-country project is proposed to combat illicit trafficking with 7 different countries, RF, Kazakhstan, Ukraine, Georgia, Armenia, Moldavia and Belarus.

4 – TACIS Safeguards support program 2005 -2008

The new programme proposal is larger in terms of budget as well as geographic distribution. Although it completes previous projects, reinforces and sustains past activities it mainly addresses new challenges with the same objectives: the dissemination of a safety culture, by the transfer of know-how and knowledge and the enforcement of the nuclear security.

15 projects within the 7 a.m. countries will still be implemented by the two institutes, IPSC and ITU.

The new series of projects continues dealing with safeguards issues, tracking the nuclear material by improving the NMAC of fuel cycle to avoid diversion and possible dissemination. But as mentioned before, it also addresses new challenges in particular with the situation in Northwest Russia where nuclear spent fuels from submarines and icebreakers are waiting to be evacuated.

These projects are listed below:

- Improvement of accountancy and control of hold-up and waste in RT-1 plant at Mayak;
- Establishment of testing laboratory at VNIIA for certification of NMAC instruments;
- Development and introduction of modern sealing devices at Minatom's enterprises;
- Analytical and metrological support on NMAC;
- Nuclear material accountancy and control (NMAC) applied to naval spent fuel in North West Russia;
- Implementation of measures to combat illicit trafficking of radioactive and nuclear material – Multi-country project dedicated to Russian Federation, Ukraine, Republic of Moldova, Georgia, Republic of Kazakhstan;

- Containment/Surveillance system for RBMK spent fuel storage on Kursk NPP;
- Ukrainian border crossing station (Measures of fight against illicit trafficking of nuclear and radioactive material);
- Armenian border crossing station (Measures of fight against illicit trafficking of nuclear and radioactive material);
- Adaptation and commissioning of a computerized NMA system in Armenian NPP Medzamor;
- Enhancing the capability for analysis of seized nuclear materials and radioactive substances by the main expert organization of Ukraine;
- Enhancing the capability for analysis of seized nuclear materials and radioactive substances by the main expert organization of Kazakhstan;
- Automated data analysis and interpretation for Near Real Time Accountancy at the Ulba Metallurgical Plant;
- Sustainability of UrSiMRC.

In both cases, for past and new projects, enhancement of safety and security is achieved by delivery of equipment, obviously, but also training in safeguards methodology and techniques and specific support for NMAC and fight against Illicit Trafficking.

5 – JRC capabilities in nuclear security

The geopolitical situation brought more attention to security aspects, including in the nuclear field. New threats by terrorist groups that may utilise nuclear or radioactive material for so-called dirty bombs urge enhanced control measures. According to Romyantsev cited in Nature, “it is impossible to completely that no terrorist has any access to fissile material or nuclear industry allowing the production of nuclear weapons”.

Traditional safeguards activities supported by the JRC are being confirmed and extended in the proposal for the next framework programme 2007 – 2011. In particular, R&D in automated and portable Destructive and Non-Destructive Assay (DA and NDA) techniques to support safeguards inspections will continue. New systems of Containment and Surveillance (C/S) will be investigated and classical Mass and Volume (M/V) measurement techniques will evolve to an integrated system dedicated to Near Real Time Accountancy (NRTA) to enhance the first line of defence, i.e. detection of nuclear material diversion. Finally, combating illicit trafficking and nuclear forensics will continue and evolve, taking into account the risk associated with radioactive sources and deploying detection systems to the outside borders of future enlarged Europe.

Complementary, with the aim to support Commission services and to collaborate with IAEA and Member States authorities, the JRC will continue to systematically collect and analyse information from a variety of sources on nuclear non-proliferation issues (possibly extending into other WMD and delivery systems). This information will be used to produce country reports where the evolution of nuclear activities and of import and/or export of nuclear direct and dual use equipment and technology in selected countries will be closely followed. The information from these open sources will be corroborated with satellite imagery and other powerful tools as container traffic monitoring. To underpin this work, JRC will further develop multilingual web search, knowledge management and data mining technologies.

6 – Conclusion

The JRC involvement in the safeguards area is confirmed for the near future and commitment to pursue TACIS support program is illustrated by the on-going approval of proposed series of projects with an increased budget.

Past and future activities are dealing with traditional safeguards issues and prospective studies are being conducted to adapt and enlarge activities in a more global security approach. Evolving from a demand-driven to discussion-driven relationship with our CIS partners, a clear strategic paper on NMAC issues, with a clear vision of goals and corresponding needs has to be issued to anticipate and orient the next support program.

Safeguards activities will be extended to security with a possible application of the recognised safeguards systems to materials used in other weapons of mass destruction.

Finally, the JRC will seek to co-ordinate its efforts with other ongoing international activities (ISTC, USDoE, support of the Donor's States, etc...). To avoid duplication with other international projects in the CIS, a new tripartite meeting with EC-RF-US is planned.

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