NUCLEAR TERRORISM: HOW REAL IS THE THREAT?

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1. The paper will be based on Open Source materials and focus mainly on non-state actors such as terrorist, criminal, guerrilla and other, including religious, groups.

2. It will discuss the trafficking of highly enriched nuclear materials and less radioactive materials in the post-Cold war period, focusing on the smuggling from the former Soviet Union and from former Warsaw Pact countries.

3. The capabilities of terrorist and other groups in acquiring, handling and delivering nuclear and radiological materials will be addressed.

4. The intentions of various groups to use such weapons are explored and the goals they might pursue will be analysed.

5. Forecasts about the future will be made, based on the incident database of the Terrorism Prevention Branch and other databases and on scenarios which are currently discussed.

STRENGTHENING GLOBAL PHYSICAL PROTECTION PRACTICES; GAINING BETTER INFORMATION ON NATIONAL PRACTICES FOR PROTECTION OF WEAPONS-USABLE MATERIAL

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Unlike the Non-Proliferation Treaty requirement that non-nuclear-weapon parties provide "safeguards" information to the IAEA on their nuclear materials and their state systems for *accounting* and *control*, there is no related requirement to provide information on state systems of *physical protection*. A review of 1997 IAEA and Stanford physical protection conference proceedings showed both the absence of information on important practices from many states and the great variation in practices from state to state. Besides the lack of internationally required standards for domestic protection, reasons for the variations described in Stanford-Sandia National Laboratories research include:

- differences in states' perceptions of the threats to their materials,
- differences in their abilities to pay the cost of stronger physical protection,
- differences in their laws and regulatory practices in general, and
- differences in their cultural attitudes –for example, attitudes toward whether to arm personnel guarding weapon-usable material or to require clearances for personnel with access to such material.[1]

The information presented to the 1997 IAEA and Stanford conferences was supplied voluntarily. The two global documents which provide norms for physical protection do not require submission of such information. These are the 1980 Convention on Physical Protection of Nuclear Material and the 1999 IAEA INFCIRC/225/Rev.4. [2 and 3] This means that, without bilateral cooperation, no state can find out how other states are protecting their nuclear material. Yet, as IAEA Director General El Baradei has said,

> *[I]t is not a matter of indifference to other States whether and to what extent [physical protection] responsibility is fulfilled.…The need for international cooperation becomes evident in situations where the effectiveness of physical protection in one State depends on the taking by other States also of adequate measures to deter and defeat hostile actions against nuclear facilities and nuclear materials, particularly when such materials are transported across national frontiers. (INFCIRC/225,Rev.4, Preface)*

Contributing to recent efforts by the United States and others to strengthen global standards for physical protection [2 and 3], a Stanford project proposes ways to increase cooperation by providing more information about physical protection practices. The project has developed a questionnaire on physical protection practices. We recognize that some information about a state's system of physical protection can't be made public because of the fear that key secrets of protection might be used by terrorists or thieves in subsequent efforts to steal or sabotage the material. (See INFCIRC/225/Rev.4, par. 4.3) For those states willing to complete our questionnaire for a facility, we have promised not to make information public without their consent. But state-to-state comparisons of perceived threats and overall plans to counter them might be particularly educational.

With cooperation from Sandia and industry, the Stanford project hopes to demonstrate sensors and other means for physical protection. For example, the project's Friedrich Steinhausler has proposed the development of a "Virtual Walk-Through Facility" – a three-dimensional, computer assisted, simulation-demonstration showing the effectiveness of various possible protections for weapon-usable material against a variety of threats. This would be useful for training, for appraising protection proposals, and for evaluating the capabilities of existing facilities. It could be a significant addition to the display of physical protection technology and methods at Sandia's Cooperative Monitoring Center and a tool for use in IAEA training courses, demonstrations or conferences like this one.[4].

The basic goal of the Stanford project is to help strengthen global physical protection practices and standards. We have already made specific recommendations, and intend to continue our analysis of possible improvements. [2] and [5].

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PREVENTION OF THE USE OF LEGAL TRAFFICKING FOR NUCLEAR MATERIAL AND RADIOACTIVE SOURCES SMUGGLING

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Countries like Russia, which have a large nuclear industry, export a significant number of radioactive sources and substances. Some of them are nuclear material. In general, it is the task of the customs inspectors to verify that the content of the shipment is in agreement with the declaration (as safeguards inspectors verify operators declarations). In case of other goods, this is easy. The consignment can be opened and the content can be seen and compared with the declaration. In the case of radioactive shipments this cannot be done. The radioactive substance is in a shielded container and opening is often only possible in a hot cell. Opening of the package and measurement of the removed source in presence of the customs inspector is impossible because the customs inspector is impossible because the customs control begins only after the declaration has been registered. Therefore, the Russian customs authorities have contracted a company to develop a gamma spectrometer, which can be used to verify the source, even if inside the shielded shipping container. Throughout the country – near the where many shipments or receiveales take place - there are 18 customs offices, equipped with gamma spectrometers and special software. If a container arrives for customs inspection, its design is called from a database. Then the gamma spectrum outside the container is measured and the measured gamma peak energy and intensity is compared with the expected, which is calculated by software based on the design information of the container. This approach works well. Several cases were already discovered in Russia, where there were attempts to use legal shipments for smuggling radioactive sources.

I would like to mention some technical problems concerning control of legal export and import of radioactive sources:

a) There are not enough commercial suppliers which offer the needed equipment; because of lack of competition prices for the equipment are too high

b) Presently available equipment is mainly based on HPGE cooled with liquid nitrogen. Therefore, it is difficult to use in customs offices. Alternative detector options, which do not require liquid nitrogen cooling should be explored

c) Verification of legal shipments is presently only done is Russia, to extent it worldwide an international data base containing design information of all shipment containers would be required; this is also important for the receiving country to verify arriving shipments. The data base must allow integration into available measurement and verification software

d) Presently no procedures for test, validation and certification of methods to verify legal shipments are available, therefore in Russia such measurements can only be used in court if combined with an additional investigation, requiring opening of the container. This is expensive and there is s strong desire to use measurement results directly to initiate a court order

e) Even if verification measurements are made, they can be faked when the thickness of the container is altered. Presently no generic methods are implemented which allow the verification of the container design

Actuality of these problems can be confirmed by the real cases of smuggling disclosure, some of which I am going to adduce.

In view of the above it would be desirable that the International organizations, such as IAEA, WCO and others, would provide assistance to National Customs Services. The State Customs Committee of the Russian Federation is willing to cooperate with any International organizations and National Customs Services in this area.

RECOMMENDATIONS FOR STRENGTHENING THE NATIONAL SYSTEMS AND THE INTERNATIONAL REGIME FOR COMBATING O F ILLICIT TRAFFICKING

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EXTENDED SYNOPSIS

Illicit trafficking activities involving nuclear material and equipment are acts of nuclear proliferation. The threat of illicit trafficking is an international concern and the consequences of illicit trafficking, such as war or terrorist attacks using illegally manufactured nuclear weapons, might affect any country. As long as these materials and equipment remain a potential for theft and smuggling due to insufficient security and control conditions, there is a possibility that proliferators or terrorist groups may illegally take possession of such materials and equipment for illicit purposes.

A precondition for preventing illicit trafficking is the existence of effective national systems for supervision and control of nuc lear material and equipment, including physical protection and export/import control, based on an accurate and complete legislation. In addition thereto, national systems for combating of illicit trafficking, through prevention and detection within a state's territory or across its borders, incorporate such components as: supervision and control of nuclear operations; organisation of operator activities through quality assurance, internal control, security culture, etc.; law enforcement functions (police, intelligence, customs, investigation, prosecution, penalties and sanctions); and procedures for co-ordination and co-operation between supervising and law enforcement authorities.

According to a joint Swedish-Norwegian-Latvian study, there are imperfections in many national systems for combating of illicit trafficking, such as:

- Incomplete legislation on nuclear non-proliferation and safety, physical protection and export/import control;
- Unclear or overlapping responsibilities between national supervision and law enforcement authorities, leading to poor co-operation and co-ordination of preventing and detecting measures;
- Incomplete rules and regulations concerning operator functions and responsibilities, including requirements on internal control, quality assurance, security culture and individual responsibilities;
- Shortage of suitable and modern equipment for monitoring and detection of radioactive material;
- Shortage of staff and training capabilities and insufficient financial resources concerning supervision and law enforcement authorities;
- Insufficient access to relevant information and data bases.

A first step to improve national systems would be to assist states, by educating key-persons and authority staff, how to establish good, state-of-the-art national systems for combating of illicit trafficking, which would meet the requirements of international legal instruments, recommendations and guidelines. State Governments need to be made more aware of the seriousness of the proliferation threat and be convinced that supervision and law enforcement resources must be reinforced for bringing their national systems up to international standard.

On the international level, combating of illicit trafficking would be ameliorated by improving the communication links between national authorities bi-laterally and with the international organisations. Also increased information exchange between national and international databases would improve prevention and detection capabilities.

For the effective and consequent combating of illicit trafficking of nuclear material and equipment, it is, however, necessary that the international non-proliferation regime be strengthened through new initiatives and approaches. These should focus on, inter alia, a set of minimum requirements to be implemented, and to pursue, impose, follow-up and audit the implementation of those requirements into the national systems for combating of illicit trafficking.

The IAEA is the recognised international organisation, both for nuclear energy promoting activities, and for the implementation of the international non-proliferation regime. The IAEA has, within its area of competence, relevant know-how and capability, including qualified staff, information systems, etc. In order to be assigned the task to serve the function of the international regime for the combating of illicit trafficking, the IAEA needs, however, an additional mandate.

The full paper will elaborate on these and related issues and will summarise a set of key recommendations.

REVISED PHYSICAL PROTECTION AT AUSTRALIA'S FORTY-YEAR OLD RESEARCH REACTOR

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Summary

The High Flux Australian Reactor (HIFAR), a DIDO class, 10 MW (thermal) research reactor operating with HEU fuel, is over forty years old. The design of installations of that era called for a protected area which encompassed not only the reactor but a number of other site facilities. As a research reactor it was exempt from the recommendations of INFCIRC/225, but times and circumstances change. The paper describes the work done by Australia to update Physical Protection measures at ANSTO's Lucas Heights site in line with INFCIRC/225 recommendations. The work was commenced in 1991 and completed in 1995 and PP at the reactor now meets or exceeds the latest (Rev.4) recommendations, which Australia has adopted as its national standard.

MEASURES AGAINST ILLICIT TRAFFICKING OF NUCLEAR MATERIAL AND RADIOACTIVE SOURCES IN THE REPUBLIC OF BELARUS

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The Republic of Belarus strives to take an active part in international cooperation in the field of prevention and interception of illicit uses of nuclear material and radioactive sources through:

- multilateral international agreements and bilateral interagency treatments;
- information exchange within the IAEA Illicit Trafficking Database;
- participation in different international seminars, workshops, conferences including those under the IAEA auspices etc.

Belarus is constantly improving regulatory, legal and technical aspects of activities aimed at:

- accounting, control and ensuring of physical protection of nuclear material and security of radioactive sources;
- exercising efficient control over their export and import;
- detecting cases of their illicit uses and illegal cross-border movements and informing of such cases through the IAEA Illicit Trafficking Database;
- developing and providing training opportunities for personnel.

Through Resolution "On Measures for Physical Protection of Nuclear Materials" issued by the Council of Ministers in 1993, Committee for Supervision of Industrial and Nuclear Safety (PROMATOMNADZOR) was appointed as the authority responsible for ensuring physical protection of nuclear materials and facilities.

Through Resolution "On Measures for Fulfillment of Provisions of the Non-Proliferation Treaty" issued by the Council of Ministers in 1993, Promatomnadzor was designated as the national competent authority responsible for the establishment and maintenance of the State System of Accounting and Control of nuclear material. The system accounts all the nuclear material meeting the criteria defined in the Safeguards Agreement with the IAEA. The system includes two levels: i.e. on-site accounting and control and state accounting and control exercised by Promatomnadzor. Apart from reporting to the Agency, the system also provides for national tasks being accomplished: control over uses of nuclear material, its physical protection, access control etc. Promatomnadzor is also a central communication point in the case of a loss, unauthorized use or seizure of nuclear materials.

The State System of Accounting and Control of ionizing radiation sources was set up and commissioned through Resolution issued by the Council of Ministers in 1999. The system consists of 2 levels: primary accounting by users and state accounting and control by Promatomnadzor. Promatomnadzor laid down and requirements for submitting information on a source itself, its owner, timing of reporting. All the sources meeting the established criteria are registered in the database of Promatomnadzor irrespectively of their ownership.

The database allows both tracing a concrete source, and acquiring information on a single user. Promatomnadzor informs the Ministry of Internal Affairs so that control over the guarding system and requirements for security of ionizing radiation sources is ensured. Promatomnadzor, Ministry of Health and, if needed, Ministry of Internal Affairs and Ministry of Labor are informed of any radiation incident including a loss or occasional detection, unauthorized uses of nuclear and radioactive material. Following such cases a special commission is established. Headed as a rule by an official from Promatomnadzor, the commission makes a narrow inquiry into the facts and compiles an act of investigation. Based on the act, measures are taken to address the case and to prevent it from recurring. If needed, the Prosecutor's Office is approached to commence prosecution.

Should an incident occur at the customs border, the customs authorities themselves investigate the case, which may result in taking criminal proceedings. Representatives of Promatomnadzor generally take part in the investigation.

Export-import measures also belong to those aimed at preventing and intercepting illicit trafficking of nuclear material and radioactive sources. Thus, in order to cross the customs border a user of an ionizing radiation source is to get a permit from Promatomnadzor. Pursuant to the Law "On Export Control" adopted in 1998 a license from the Ministry of Foreign Affairs is also needed when nuclear material is concerned.

One can suggest the following measures to upgrade the existing infrastructure in the field:

- to improve the national system of mutual notification of incidents involving ionizing radiation sources by setting uniform requirements for information to be submitted and through establishing a computer database to register all the incidents;
- to upgrade the laboratory under Promatomnadzor conducting primary measurements and identification of detected ionizing radiation sources;
- to explore a possibility of setting up a national laboratory capable of conducting complex measurements for identification of revealed nuclear material, including destructive analysis; such a lab can be founded at existing research institutes and scientific centers;
- to train and retrain personnel;
- to develop technical capacities of customs check-points.

COMBATING ILLICIT TRAFFICKING OF NUCLEAR MATERIAL AND OTHER RADIOACTIVE SOURCES IN REPUBLIC OF BULGARIA

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Abstract

The turbulent history of the Republic of Bulgaria is proof of its importance for the commercial and military interests of the nations that have conquered and exploited the country through the ages. It is clear that it is the connecting node of two continents, Europe and Asia. It is a natural stop in the movement of goods for transcontinental commercial purposes as well as a natural resting place for the movement of armies during the ancient and medieval times.

The geopolitical situation that currently exists in Republic of Bulgaria may form condition for illicit trafficking. This paper gives a short description of the efforts of the Government of Bulgaria to combat the illicit trafficking of nuclear material and other radioactive sources.

I. INTRODUCTION

The general principle in the legal instruments in the field is providing security of radioactive materials and public safety of radiation sources. All acting legislative acts are based on European and other International Conventions and Treaties on use of atomic energy and on the commitment that in Bulgaria the atomic energy should be used only for peaceful purposes. The co-operation with the other countries in that field would be under the terms of the Treaty on Non-proliferation of Nuclear Weapons.

The legal instruments regulating the regime of registration, handling, storing, use and disposition of radioactive materials are as follows:

- The Treaty on Non-proliferation of Nuclear Weapons;
- The Vienna Convention on Civil Liability for Nuclear Damage;
- The Act on Use of Atomic Energy for Peaceful Purposes /1985/;
- The Regulation for Implementation of the Act on Use of Atomic Energy for Peaceful Purposes /1986/;
- The Rules for Gathering, Keeping, Processing, Storage and Disposition of Radioactive Waste on the Territory of the Republic of Bulgaria.

The Act on Use of Atomic Energy for Peaceful Purposes /AUAEPP/ has been passed in 1985. It regulates the use, the right of property, the management of use, the government control, the civil liability for nuclear damage and the administrative and criminal responsibility of the persons in charge of management and using of atomic energy. The last amendments to the act took place in 1995 and concerned the right of property, control and accounting of radioactive materials. Now only the special nuclear materials are exclusive property of the state, while the other ionizing radiation sources may be property of legal and physical persons too. These new provisions to the act have caused passing a new section V in the **Criminal Code,** concerning higher criminal responsibility of the persons in charge of handling and control of such materials.

The Committee on the Use of Atomic Energy for Peaceful Purposes (CUAEPP) co-ordinates government policies in the field of use of atomic energy.

The Inspectorate on Safe Use of Atomic Energy within the CUAEPP provides government supervision and control on safe use of atomic energy in interaction with the other authorized specialized controlling agencies.

In 1998 has been established the *Standing Commission for Co-ordination, Information Exchange in the Field of Proliferation.* The members of this commission are officers from the National Service for Combating Organized Crime (NSCOC), the National Security Service, the Border Police and the General Department of Customs, the Ministry of Economics and the Committee on the Use of Atomic Energy for Peaceful Purposes (CUAEPP).

II. COUNTERING ILLICIT TRAFFICKING OF NUCLEAR MATERIAL AND OTHER RADIATION SOURCES EXPERIENCE AND TRENDS

The *Ministry of Interior (MoI)* is authorized to provide control on radioactive materials on the sites, where they are used and stored and in the time of their transportation. As the illicit trafficking of nuclear materials is a great concern of our government and the MoI, in the early 90's a special operative and investigative section has been set up within the *National Service for Combating Organized Crime,* which deals with non-proliferation of nuclear materials.

We consider any case of diversion of radioactive materials as a possibility for single state or terrorist groups or organizations to ignore the international convention for non-proliferation of radioactive materials. In addition the radioactive materials in combination with the conventional explosive substances may be used to create a panic or to cause radioactive contamination in residence areas or water sources and in this way poses a threat to the public health and the environment.

These factors determine the high degree of public threat of all kinds of nuclear crimes and that is why the domestic and the international communities are aware of them.

The Republic of Bulgaria is mostly a transit country for the alleged illegal trafficking of nuclear and radioactive materials. That is why the law enforcement authorities are trying to be active partners of the competent international and national authorities in the concerned countries.

The analysis of the criminal acts involving radiation sources and radioactive materials in Bulgaria for the period 1992-2000 has outlined the following factors, which have caused the rise of this specific new type of crime.

In the first place, the decay of the USSR and the consequent economic stagnation in the former socialist countries in Central and East Europe have led to dismissing of a lot highly qualified scientists and specialists, employed before in nuclear, military, missile-aviation and space industries and Research Centres, and Institutes. The criminal organizations have envisaged the great potential of these professionals and their likely incorporation in future illegal/criminal activities. Further the criminal organizations have demonstrated notable interest in high technologies, know-how, materials and equipment, involving radiation sources and radioactive materials, as necessary prerequisites for profitable eventual illegal/criminal production or transfer in the countries under embargo.

In the second place the inadequate legislative practice in force in the early 90's for the new social and economic situation in the country in transition and the legal nihilism, demonstrated by most of the people and the parties, dealing with radioactive materials.

In the third place the loose control over the entire process of keeping, storage and handling of such materials in the early 90's have favoured some unscrupulous elements to make use of illegal trafficking in nuclear and radioactive materials.

The criminals involved in illicit trafficking in nuclear and radioactive materials are in general foreign profiteers, operating in co-operation with Bulgarian nationals and companies. These materials are usually subject of smuggling and re-export in the Middle East countries and in the countries put under embargo.

The approaches and methods in detection and identification of smuggled radioactive materials applied in the operative practice include first of all, examination of the reliability of the source and the obtained information, the appearance, colour and other specifications of the substance; Special attention is drawn to the initial use of the offered substance, in which field it has been used (kind of application, type of used equipment), weight, inscriptions and symbols on packing (containers), certificate of chemical expertise etc. If it is possible, an information on the process and place of enrichment of the substance is collected.

The more common of the recorded cases involving radiation sources and radioactive materials in Bulgaria are as follows:

- In October, 1992 140 Plutonium radiation sources, "buttons", have been seized in hotel "Sheraton" in Sofia. The investigation has revealed total amount of 0.02 g Pu, which can be considered as a radioactive material, but it can not be used for military purposes. The substance had been placed there deliberately by an English news reporter for the need of a journalist investigation of a fiction channel for smuggling radioactive materials to an unknown Arabic country with the intent to discredit Bulgaria. The investigation has not confirmed such a channel.
- In February 1994 four capsules with Radium have been seized in Plovdiv. The measured radiation emission has been insignificant.
- In July 1994 2 containers with Uranium acetate and 2 containers with Mercury oxide have been seized. Both substances pose a threat to people, but they are not weapon-usable.
- In 1994, 1 metal container with 0.5 g Uranium oxide has been seized in Sofia. The expertise has confirmed the substance poses a threat to people, but it is not weapon-usable.
- In October 1994 four metal containers with an alloy of Alluminium, Manganese, Magnesium have been seized by Custom officers in a Turkish bus, but no radiation sources have been detected.

On the grounds of the available information the following conclusions can be done:

In the period until 1996 the demand on radiation sources and radioactive materials of various types and kinds for the purposes to be transferred to the countries under embargo has been considerably high. Most of them originated from Russia and Ukraine and have been smuggled to the Western Europe or Middle East countries, as the offered prices were too high and the demand at the domestic market was nearly absent. In the period 1996 - 1998 the numbers of recorded cases of detection or smuggling of radiation sources and radioactive materials has suddenly fallen. The available information on such cases has decreased too

In 1999 there was a case of transit trafficking of U-235 through the border cross control point in the city of Rousse. In addition 19 containers with Strontium and Americium of the type "Gamarid" have been stolen. They have been in possession, handled and stored by a company.

The analysis of the registered cases involving radioactive materials has displayed that in the most of cases some individuals and companies had tried to speculate and to realize fraudulent deals, offering and selling some times innocuous or false radioactive materials. The seized substances generally originated form civil facilities and are used in sensors, gauging and calibration appliances, and are not weapon-usable. There are no any registered cases of detecting or seizure of U-235, Pl-239 or any other weapon-usable radioactive element. Nevertheless some of the seized materials are emitting dangerous radiation for people and environment.

III. CONCLUSION

The geographical situation of Bulgaria at the crossroads between Europe and the Middle East has specified it as one of vulnerable transit countries for illicit trafficking of radiation sources and radioactive materials from Europe to Middle East countries. That is the reason to consider the crimes involving radioactive materials as posing a serious threat to the health and public security of people, and environment and to support any efforts to co-operate and integrate with all concerned international organizations and special enforcement forces in dealing with this serious threat.

OVERVIEW OF THE ACTIVITIES ON PREVENTION AND COMBATING ILLICIT TRAFFICKING IN NUCLEAR MATERIALS AND UPGRADING OF PHYSICAL PROTECTION SYSTEMS IN THE CZECH REPUBLIC

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The paper describes the effort and co-ordination role of the State Office for Nuclear Safety in prevention and combating of illicit trafficking in nuclear materials in the Czech Republic.

There are given details on the activities to strengthening the national regulatory programme. The scheme to response the incident of illicit trafficking is covered. Basic information on R&D programme on the development of analytical methods suitable for forensic analysis of nuclear materials of unknown origin as well as close co-operation with the Institute for Transuranium Elements (Karlsruhe, Germany) are describes. The basic information on illicit trafficking in nuclear materials occurred in the Czech Republic are summarize.

The second part of the paper comprehensively describes the upgrading of the physical protection systems at the different types of the nuclear installations (research reactors, storage of nuclear material including spent fuel, power reactors - WWER 440 and WWER 1000) to fulfill the more strict requirements of the new Atomic Law No. 18/1997 Coll. and Regulation No. 144/1997 Coll., on physical protection of nuclear materials and nuclear facilities which entered into force in 1997.

The follow up actions in connection with IAAEA IPPAS mission carried out in 1998 are given. Basic information on physical protection of NPP Temelin in connection with start of the operation of the first unit in 2000 and continuous construction of the second unit will be given.

UPGRADING OF PHYSICAL PROTECTION OF NUCLEAR MATERIALS IN AN OLD NUCLEAR RESEARCH REACTOR FACILITY

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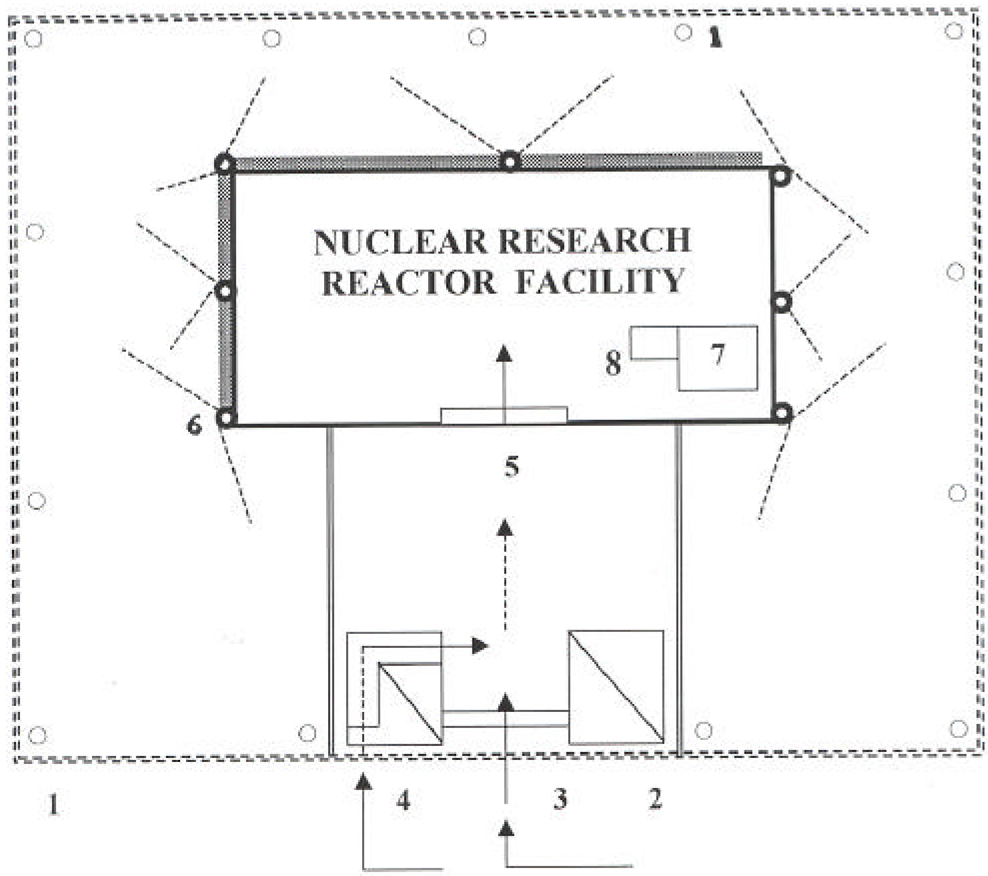
The present paper describes a system for upgrading the physical protection of nuclear and radioactive materials in an old nuclear research reactor facility (NRR). The approach and implementation of the system are considered as an integration to the existing system of nuclear material safeguards and facility nuclear security. The system provides measures for external protection, guards, entry and access control, safety and protection for transport; and personnel and administrative control [1,2].

A peripheral fence has been built around the nuclear research facility as a second barrier. The first barrier is the fence of the Nuclear Research Center-AEA where people may be allowed entry/exit through the main gate " point ". The NRR facility fence is provided with a local center, with guards, communication equipment and direct contact with the main guard and security center. Also, the fence has television cameras allowing complete visibility of fence zone as shown in Fig.1 In order to ensure functioning of the surveillance 24 hours per day, an illumination system is employed through a universal power supply (UPS).

The access of personnel to the NRR facility is controlled through a personnel Entry/ Exit port located near the local security guard where only authorized personnel [carrying a special card with a code number, or a special magnetic card] may be allowed entry to the NRR facility-after registering and signing in an administration registration book.

The access control inside inner areas [1] (e.g. the reactor hall) is done under direct authority of the facility manager (assisted by radiation protection specialist) for a limited number of personnel involved in specific tasks. A closed circuit television system is used for surveillance inside the inner areas. The system can locate any personnel inside the interior area from the reactor control room.

It seems that the process of upgrading the NRR facility physical protection is in the proper direction. But for further development, an intrusion detection system may be considered [1,3].



1. Fence Perimeter & Illumination
2. Guards Local Center
3. Vehicle Entrance
4. External Personnel Entry Control
5. Facility Entry Control
6. Video Surveillance System
7. Inner Area
8. Intrusion Detection System

Fig. 1: Schematic diagram of the upgraded physical protection system for an old nuclear research reactor facility.

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STRATEGIES TO REDUCE ILLICIT USES OF RADIOACTIVE MATERIALS THE ETHIOPIAN PERSPECTIVE

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1.0 SYNOPSIS

The illicit uses of radioactive sources can impose a direct danger to public health and safety. A number of cases worldwide have resulted in ionizing radiation exposures to individuals.

Although the incident of illicit trafficking is greatly influenced by the national system of protection of radioactive materials at their use and storage location this alone may not ensure an absolute guarantee against such occurrence.

The challenges of preventing illicit uses of radioactive sources and activities is more complex in the face of more integrated global economic environment. The national system of control, the cross border involvement, multiplicity of participants in the supply to end-use chain, diversity of systems and instruments are factors contributing to this complexity.

Smooth interplay and overall systemic effectiveness of the national system of regulatory control, the strategic coordination of responsible parties and the systemic tie of such bodies, the efficiency of information flow and the pattern of know-how and training is what ensure the effectiveness of preventing, detecting and responding to any illicit activities and trafficking of radioactive sources.

In Ethiopia, the attempts /incidents of illegal use were so far limited. However, the possibility of such occurrence cannot be ruled out and due attention should be paid as the activity is complex and is global problem of general concern. Therefore, in addressing these issues the following strategies are believed appropriate in Ethiopia's perspective for preventing and controlling illicit uses and trafficking of radioactive materials.

- Strengthening the national system of control and protection including boarder controlling;
- Achieving effective coordination within and among regulators, law enforcement bodies and customs;
- Developing and maintaining effective system of information handling and flow;
- Training of principally responsible parties in the prevention, detection and response to illicit trafficking.

The proposed paper deals on the details of the recommended strategies pertaining to the realities and conditions of Ethiopia.

ASSISTING EASTERN EUROPEAN COUNTRIES IN THE SETTING UP OF A NATIONAL RESPONSE TO NUCLEAR SMUGGLING.

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Introduction

Since the mid-90's, ITU assisted national authorities in revealing the intended use and possible origin of seized nuclear materials. Existing tools, used in the characterisation of nuclear fuels, were adapted to this task; other analytical techniques, together with an appropriate methodological approach were developed (see I. Ray et al. presented to this conference). From a joint effort within the International Technical Working Group on Nuclear Smuggling, a Model Action Plan resulted, which included the Nuclear Forensic Methodology as developed by ITU, as a complementary measure to assist a state. In the frame of TACIS/PHARE support, we tested this concept together with the concerned authorities of the Czech Republic, Hungary, Bulgaria and the Ukraine. Based on the above, a new initiative is being developed for all thirteen future Member States to the European Union. A general meeting to start-up the support projects, organised at ITU on November 9 and 10, 2000, and was attended by two representatives per country. All presented their national situation with respect to nuclear smuggling (real cases, response...) and committed to support the implementation of a structured approach to both improve the national situation (and bring it up to international standards) and to seek for cross-border collaboration.

Past experience in the characterisation of seized nuclear material

In order to characterise material to the required extent a new methodology - nuclear forensics - had to be developed. The methodology followed the principle of diagnosis; i.e. the progressive steps of the investigation were guided by the results of the preceding steps, according to which the tools and techniques for the further investigation were selected. See paper presented by I. Ray during this conference.

Experience in implementing the Model Action Plan by running demonstration exercises

The portable U/Pu gamma spectrometer, delivered in the frame of a Phare project, was used in Hungary in a complex exercise aimed at demonstrating the full procedure of response to a seizure of nuclear material of unknown origin at a simulated Hungarian border checkpoint. This demonstration exercise was organised and guided by the Hungarian Atomic Energy Authority calling on intervention of the Hungarian border guards, customs, and police. For the first on-site analyses experts from the Frederic Joliot-Curie National Institute for Radioprotection and Radio-hygiene and for on-site characterisation experts from the Institute of Isotopes and Surface Chemistry of the Hungarian Academy of Sciences were involved (Fig. 1).

Fig. 1. L. Lakosi and J. Zsigrai (spectrometrists from the Institute of Isotopes of the Hungarian Academy of Sciences, Budapest) performing non-destructive categorisation using a portable gamma spectrometer.

In a TACIS project on counteracting the illicit trafficking of nuclear materials in the Ukraine in collaboration with the Ukrainian Ministry for Environmental Protection and Nuclear Safety a Handbook for the Ukrainian Nuclear Regulatory Administration on the appropriate response procedures, in line with the Model Action Plan of the International Technical Working Group, was developed in collaboration with the Finnish Radiation and Nuclear Safety Authority (STUK). In order both to gather the essential input for this handbook and to validate the initial procedures, a demonstration exercise was organised in Odessa, using seized material. The detection, radioprotection, criminal investigation and nuclear material characterisation were executed on the spot, involving all relevant authorities and using highly sensitive mobile equipment for the determination of the isotopic composition of the real material. Western participants came from IAEA, Scotland Yard, STUK and ITU. (fig 2) For this exercise the portable equipment was brought to the spot by the ITU representatives and operated by the trained spectrometrists from INR. Some INR personnel received further training at ITU on nuclear analytical techniques for the more detailed (destructive analytical) investigation of the material, after transport by IAEA of a representative subsample to ITU.

Fig 2 : A. Berlizov (Institute for Nuclear Research, Kiev) and T. Honkamaa (Finnish Radiation and Nuclear Safety Authority) measuring enriched U pellets with a portable gamma spectrometer and verifying absence of neutron irradiation

Assistance to national response plan

Summary

The paper will report the experience gained in the implementation of the national assistance projects, including the detailed assessment of the national situation compared to the ITWG Model Action Plan, the upgrading of the technical skills, the training of national experts and the joint analysis of nuclear material at ITU. The status of the work with the 13 future Member States to the European Union will also be reported on during the conference.

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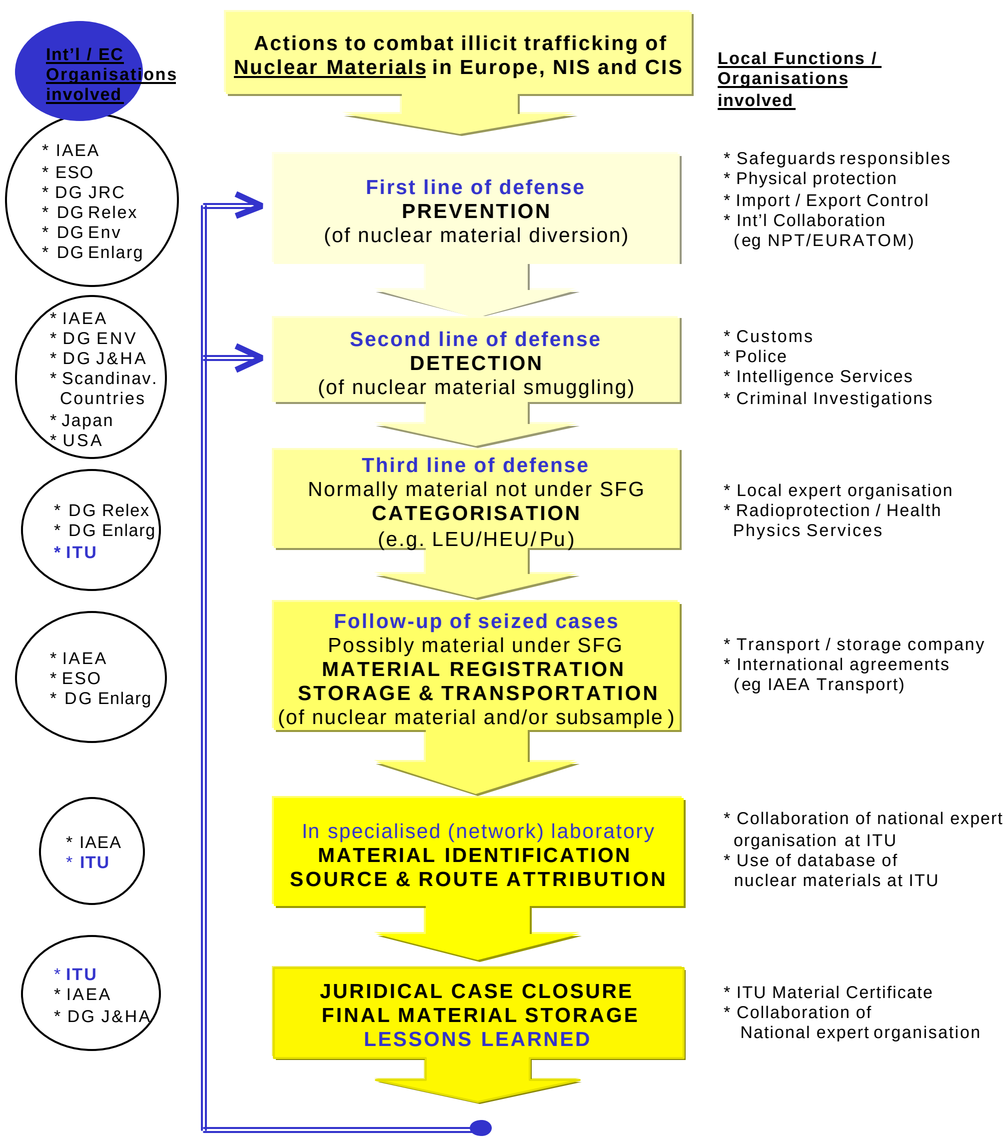
The objective of the recently started projects at ITU with all future Member States to the European Union is to assist the countries in combating illicit trafficking of nuclear materials according to the following scheme:



ASSESSMENT OF PHYSICAL PROTECTION SYSTEMS : EVA METHOD

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CEA's missions in various sectors of activity such as nuclear, defence, industrial contracts and the associated regulatory requirements make it necessary to develop a strategy in the field of physical protection. In particular, firms having nuclear materials are subject to the July 25, 1980 law n°80-572 on the protection and control of nuclear materials. A holding permit delivered by the regulatory authority is conditioned to the protection, by the operator, of the nuclear materials used. So in France, it is the nuclear operator who must demonstrate, in the form of a security study, that potential aggressors would be neutralised before they could escape with the material.
To meet these requirements, we have developed methods to assess the vulnerability of our facilities.

The EVA method, the French acronym for "Evaluation de la vulnérabilité des Accès" (Access vulnerability assessment) allows dealing with internal and external threats involving brutal actions. In scenarios relating to external threat, the intruders get past the various barriers of our protection system, attempting to steal a large volume of material in one fell swoop and then escape. In the case of internal threat, the goal is the same. However, as the intruder usually has access to the material in the scope of his activities, the action begins at the level of the target. Our protection system is based on in-depth defence where the intruders are detected and then delayed in their advance towards their target to allow time for intervention forces to intercept them.

To assess facility physical protection system, we start to make a crossing means model of the various protection barriers.
Then, the assessment after having found the various ways to reach the target, consists of the calculate of:

- the probability of intercepting intruders,
- the probability of detecting intruders,
- the margin or the delay of the intervention force,
- the critical detection point,
- the most vulnerable passage areas.

The critical detection point is the last detection point allowing to intercept intruders on their path.

Our Physical Protection Laboratory measures indispensable parameters for the use of our methods :

- penetration time of various obstacles that delay the intruders in their progress. This time depends particularly on the characteristics of the obstacle (structure, materials) and the intruders 's tools.
- intrusion detection probabilities corresponding to the various sensors in their conditions of use.

Today, we have realised more than 200 tests (fig. 1) with various obstacles (fences, walls, windows, doors, roof, …) to know the penetration time using various tools kinds (thermal cutting torch, explosives, …) and with various detectors (video motion detection, active infrared sensors, fence sensors, interior motion sensors, …) to know the detection probabilities using various penetration means (cutting of a manhole, jumping, climbing, …).

We have developed the EVA software associated with this method. It allows users to take advantage of the convenience of computer tools : processing of a large number of scenarios, rapid modification of parameters, simulation of situations like the protection strengthening effect with a view to optimise the cost-efficacy ratio or the protection deterioration effect and check the breakdown measure efficacy.

This software is very user-friendly. It operates under Windows on a simple office computer and its use is no more complicated than that of a simple calculator (fig. 2).

Our physical protection system assessment methods are tools :

- which allow an homogeneous treatment of facilities security,
- which reduce assessment subjective aspect,
- for help to take decision for conceivers, nuclear operators, analyst.

The EVA method is appreciated by the nuclear operators for its simplicity to use and its high teaching qualities. The tree aspect of the protection appear very clearly : detection, intruders penetration time and intervention force time.
So, its use facilitates the security various actors implication in the analysis process. That is essential to get good results and to acquire a security coherent culture.

fig. 1 : Intrusion test :
attacks on standard doors (2 metal sheets - thickness : 3 mm)
Adversary : one man
Techniques : realisation of a manhole (40 cm x 40 cm)
Tool : thermal cutting torch
Result : penetration time

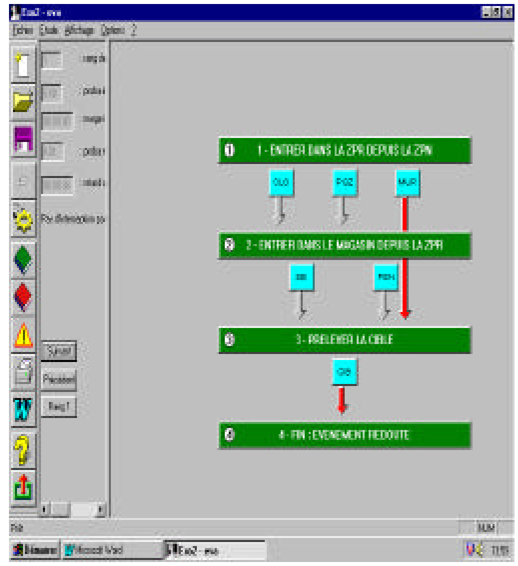

fig. 2 : EVA Software :
Diagram of a hypothetical facility with various ways to reach the target, probability of detecting intruders, probability of intercepting intruders, margin or the delay of the intervention force, critical detection point, most vulnerable passage areas.

PROTECTION OF NUCLEAR INSTALLATIONS AND MATERIALS AGAINST MALEVOLENT ACTIONS

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The approach adopted, in France, for considering malevolent actions affecting the design and operation of nuclear facilities is aimed at determining the extent to which the facilities are protected.

When carrying out these studies, operating organizations have to demonstrate that they are complying with the objectives set by the Competent Authority for reducing the risk of internal or external malevolent actions.

The operating organization studies are assessed by the technical support body of the Competent Authority. The technical support body submits the assessments to an interministerial advisory group that sends its comments and any specific technical instructions which may be necessary to the Competent Authority.

The approach to be followed can be summed up as follows:

1) The sensitivity of each zone is determined; this can be characterised by the level of the radiological consequences resulting from a malevolent action. Sensitivity is determined by taking into account :

   - the radioactive product inventory,
   - possible accident situations,
   - an estimate of the consequences of these accidents.

Depending on the gravity of the consequences of a malevolent action, three types of zone have been defined :

- zones or systems at risk, when an action is not serious enough to lead to radiological consequences; to cause a significant accident, at least two zones or systems at risk have to be affected,
- critical zones or systems, when an action leads to radiological consequences deemed acceptable from a safety point of view.
- vital zones or systems, when an action leads to more serious radiological consequences than those taken into account in the safety case.

2) The vulnerability of the various zones to each type of aggression is estimated, in other words, an estimate is made of the extent to which it is difficult to carry out a malevolent action in the zone in question.

The vulnerability assessment of the zones and systems identified previously can be broken down into two parts:

- an estimate of the resources required to destroy or sufficiently damage a system or function (for example, the quantity of explosives necessary),
- qualification of the paths leading to zones or systems deemed sensitive.

3) If need be, counter-measures are taken to protect zones for which the consequences would be unacceptable compared to the force of the aggression. Counter-measures are intended both to minimise sensitivity and make it more difficult to carry out the aggression envisaged.

Several types of threats have been identified for the purposes of these studies:

- Internal threats involving actions taken by insiders acting alone or not.
- External threats involving actions by small group of attackers. Two assumptions are made when testing the ability of protection systems to counter aggressions of this type. The first involves a small team of attackers with limited resources, and the second takes into account a larger team with more sophisticated resources.

Assumptions are also made as to the types of action which could be taken by malevolent workers in sensitive zones and the aggravating factors to be considered. As an example the loss of the offsite power supply could be taken into account.

Acceptable consequences are taken as being those leading to levels of radioactive releases less than, or equal to, those taken into account in the facility safety case. This implies that vital zone vulnerability be reduced to a minimum so that an excellent level of protection can be provided for these areas. In the case of critical zones, the level of protection is considered on a case-by-case basis, depending on the consequences of malevolent actions.

Finally, the paper will describe the concrete case of a nuclear installation. Emphasis will be paid on the defence in depth approach organized around prevention, management and mitigation measures.

THE FINANCIAL IMPLICATIONS OF CERTAIN TYPES OF CROSS-BORDER POLLUTION: THE POLLUTER-PAYS PRINCIPLE

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Abstract

Favorable Paris Convention regulations: absolute liability, exclusive liability, channeling of liability to the operator in case of nuclear damage, financial security, limited maximum liability, single legal forum, ten-year time limit.

Difficulties of application for certain types of cross-border pollution not covered by the Paris Convention: so-called orphan sources (stolen, lost, or abandoned sealed sources or confiscated contaminated metallurgical scrap).

Benefits of the polluter-pays principle: identification of the polluter, identification of the holder of the polluted materials, responsible parties held accountable, financial reparations.

Analysis of the polluter-pays principle already recognized in numerous international texts on environmental law.

1. INTRODUCTION

In the United States in 1957 and then in Europe in 1960, a special régime for third-party nuclear liability was developed for the first time and integrated into law and convention (the Price-Anderson Act in the United States and the Paris Convention in Western Europe). As underscored by the Paris Convention's guiding principles, this unique set of regulations governing nuclear liability was needed because ordinary common law was not well suited to dealing with nuclear energy's particular problems. Indeed, if ordinary law were applied, several different people might be held liable for the damage caused by a nuclear incident, and the victims would likely have great difficulty establishing who was, in fact, liable.

To summarize briefly, the Paris Convention is characterized by the operator's **absolute** (fault does not have to be established) and **exclusive liability** (this is channeling) in case of nuclear damage. As a result of these clear principles, the operator who internalizes his risks maintains adequate insurance coverage or other **financial security** and benefits from **limited aggregate liability**. Likewise, claims for damages are presented before a **single legal forum** (unity of jurisdiction) **within ten years** (rather than the thirty years accorded under ordinary common law) after the nuclear incident.

If the Paris Convention's special régime ensures adequate compensation for victims of nuclear incidents occurring in a nuclear installation (or during transport of nuclear materials) and causing damages to the environment of the country within which the incriminated installation is located, as well as beyond its borders, the fate of victims of certain specific types of cross-border pollution, whose consequences are not entirely covered by the implementation of this convention, remains unclear.

Thus, this presentation will address the legal and financial ramifications of so-called orphan sources (for example, stolen, lost, or abandoned sealed sources or confiscated contaminated metallurgical scrap) for which the polluter-pays principle could prove to be a valuable tool.

The international conference organized by the IAEA in Dijon, in September 1998, allowed us to consider the financial consequences of the detection and seizure of illicit radioactive materials[1]. The seminar organized by the United Nations Economic Commission in Prague, in May 1999, provided an opportunity to analyze the practical application of current regulations to the movement of metallic substances contaminated by radioactivity[2]. This international Conference organized in Stockholm by the IAEA, affords us an opportunity to reflect more deeply on the financial implications of certain types of cross-border pollution and the polluter-pays principle.

2. SIGNIFICANCE OF CROSS-BORDER POLLUTION

Failure to respect the regulations governing radioactive substances is apt to affect the territory of two or more nations. This is what the OECD calls “cross-border pollution” or a “transfrontier accident.” The evolution of this concept of **long-distance pollution** (more than 30 kilometers beyond a border) is a result of the ability to detect pollution at greater distances. Consequently, the law's basis for intervention must be the phenomenon itself and not just the geographical area in which it is produced.

According to a generally recognized principle, States exercise sole jurisdiction over their own territory. When acts originating in one State cause damage or potentially threaten the sovereignty of another State, a conflict between those States arises. Thus a State is strongly tempted to argue its right to absolute sovereignty over its own territory. **But the State whose territory sustains the financial consequences of pollution has no less a right to demand reparations.**

First of all, it is naturally up to the various parties involved **to prevent cross-border pollution** and, failing that, to make provisions for reparations.

There are numerous situations in which no claim or legal proceeding is likely to be pursued. The financial damage sustained may not appear, at first glance, to be sufficiently serious. **The determination of liability may not be properly handled.** As a result, claims for damages would lack a solid legal basis and thus have little chance of success. Finally, legal action might be opposed in the interests of political order. States that can, by turn, appear to be either polluters or victims of pollution
stand united. International responsibility is then difficult to invoke, even when pollution results from a lack of knowledge about conventional obligations.

If the pollution is serious enough to cause significant damage, there are likely to be many injured parties in both the public and private sectors. That being the case, any number of liable- and injured-party combinations would be possible. **Depending on the nature of the parties involved, the situation could fall under the jurisdiction of either national or international law.** In some cases, after exhausting internal avenues of recourse, a case could be taken to an international court. In addition, several commercial enterprises could be implicated in varying degrees without its being possible to determine their actual level of responsibility.

Finally, issues of the pollution's origin and of unidentified responsible parties obviously raise the question of indemnification. Metallurgical scraps contaminated by previously uncontrolled radioactive sources well illustrates the difficulties encountered. The same problem is posed by agricultural products coming from a third country affected by the provisions of the July 27, 1999, (EC) regulation no. 1661/1999.

3. ANALYSIS OF THE POLLUTER-PAYS PRINCIPLE

Identification of the polluter must first of all determine who caused the pollution, be that the producer or the party actually in possession of the source of pollution. Once the responsible party has been identified, the question of **form of indemnification** arises. Compensation may be in-kind reparations or the payment of a sum of money to the public authorities charged with handling the matter.

The **level of payment** must be determined. The polluter may only be required to pay for the measures that need to be taken in order to achieve an acceptable level of pollution (the standard Polluter-Pays Principle). The polluter might also pay a sum needed to cover the social damages resulting from an acceptable level of pollution (the extended Polluter-Pays Principle). Originally, the polluter-pays principle only covered the cost of preventive measures related to administrative demands (surveillance, inspection, authorization régimes, etc.) and the cost of curative measures. **The current tendency is to expand the costs charged to the polluter in order to internalize costs more completely.**

Recognition of the polluter-pays principle fulfills four main functions. The **economic integration function** aims, first of all, to ensure that the rules of free competition are respected. In order not to upset the market's rules, subsidies must not be accorded to businesses that do not respect the norms of safety and security.

The **redistributive function** of the principle rests on the idea that the polluter must assume the costs of pollution prevention and control established by public authorities.

Through its **preventive function**, the polluter-pays principle can contribute to the reduction of pollution. From an economic point of view, polluters must be motivated to reduce pollution by making the cost of polluting outweigh the benefits derived therefrom. Application of this principle must motivate the
polluter, within the framework of a self-regulatory system, to assume responsibility for taking the measures needed to reduce the pollution he creates.

Finally, the **curative function** can guarantee full compensation for damages sustained and hasten the payment of damage claims by ascertaining the responsibility and liability of the holders (receivers) of these polluted materials.

Application of the polluter-pays principle can, however, encounter a certain **number of obstacles**.

The Rio Conference's declaration on environment and development recognizes the polluter-pays principle in principle 16. However, this United Nations declaration expressly states that ***the implementation of this principle must not distort international trade and investment.***

Despite what appears to be its constraining nature, implementation of the polluter-pays principle may be moderated by invoking an **Act of God or the intervening act of a third party (*la force majeure*)** and, to a lesser extent, **necessity**. An Act of God is a situation in which an unforeseen event, beyond one's control, makes it impossible to meet one's international obligations. No one can be expected to do the impossible. On the other hand, necessity is a situation in which one is able to meet one's obligation but at a cost requiring heavy sacrifices that surpass common practice. Recourse to necessity can amount to same thing as invoking extenuating circumstances.

4. CONCLUSION

The neighboring States affected by cross-border pollution must first of all be notified with utmost urgency so that they, too, can analyze the financial consequences of the losses sustained and take the necessary protective measures. International collaboration is then necessary in order to evaluate the facts gathered and communicated. International assistance must also allow us to identify the principal parties, especially in cases involving several parties located in different States. The consultation principle must be recognized, with a view toward allowing the injured parties to follow the compensation process. **Finally, international cooperation should facilitate the recovery of damage claims.**

The logic of indemnification often runs up against with the difficulty of allocating pollution clean-up costs to the responsible parties. **The polluter-pays principle**, however, is not intended as a substitute for the normal criteria of liability in the nuclear sector. **It has a highly symbolic value. It also better takes into account the financial costs of pollution. Its recognition in texts in the nuclear field could constitute a guiding principle that would contribute to more appropriately assigning responsibility to the various parties involved.**

The opinions expressed herein are the author's alone and require further collective consideration.

[1] Proceedings Series Safety of Radiation Sources and Security of Radioactive Materials - IAEA Vienna 1999 p. 362 ; IAEA-TECDOC-1045/CN-70/11 - September 1998 ; IAEA Safety Standard Series Draft Safety Guide Preventing, Detecting and Responding to Illicit Trafficking in Radioactive Materials N S 61 - 1998-12-29

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SECURITY STUDIES

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Security studies constitute one of the major tools for evaluating the provisions implemented at facilities to protect and control Nuclear Material against unauthorized removal. Operators use security studies to demonstrate that they are complying with objectives set by the Competent Authority to counter internal or external acts aimed at unauthorized removal of NM. The paper presents the context of security studies carried out in France.

The philosophy of these studies is based on a postulated unauthorized removal of NM and the study of the behavior of the systems implemented to control and protect NM in a facility

The potential unauthorized removal of NM usually may take place in two stages. The first stage involves the sequence leading to handling of the NM. It occurs inside the physical barriers of a facility and may include action involving the documents corresponding to Material Control and Accounting systems. At this stage it is possible to limit the risk of unauthorized removal of NM by means of detection capabilities of the MC&A systems. The second stage is more specific to theft and involves removing the NM out of the physical barriers of a facility in which they are being held, notably by affecting the Physical Protection System.

Operators have to study, from a quantity and time lapse point of view, the ability of the installed systems to detect unauthorized removal, as well as the possibility of tampering with the systems to mask unlawful operations. Operators have also to analyze the sequences during which NM are accessed, removed from their containment and further removed from the facility in which they are stored. At each stage in the process, the probability of detection and the time taken to carry out the above actions have to be estimated. Of course, these two types of studies complement each other.

Security studies have begun, in France, for more than fifteen years. Up to now more than fifty security studies are available in the field of PP and most of them have been revised at least once. They have been produced by the French Operators, assessed by the IPSN and approved by the French Competent Authority. They are mandatory as far as PP is concerned for NM held in category I facilities. To go ahead preliminary security studies in the field of MC&A have been performed by operators of two different types of facilities, the results of which are very encouraging.

In the field of PP, security studies are based on an analysis consisting in grouping together all the possible paths leading to NM in compliance with a set of threats. Diagrams could be used to show which actions have to be taken to successfully carry out the theft of NM. This may involve crossing zones or outwitting detection devices and overcoming obstacles. By following the diagrams mentioned above, the probability of undetected persons or nuclear materials as they progress in the facility is evaluated. The relevant criteria to assume that the theft has been detected is determined. Then the time elapsing between positive detection of the action and the removal of the NM from the facility is estimated. This estimate is based on documented data and/or the results of tests carried out in the facility or elsewhere. Critical paths are taken as being those along which nuclear materials can be removed from the facility in the shortest time after detection. Special care is taken when analyzing these paths.

In the field of MC&A, when unauthorized removal or dysfunction occurs, a discrepancy appears between the physical reality of NM and the way in which it is represented in the MC&A systems. In the case of these studies, an assumption is made that such a discrepancy exists in compliance with a set of threats. Then, the purpose of the security study is to analyse the way in which the discrepancy is revealed in connection with a discovery threshold amount, if any. It should be noted that possible detection of the discrepancy by the physical protection system is not covered by such studies, since this type of detection gives no information on either the effectiveness or the reliability of the MC&A systems.

A critical scenario is defined as one which leads to discrepancies involving substantial amounts of NM or for which the detection delay is long. Special care is taken when analysing these scenarios. For critical scenarios, sensitivity analysis could be made to determine the smallest quantity of NM the disappearance of which could be detected or the criteria leading to the detection of the disappearance in the control system or in the accounting system.

The threats taken into account are identified with reference to the design basis threat specified by the competent authority. Both internal and external threats are taken in account. Internal threats are defined as attempts by insiders to steal quantities of nuclear material, either once or on several occasions; accumulating these quantities leads to a significant quantity of NM. External threats are defined as attempts by groups of aggressors to steal significant amounts of nuclear material. Two hypotheses are taken into account to test the ability of the physical protection system to counter threats of this type. The first is based on a small group of aggressors with limited resources and the second involves a larger team with more sophisticated resources.

Of course security studies have to be carried out in compliance with the corresponding confidentiality rules. In addition, such studies have to be regularly updated, notably if significant modifications are made in the MC&A or PP systems.

It is important that security studies are available in the facilities for competent personnel, as it gives the rationale behind control and protection of NM. In particular, it could be used, in a performance-based approach, to support analysis reports or to illustrate that the required level of security has been reached.

THE DECLARATION REGIME : AN EFFICIENT TOOL TO IMPROVE CONTROL AND PROTECTION OF NUCLEAR MATERIALS IN FRANCE

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The French government set up a national safeguards system under the authority of the Ministry for Industry to control nuclear materials within national boundaries and to ensure physical protection for nuclear materials, even for the small quantities held by users in industrial, medical and research areas.

The main nuclear materials detained by small owners are depleted uranium and thorium. These materials are present in manufactured equipments (radiation shielding in industrial gammagraphy and radiotherapy, collimation devices and other accessories) which are used or unused, which may be damaged or left as scraps.

The French protection and control system of nuclear materials is an original system based on detailed and comprehensive regulations, taking into account in a specific way the small users of nuclear materials.

The decree n°81-512 of 12 May 1981 establishes three different regimes : licensing, declaration and exemption, according to the nature and quantity of nuclear materials involved. Typically, the declaration regime applies to quantities of depleted uranium or thorium, greater than 1 kg and lower than 500 kg.

The Order of 14 March 1984 sets the requirements related to the control and physical protection of nuclear materials in the frame of the declaration regime.
A declaration must be established every year by the operator and sent to the IPSN, acting as technical support body of the national authority. This declaration provides the stock of all nuclear materials held by the operator and stock variations occurred during the previous year, including the identification of senders and receivers. Before fulfilling its annual declaration, the operator must carry out a physical inventory of all nuclear material, both used and unused. The declaration also describes the main features concerning facility layout related to surveillance and physical protection of materials.

With respect to physical protection requirements, nuclear materials should be kept under lock and key, and keys should be accessible to authorized personnel only. Alarm and gardiennage are not mandatory, but in some special cases, an alarm system has been required by the authority.

It should be noted that these requirements are very often the same than those set by national authorities dealing with sealed radioactive sources. In the case of operators using gamma radiography devices, several regulations regarding licensing of sealed radioactive sources users, radiation protection of public and workers, and environmental protection, require physical protection measures in order to prevent theft of radioactive sources and to ensure their protection against fire or other damages. Usually, the arrangements made by the operator for the protection of devices containing both a radioactive source and nuclear material comply with the requirements related to physical protection of depleted uranium.

This is not the case for empty devices whose radioactive source has been removed and for the accessories such as directional and panoramic collimators, transfer casks, trimmers, which contain DU and are not submitted to other regulations. Declarants are rended sensitive to that point in order they ensure the same level of physical protection to all devices containing DU, both used, useless or damaged.

As an example, gammagraphy operators should not store and leave without surveillance these type of accessories inside vehicles, as the risk of theft is significant.

In the medical field, trimmers may have been removed from the radiotherapy unit, and very often, shaping block made of DU, delivered with the unit, are not used by the medical personnel, because of their radioactivity. These items, containing a few kilograms of DU, have to be inventoried by the operators, labelled and kept under lock and key.

When possible, operators are invited to return unused and damaged equipment to the manufacturer.

In order to implement the declaration regime requirements, IPSN gathers all the declaration forms fulfilled by declarants. It allows to identify lacks of consistency in the stocks inventoried and declared by operators.

Implementation is also ensured by on-site inspections, carried out by sworn and accredited inspectors under the authority of the Ministry for Industry. Checks are carried out notably on the compliance of the physical protection arrangements made by the operator and on the exhaustiveness of physical inventories of nuclear materials. In this way, every year, tens of items and tens of kilograms of nuclear material (mainly depleted uranium) are put back into a controlled environment.

Even if the nuclear materials held by declarants are of low sensitivity as far as proliferation is concerned, a total absence of regulations on the low quantities concerned might lead to an increased attractiveness for unauthorized uses. The declaration regime is a balanced approach between exemption and licensing. Moreover, good practices in terms of control and physical protection of nuclear materials held by declarants reduces the occurrence of incidents related to losses or thefts of equipment or products containing nuclear materials.

THE GERMAN SYSTEM TO PREVENT, DETECT AND RESPOND TO ILLICIT USES OF NUCLEAR MATERIALS AND RADIOACTIVE SOURCES

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The German system to prevent, detect and respond to illicit uses of nuclear materials and radioactive sources consists of a variety of different elements:

- International and national laws and regulations covering safeguards, physical protection, and import/export control;
- Licensing and regulatory supervision of all activities related to nuclear materials and radioactive sources, including import and export;
- Responsibility of the licensee to ensure compliance with licensing conditions; sanctions.
- Law enforcement by police, security and customs authorities; prosecution and penalties.
- Detection of illicitly trafficked radioactive materials through intelligence and technical means; analysis capabilities.
- Response arrangements for normal and for severe cases of illicit use of nuclear materials;
- Participation in international programmes and POC-systems.

The Federal Republic of Germany is a federation of 16 States (called "Länder"); for constitutional reasons functions like licensing and regulatory supervision of most of the activities related to nuclear materials and radioactive sources, law enforcement, detection and analysis, and response (prosecution, hazard prevention) rest with State authorities; international obligations, import/export licensing and control, and licensing of nuclear transports are taken care of by Federal authorities.

Safeguards measures have been implemented in Germany in accordance with the Non-Proliferation Treaty and with safeguards agreements based on INFCIRC/153; they are going to be enhanced to meet the requirements of INFCIRC/540 (The Additional Protocol). As Germany is a member of the European Union, the Euratom Treaty and the Euratom-Ordinance Nr. 3227/76 together with the Verification Agreement between the IAEA, the European Commission and the European Member States have led to safeguards measures jointly implemented by the IAEA and by Euratom.

The relevant international law for the **physical protection** of nuclear material in force in Germany is the Convention on the Physical Protection of Nuclear Material; the categorization scheme for nuclear material contained in Amex II of the Convention became legally binding in Germany through the ratification process. The recommendations on physical protection objectives and fundamentals and on physical protection measures specified in INFCIRC/225/Rev. 4 have been taken into account in various national regulations pertaining to the national design basis threat, the physical protection of LWR nuclear power plants, of interim spent fuel storage facilities, of facilities containing category III material, of nuclear material and radioactive waste transports by road or railway vehicles, aircraft or sea vessels; additional guidelines cover requirements for security guards, physical protection commissioners and escort personnel, for reporting of security relevant events, and for advance notifications of shipment of nuclear material.

The relevant national legislation for the **licensing and supervision** of all nuclear activities and activities with radioactive sources are the German Atomic Energy Act and the Ordinance on the Protection Against Damage and Injuries caused by Ionising Radiation; a specific ordinance covers the security clearance for trustworthiness. The following activities need a license or authorization by the competent authorities: import/export of nuclear material, transportation of all radioactive substances, storage and use of nuclear and other radioactive substances, construction and operation of all nuclear facilities. Physical protection, including trustworthiness of all personnel, and safeguards measures are licensing conditions as far as nuclear materials are concerned; for radioactive sources security measures are required, including trustworthiness of relevant personnel. The respective licensee is responsible to ensure the implementation of the licensing conditions at any time; he is subject to permanent regulatory supervision by the competent authorities; for cases of non-compliance **sanctions** are specified in the national legislation, including administrative penalties, amendment or revocation of the license.

Additional legislation and regulations covering the **export** of nuclear materials and technology are the German Foreign Trade Act and the Foreign Trade Ordinance, supplemented by the Zanger Committee Trigger List and by the NSG Guidelines, Parts 1 and 2, as published in the IAEA document INFCIRC/254. The War Arms Control Act pertains to the export of weapons components and items usable for weapons construction. The export licensing authority is the Federal Office for Foreign Trade; it is supported by an interdepartmental advisory group. Compliance control of nuclear import and export activities with legal requirements is carried through at the national borders, at sea- and airports, and also inside the country by the Customs Border Control, and by the Customs Investigation Service.

Penalties for offences against nuclear laws and regulations, especially for any kind of illicit use of nuclear materials and radioactive sources, are stipulated in the German Penal Code. The penalties may range from fines to imprisonment for up to ten years, even up to lifetime imprisonment in very severe cases. Criminal investigations will be carried through by State and – in special cases by the Federal – Criminal Investigation Offices; in addition, the Customs Crime Office has a wide competence for criminal investigations of its own.

Detection of cases of illicit use of nuclear materials or radioactive sources will be either through intelligence and criminal investigation activities, also making use of under-cover agents and of information available through intelligence services and other security authorities. For the detection of radioactive substances by technical means, the police and the customs authorities are equipped with hand-held detectors and car-mounted systems. They will be supported by the radiation protection authorities with sophisticated detection and analysis systems. An in-depth chemical and physical analysis of confiscated nuclear material will be made by the European Institute for Transuranium Elements, of other radioactive materials by university institutes or nuclear research centres.

Regulations and recommendations for the joint **response** of State and Federal authorities (nuclear supervisory and radiation protection authorities, law enforcement and customs authorities, explosives disablement services, fire brigades, etc.) in cases of illicit use of nuclear materials or radioactive substances are in place. They cover the assignment of responsibilities and tasks, coordination and leadership, communication links, reporting and alerting procedures and systems; they pertain to search, detection, safe access, analysis, estimation of radiological consequences, mitigation of radiological consequences of disablement, storage of seized material [1]. In severe cases, the interdepartmental coordination group on State level may be assisted by a Joint Staff on Federal level, which could deploy a Federal Support Group formed out of experts from the Federal Office for Radiation Protection, the Federal Office for Criminal Investigation and the Federal Border Police; this group is especially equipped and trained.

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PHYSICAL PROTECTION NUCLEAR FACILITIES AGAINST SABOTAGE

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INFCIRC 225 Rev. 4 has introduced the Design Basis Threat, DBT, as a key element of the states physical protection system. The DBT is a definition which determines the level of physical protection of nuclear material during use, storage, transport and of nuclear facilities. It the basis for physical protection concepts and for the design of measures the operator or licensee has to provide. By this means it is also a definition of the responsibility for the physical protection which the operator accepts with the license.

The new chapter designated to the physical protection against sabotage which has resulted also in the amendment of the title in INFCIRC 225 demonstrates the grown international concern about the potential consequences of sabotage.

More than the physical protection against unauthorized removal the physical protection against sabotage has interfaces with the nuclear safety field. The basis of protection against Sabotage therefore is much more based on the facility design-the safety design of the facility. Using the DBT the competent authority is in the position to determine the level of protection against sabotage and the remaining risk which has to be accepted.

This risk of course depends on the real threat which is not known in advance. The acceptance of the remaining risk depends on both the assessment of the threat, its credibility and the potential consequences. There has been no serious act of Sabotage in the past nor an Attempt of. Despite of this the Hamun attack of the Japanese underground and some other recent terrorist activities could have given reasons to reconsider what threat might be credible.

The German physical protection System has been developed since the increasing terrorist activities in the 1970ies. From the beginning the protection against Sabotage played an important role in the German system of Physical Protection. The requirements for the physical protection against unauthorized removal and against sabotage were defined by “Security Categories”. This method of categorization took into account the attractiveness of the nuclear material for unauthorized removal and the potential radiological consequences of an act of sabotage against the material directly or against the facility where the material is used or processed.

Category I nuclear material and nuclear power plants were assigned to the “Security Category” which required the highest level of physical protection. This level was defined by required measures in a “Security Measure Catalogue”. These requirements were based on a certain model of potential adversaries, the DBT. Having the DBT translated into a number of requirements it was a so called compliance based approach.

This system was changed because this approach lacked of flexibility and did not fit with categorization table in the CPPNM. The Catalogue system was replaced by guidelines considering the actual main nuclear activities in Germany which are the operation of light water NPP’s and transport of fresh and spent fuel.

In the guideline for the physical protection of NPP's with light water reactors based on a safety analysis a specific objective is defined which requires the protection of certain functions concerning cooling, power supply and integrity. The way how to protect these functions and on which level is a result of the application of the DBT.

An attempt of sabotage might be successful by a destruction of certain vital equipment only. In this hypothetical case only the consequences of a sabotage can be mitigated. That is one of the important differences to the protection against unauthorized removal of material. In order to give the response forces a realistic chance to terminate an attempt of sabotage in time which might be performed by outsiders the measures of prevention and delay - that means on site measures - become of more importance.

Concerning the protection against malevolent acts by an Individual from inside a facility the number of interfaces to the safety design, the industrial safety, radiation protection increases very much. Also here the DBT is a tool to organize or if necessary to modify the existing measures which are originally not designed against an insider but can used against an insider and to identify areas where additional measures have to be provided.

The presentation will give some examples of the German approach to achieve the necessary physical protection against sabotage and will give a view on efforts and problems of elder facilities to prove sufficient physical protection against the actual DBT.

DETECTION OF SMUGGLING OF NUCLEAR MATERIAL COVERED BY A LEGAL TRANSPORT OF RADIOACTIVE MATERIAL

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One of the worst scenarios for detection of illicit trafficking of nuclear material is when a legal transport of radioactive material is used to cover the radiation of the smuggled uranium. Feasibility study was performed in the Institute of Isotopes and Surface Chemistry of the Chemical Research Centre of the Hungarian Academy of Sciences (hereinafter: Institute) in order to study the possible on site measurement techniques and approaches applicable in such cases.

As the type A and type B packages always incorporate a feature such as a seal, in a realistic scenario the confiscated nuclear material is expected to be placed outside the package. The passive neutron emission of the uranium is negligible for a reasonable isotopic abundance therefore the feasibility study was concentrating on non-destructive, passive gamma-spectrometric methods. Possible application of NaI (∅40x40 mm^3), large planar (15x15x3 mm^3) and a hemispheric CdZnTe (500 mm^3), and high purity Germanium detectors was investigated. During the on site measurements portable electronics, mini multichannel analyzer, palmtop and/or notebook computer were used. The shielding material of the packages was lead or depleted uranium.

The smuggled material was simulated by a package of reactor fuel pellets containing low enriched or natural uranium (materials confiscated in earlier cases) and standards containing low enriched uranium.

During the supposed scenario the portal monitor provides an indication of an elevated level of the environmental radioactivity. Then the responsible (e.g. customs) officer investigate the vehicle by a hand-held survey meter in order to search for peaks in dose rates. If a peak was localized, which is different from the position of the legally transported package(s) the officer requests for the expertise of the designated institutes.

The following model cases provided the basic conclusion:

1. The legal transport of the radioactive material was simulated by a 4.8 TBq ^{192}Ir source in a depleted uranium shielding and by a 17.25 GBq ^{60}Co source in the same type of container. The confiscated material was simulated by a package of 0.809 kg UO_2 (pellets) containing natural uranium, and by another package of 1.712 kg UO_2 (pellets) containing low enriched (2 %) uranium. The "smuggled" nuclear material was placed beside the "legal package". Gamma spectra were measured by NaI and hemispheric CdZnTe detectors. The typical measurement time was in the order of 10 minutes. Based on the results the following first conclusions can be drawn:
   a) In the background of the container, containing the ^{192}Ir source (the surface dose rate was 40-50 μGy/h) the spectra taken by the NaI detector could not provide

significant indication for the presence of the "smuggled" packages containing natural or low enriched nuclear material. The spectra taken by the CdZnTe detector provided significant low energy (186 keV) peak. This conclusion remained valid for one pellet (15 g) as well.

b) Based on the measurements performed in the background of the container, containing the ^{60}Co source (the surface dose was 220 μGy/h) similar conclusion can be drawn, but the detection limit proved to be significantly higher.

2. The legal transport of the radioactive material was simulated by a 0.346 TBq ^{192}Ir source in a lead shielding. The confiscated material was simulated by two standards containing low enriched uranium (in the form of 200 g U_3O_8). Gamma spectra were measured by high purity Germanium planar detector (1000 mm^2 x 15 mm). Based on these measurements the following first conclusions can be drawn:

   a) In the background of the container, containing the ^{192}Ir source the low energy lines of the ^{235}U in measured spectra (144, 163, 186, 205) proved to be a reliable indicator of the presence of the "smuggled" nuclear material. In this case the determination of the isotopic abundance (based on intrinsic calibration method) provided an additional confirmation - and at the same time categorization - of the material. The detection limit is below 200 g.

   b) In the background of the empty transport container, containing depleted uranium as shielding material, similar conclusion can be drawn, but one should be careful concerning the categorization of the smuggled uranium, as the influence shielding material might distort the isotopic abundance.

Additional measurements were performed on different samples (including fertilizer containing potassium) and using some other detectors (e.g. planar CdZnTe detector with charge loss corrector circuit).

The most important conclusion of the feasibility study is, that gamma spectrometry can be considered as a promising tool for confirmation of the suspicion of smuggling of nuclear material covered by a legal transport of radioactive material. In spite of the lower detection efficiency, the higher resolution of the measured spectra provides significant advantages.

THE SAFETY AND SECURITY OF RADIOACTIVE MATERIALS

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The International Atomic Energy Agency has two complementary programmes relating to the security of radioactive materials. One finds its origins in the General Conference resolution in 1994, GC(XXXVIII)/RES/DEC(1994), on measures against illicit trafficking in nuclear materials. This resolution was undoubtedly an expression of the concern on the matter that arose following the break-up of the Soviet Union. The other is an integral part of the broader programme of radiation safety, which, in essence, finds its origins in the statutory functions of the Agency. Article III, part A.6 of the Statute states that the Agency is authorized 'to establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, standards of safety for protection of health and minimization of danger to life and property … and to provide for the application of these standards …'.

The objectives of the first programme are to improve Member State's ability to protect nuclear materials and other radioactive material from sub-national, terrorist or unlawful activities that could impose a non-proliferation threat, or that could endanger health and safety, and to provide Member States with the knowledge and tools for detecting and responding to such unlawful incidents. Specifically, with radioactive materials, the objective is to assist Member States in their efforts to prevent, detect and respond to illicit trafficking in such materials.

The statutory function regarding the establishment of safety standards and providing for their application has been taken seriously by the Agency since its inception, the first part being expressed particularly in the Basic Safety Standards. The Board of Governors first approved radiation protection and safety measures in March 1960 and the first basic safety standards in June 1962. Since then, there has been a number of revisions; the latest standards giving the basic requirements that must be satisfied to ensure safety for particular activities or application areas where published in 1996 as the International Basic Safety Standards [1]. These standards are supported by safety guides, which provide recommendations relating to the fulfilment of the basic requirements; safety reports, which provide practical examples and detailed methods that can be used to apply the standards or guides; and other documents.

In spite of the existence of such safety documents, radiological accidents have occurred in various parts of the world. In recent years, there has been a growing awareness of the potential for accidents with radiation sources, particularly those containing radioactive materials as sealed sources. Some of these accidents have had serious, even fatal, consequences. A number has their origins in the inadequacy of security measures and have involved members of the public or workers who unknowingly have come into contact with the radioactive sources. As sources may be transported across borders, the problems associated with them may not necessarily be confined to the State in which they were originally used. There are instances where discrete sources have become mixed with scrap metal. Because of the substantial international trade in scrap metal, this particular aspect of the problem has become a matter of major concern.

The term 'orphan source' has now crept into common usage to indicate a source that was never subject to regulatory control, but should have been, or that was subject to such control but had been abandoned, lost, stolen, removed without proper authorization, or otherwise misplaced.

It is important to recognize the difference between this problem and that of illicit trafficking in radioactive materials. Key differences lie in the intent of the persons involved, and the means of detection. Illicit trafficking usually associated with criminal intent to harm and is more effectively detected via the use of intelligence. Radiation monitoring and detection has a role in both fields and necessitates appropriate co-ordination between two complementary Agency programmes.

The concern over the 'orphan source' problem was expressed in General Conference resolution GC(42)/RES/12 in September 1998. During the following year, an *Action Plan* was prepared and this was approved by the Board of Governors in September 1999 and, shortly after, endorsed by the General Conference, in resolution GC(43)/RES/10. This *Action Plan* covers seven main areas regarding the safety and security of radioactive materials, including the problem of orphan sources:

- regulatory infrastructures;
- management of disused sources;
- categorization of sources;
- response to abnormal events;
- information exchange;
- education and training;
- international undertakings.

Each specific action under these main areas was placed in 3 sets. The first set of actions was required to begin immediately following adoption of the *Action Plan*; the second set within a year; and the third set after the categorization of sources, which is now complete [2].

The purpose of this paper is to report on the progress in the implementation of the *Action Plan*, to identify specific areas to which further attention is required, and to discuss a number of issues that have arisen.

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IMPROVEMENT OF EQUIPMENT NEEDED FOR THE DETECTION AND CHARACTERIZATION OF NUCLEAR MATERIAL AND RADIOACTIVE SAMPLES AT BORDERS

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Nuclear radiation measurement instruments and devices for the detection and characterisation of nuclear material and radioactive isotopes at borders play a decisive role in the set of technical measures needed to deal with the problem of illicit trafficking. Therefor the availability of a range of devices with adequate performance at affordable prices is essential.

The needed equipment can be classified into the following categories:

- Detection equipment (border monitors and radiation pagers)
- Hand held devices for neutron/gamma source search and in-field characterisation of radiation sources by customs inspectors
- NDA (non-destructive assay) instruments for in in-depth investigation of a seized item by experts either in the field or under laboratory conditions.

Instruments and techniques, which use destructive assay methods, are not considered in this paper.

The most recent overview on the performance of such instruments is given in the Final Report of ITRAP (Illicit Trafficking Radiation Detection Assessment Program, [1]). According to the findings of ITRAP, although in all above mentioned categories equipment is commercially available, deficiencies and shortcomings were identified.

In this paper we describe our effort in addressing some of the most essential equipment problems, identified in ITRAP – the sensitivity of border monitors with respect to the detection of nuclear material and the performance and usability of hand held and portable devices needed for in-field characterisation of seized items by customs inspectors.

The sensitivity of a border monitor is determined as a trade-off between the false alarm rate and the ability to detect low amounts of nuclear material in a short time. While in the gamma channel of the monitor the false alarm rate is mainly determined by changes in the natural (terrestrial) gamma background radiation, the false alarm rate of the neutron channel is impacted by neutrons induced by cosmic radiation in the detector structure and its surroundings. The cosmic neutron events have a time distribution which is normally much shorter compared to the minimum time resolution of the multi scanning scaler of the border monitor. Therefore short neutron events caused by cosmic radiation can be suppressed or eliminated by excluding short neutron spikes, which fall in single time channel. In the paper this concept is investigated, with respect to the obtained sensitivity gain for the detection of a weak neutron emitter in a short time interval.

Because of deficiencies in their performance, hand held isotope identifiers are presently seldom used by customs inspectors at borders. Therefor we have concentrated on the most pressing issues - improvements of isotope identification and of the usability. As shown in [2,3] the their performance could considerably be improved, if in conjunction with the scintillation detector, a CdZnTe detector is used. In this paper we compare different CdZnTe detector options with respect to their suitability to detect shielded sources and nuclear material masked by medical or industrial gamma emitters. Excellent results can be reported. CdZnTe detectors exhibit a good long-term stability, which allows their operation without a complicated peak stabiliser. Their good energy resolution allows detecting shielded and mixed gamma sources. As shown, e.g., on Figure 1, a shielded Pu source can be detected with a CdZnTe detector if used with optimised isotope identification software.

Since hand held gamma spectrometers are operated by non-experts in gamma spectrometry under field conditions, their user interface is important to make them acceptable. The results of a usability review, performed on two devices, have revealed design weaknesses and feedback and design guidelines are provided to the manufacturers.

We conclude, that more effort is needed to optimise instrument performance and to test the improved devices. The outline of a Co-ordinated Research Programme and that of a new equipment evaluation and test programmes as a follow-on of ITRAP, both being prepared at the Agency, are described.

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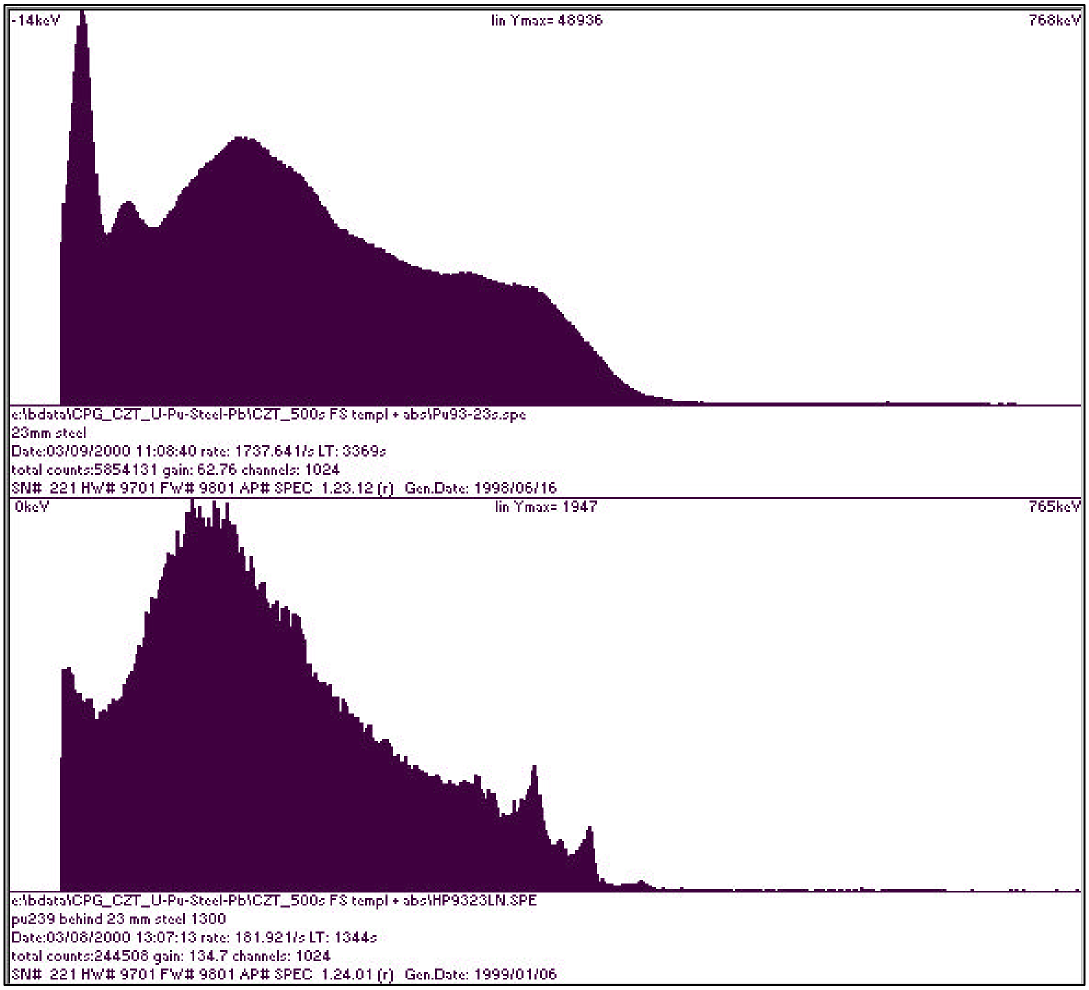

Figure 1 Comparison of gamma spectra of a Pu source (93% Pu-239; 23mm steel shielding) measured with NaI detector (upper trace) and with CZT/500 detector (lower trace). Only the spectrum taken with the CZT/500 detector shows enough gamma peak information which allows to identify Pu.

TECHNICAL CONSIDERATIONS FOR DETECTION OF AND RESPONSE TO ILLICIT TRAFFICKING IN RADIOACTIVE MATERIALS

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The need for guidance and recommendations explicitly directed to the problem of illicit trafficking in nuclear materials and other radioactive sources was raised by the IAEA Director General at the IAEA General Conference in December, 1994, and measures were agreed by the IAEA Board of Governors in March, 1995. Measures that might be taken to prevent, detect, and respond to illicit trafficking will be common for all radioactive materials, including nuclear materials. However, nuclear materials are, or should be, subject also to safeguards for nuclear non-proliferation purposes and to physical protection to prevent diversion. The IAEA has established close co-operation with intergovernmental and non-governmental organizations, in particular the World Customs Organization (WCO) and INTERPOL to conduct joint studies, meetings and training programs to support Member States in their border control activities. Within this programme technical information has been derived on requirements and methods to detect and respond to events involving inadvertent movement of and illicit trafficking in radioactive materials. The paper summarises the most important results and the experience obtained in this field.

Concerning "detection" information on strategy of detection, selection of an investigation level, techniques for radiation monitoring at borders, verification of alarms, search techniques and identification of radionuclides has been developed. This includes recommended minimum requirements for monitoring equipment, derived from the results of an extended international pilot study on border monitoring equipment ITRAP [1] [2], conducted by IAEA in co-operation with the Austrian government.

In order to discover illicit trafficking or inadvertent movement in radioactive materials, the following steps are required: detection of any abnormal radiation level, verification of such detection, localisation of the origin of the radiation, radiation safety measurement, and identification of the radioactive material. Specialised equipment is required for performing one or more of the steps indicated above, which can be divided into three categories: Pocket type instruments, used to detect the presence of radioactive materials and to inform the investigator about the radiation level; hand-held and mobile instruments, required to detect, locate or identify radioactive materials; and fixed installed, automatic instruments, designed to be located stationary at road and rail border crossings, airports, seaports, etc.

Detailed recommendations for technical specifications and operation of this equipment have been derived. A particular problem is the definition of an "investigation level", at which an alarm is triggered and consequent investigation of individuals, vehicles or goods should be established. This level has to be sufficiently high to avoid frequent false alarms, however, also sufficiently low to detect significant radiation sources or nuclear materials, even if they are inside shielded containers and possibly buried in metal scrap.

"Response" covers all necessary actions required after radioactive materials have been detected. Detailed recommendations have been derived for the procedures of operational response by the first responder, as well as for tactical response, when a serious radiological situation develops or detection of nuclear materials requires outside expert assistance.

Operational response, after activation of a detection alarm, initiates with the assessment of radiation hazard, verification measurements that the alarm is genuine and subsequent localisation of the radioactive material. If the radiological hazard is not to be considered very significant, i.e. if the dose rate is below 0.1 mSv/h at a distance of one meter from the item containing the source, no indication of neutron radiation is present and no suspicion of contamination exists, the first responder may continue to identify the radioactive material and determine, if it is illicit or "innocent". Innocent materials are typically medical radionuclides administered to patient, legal shipments or naturally occurring radioactive materials (NORM).

If the radiological hazard is significant, neutron radiation is observed. indicating the presence of nuclear materials or mechanical damage of the item containing the source raises suspicion of contamination, it will be necessary to adopt a tactical response mechanism. A detailed generic model has been developed for a tactical response plan including incident command structures, cordon control areas, casualty handling at the scene, requirements for seizure and temporary storage of radioactive materials, considerations on liaison with the media and incident investigation techniques.

Further important information relates to mitigation of health hazards, casualty management, needs for planning, equipment and training, transport arrangements for radioactive materials, decontamination procedures and hints for working with the media.

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SAFETY AND SECURITY OF RADIOACTIVE MATERIALS – THE INDIAN SCENARIO

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Introduction

There has been a phenomenal increase in the use of radiation sources in diverse fields such as medicine, industry, agriculture, research and teaching in India and elsewhere. Though the radiation safety record in these applications has been good, there have been a few incidents/ accidents during transport / use of radioactive materials. Current status and various aspects of regulatory control to ensure safety and security of radioactive material including incidents of missing/orphan sources in India are discussed in this paper.

Regulatory Infrastructure

Government of India enacted the Atomic Energy Act in 1962 to provide a regulatory infrastructure for control and use of radioactive materials and radiation sources. Radiation Protection Rules, 1971, were promulgated under this Act and Chairman, Atomic Energy Regulatory Board (AERB) was appointed as the Competent Authority to enforce these rules. Radiological Physics & Advisory Division (RP&AD) of Bhabha Atomic Research Centre provides technical and executive support to AERB in implementation of the regulations in the non-nuclear applications of radiation. Under the Rules, the Competent Authority has notified the surveillance procedures for various applications.

Various codes and guides on regulatory procedures relating to specific applications of radioactive material have also been issued by the Competent Authority. As per the regulatory procedures, each practice and source requires specific authorisation. The pre-requisites for the procurement of radioactive material for various applications are: (a) Approved source and equipment, (b) Approved installation, (c) Provision of an exclusive safe and secure storage facility for radioactive material when not in use or pending installation, (d) Trained manpower duly approved by the competent authority, (e) Radiation monitoring devices(area and personnel), (f) Emergency preparedness and (g) Commitment from the licensee for safe disposal of disused/decayed sources.

When the applicant complies with all the prerequisites for source procurement, the authorisation is issued with specific terms and conditions. Each source replacement , sale, transfer, transport and disposal requires a specific authorisation. In India, sources for all applications, are allowed to be imported only after obtaining prior permission from the regulatory authority. The user is required to submit safety status report with respect to the use of all radiation sources including physical inventory of the sources, at regular intervals to the Competent Authority as well as to RP & AD, BARC. For the spent/disused sources, the user is required to make sure that the sources are sent back to the original supplier and an undertaking to this effect is to be submitted to the competent authority. Full inventory of all radiation sources possessed by various users is maintained by RP&AD and updated regularly.

Incidents of missing/ orphan sources in various applications of radiation sources

In spite of regulatory procedures and inventory control in force, there have been a few cases of accidents/incidents involving missing/lost sources which might have ended up as orphan sources. The probable causes of these incidents are (a) unsecured temporary storage pending installation, (b) temporary suspension of the use of sources, (c) unsecured storage after decommissioning, (d) poor quality of labelling and marking on packages during their transport, (e) improper packages used for their transport, (f) temporary storage prior to disposal of sources, (g) illicit procurement of imported sources and (h) mobile /portable industrial radiography devices left unattended. The incidents which occurred during 1986-1999 in various applications of radioactive sources are presented in the following sections:

A. ***Industrial Radiography***

In India there are about 400 institutions spread among private and government undertakings engaged in industrial gamma radiography throughout the country. Remote operated equipment, imported as well as those indigenously fabricated, form the major support base for the use of ^{192}Ir and ^{60}Co sources. There are nearly 1100 radiography sources including 75 ^{60}Co units. These sources are used in about 500 radiography sites in India. About 800 radiography devices are annually transported for replacement and movement from one field radiography site to another by different modes such as air and road. There have been 43 radiation accidents in this field including loss of sources during use, storage and transport. Eighteen incidents relate to de-coupling or source getting stuck up in the guide of exposure device. Although most of them were of minor nature, a few of them resulted in radiation exposure to the exposed individuals. Analysis of these incidents reveals that there were 25 cases of missing radiography sources/equipment during 1986-99 out of which 28% (7 cases) relate to loss of sources due to improper transport, 20% (5 cases) relate to negligence of the operator during use and 52% (13 cases) relate to theft from the storage facility at the radiography sites. However, 13 sources could not be traced. In all the cases where the source could not be traced extensive search and interrogations were conducted before abandoning search operations so as to ensure that the source would not reach the hands of members of the public. In these cases, the chances of tracing the source are low mainly due to the delay in noticing/reporting the loss. From the above analysis, it is very clear that the improper storage or transport coupled with carelessness on the part of radiography personnel are the main reasons for the source loss. Among the possible incidents/ accidents, loss of radiography source needs to be viewed seriously because the source can readily get into the hands of members of public who may be totally ignorant of the hazards associated with radiation sources. The lost source, if not traced quickly, can lead to serious consequences.

B. ***Nucleonic Gauges/Well Logging Devices***

There are 6500 nucleonic control systems used in about 1100 institutions. ^{60}Co and ^{137}Cs sources are widely used in nucleonic gauges for level control purpose, ^{241}Am is used for thickness gauge and smoke detectors. Neutron sources such as ^{241}Am-Be and gamma sources such as ^{137}Cs are widely used for well logging. There are more than 500 Neutron & gamma sources in use in well logging at present.

A total of sixteen incidents have taken place during the period involving the well logging devices. Of these, in 50% of the cases the sources were successfully recovered and the remaining sources (five ^{137}Cs and three ^{241}Am-Be) were abandoned since these could not be fished out of the well. These wells, with abandoned sources, were plugged with appropriate thickness of concrete.

Sixteen incidents involving nucleonic gauge sources were reported including 12 lost sources, out of which 3 sources were recovered. The recovered sources included three well logging sources stolen from the storage room and these were finally recovered from a river into which they were thrown. This was an act of sabotage. In three incidents, the sources were involved in fire.

C. *Medical Brachytherapy Sources*

There are 102 brachytherapy units operating in India. There have been 9 incidents of lost sources out of which 5 sources could not be recovered. After 1990 no incident/ accident was reported as majority of the centres have switched over to remote/ manual afterloading techniques where source security is effectively ensured. The causes of these incidents are mainly improper handling and violation of safety norms.

Safety and Security of Radioactive Materials

Instances of theft of radioactive sources and equipment and illicit trafficking of radioactive materials have been brought to notice of concerned authorities in India and other countries. This problem has been addressed internationally in meetings and conferences which have been organised to highlight the seriousness of the problem and evolve the preventive measures. In India, a two- day workshop was organised during April 14-15, 1999 at BARC with participants from various organisations representing the central and state governments such as Airport Authorities, Port Trusts, Intelligence Bureau, Excise and Customs, Border Security Force, Coast Guard and Civil Defence College.

As a follow-up of this programme, one day training programme has been planned for personnel drawn from the above mentioned organisations, in order to familiarise them with radiation protection procedures, identification of radioactive package, detection of radiation using appropriate radiation measuring instruments, detectors etc. Three such training programmes have been organised in Mumbai and New Delhi specifically for the customs officials. More such courses for above agencies are planned at their training centres throughout India.

Conclusion

A well-established regulatory infrastructure coupled with regular surveillance procedures and inventory of all the sources in use and disuse will minimise the incidents of orphan sources. Such an inventory should be updated constantly. Procedures should be devised for maintaining strict control in respect to safe and secure storage of radioactive material, specially when the sources are used in public domain e.g. industrial radiography. Regular training/awareness programmes for users, maintenance staff /administrators; periodical surveillance of practices and a regulatory procedure to obtain a periodic radiation safety status from the user, say once in 6/12 months, will go a long way in ensuring safety and security of the sources and minimising chances of their loss.

LEGAL FRAMEWORK AND PRACTICE TO PREVENT AND DETECT ILLICIT TRAFFICKING OF NUCLEAR AND RADIOACTIVE MATERIALS

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Illicit trafficking in nuclear and radioactive materials in the country and across country borders has become serious problem from both nuclear proliferation and radiological hazard point of view. Prevention and detection of illicit trafficking in nuclear and radioactive materials is based on the regulation and procedure set up to ensure the control of the nuclear and radioactive materials throughout their life. Practically, prevention and detection measures in ensuring that nuclear materials do not become the subject of unauthorized use leading to illicit trafficking constitute (1) accounting for and (2) control of nuclear and radioactive materials and (3) physical protection of such materials.

The Nuclear Energy Act No. 10 year 1997 is the legislative basis for the safety, including nuclear material accounting and control activities as well as security measures on the utilization of the nuclear and radioactive material in Indonesia. Government establishes Nuclear Energy Control Board (BAPETEN) as Regulatory Body having the task to control any activities using nuclear energy. The activities of control are implemented through regulation, licensing and inspection.

The mission of the BAPETEN is to ensure adequate protection of the public health and safety, the common security, and the environmental in the peaceful uses of nuclear energy in Indonesia. To support this mission, BAPETEN has three principal regulatory functions (1) establish regulation; (2) issue licenses and (3) inspect nuclear facilities.

First component of regulatory function is establishing regulations, which define the capabilities that need to be satisfied by facility operators to protect against theft which in turn could lead to illicit trafficking. BAPETEN established the Decree on National System of Accounting for and Control of Nuclear Material (SSAC) based on the Agreement between RI and IAEA on the Application of Safeguards in connection with NPT ratified in the Act No.8 year 1978. BAPETEN also established the Decree on the Guidance for Physical Protection of nuclear material under Chairman Decree of BAPETEN No. 02-P/1999 (adopted from IAEA document INFCIRC/225 Rev.1), as the implementation of the Convention on Physical Protection of nuclear material signed in 1986 and ratified by Presidential Decree No. 49/86.

The second component of the regulatory function is licensing. An organization or individual intending to utilized nuclear energy must obtain license from BAPETEN. Guidance for applicants is provided in the form of standard format, which contain license conditions. Any utilization of nuclear energy shall maintain physical protection program or security plans. When the applicants meet BAPETEN's criteria for physical protection of nuclear material and facility, a license is granted. By this licensing, BAPETEN is able to know where, by whom, and how the use of nuclear and radioactive materials is conducted.

The third component of the regulatory function is inspection. To ensure that legal user's activities comply with BAPETEN regulation and the conditions of their licenses, BAPETEN periodically inspects BAPETEN-licensed facilities. Inspections can be announced or unannounced, and varies in scope and frequency according to the authorized activities. The finding of all inspection are documented in inspection reports. These reports are sent to the licensees to inform them of the BAPETEN findings. When inspections disclose violations of BAPETEN requirement, BAPETEN has a range of enforcement sanctions available. Recommendation stated in the inspection report requires the licensee to correct the problem, take steps to prevent a recurrence of the violation, and advise BAPETEN at the action it has taken. The result of inspection by Bapeten is published periodically and open for public. Some illicit trafficking of nuclear and radioactive materials can be detected during inspections. This detection must lead to prompt information of BAPETEN in order to take actions needed to reestablish control of lost material and to inform the public of any potential dangers.

In the case of international transfer of nuclear and radioactive material, BAPETEN closely co-operate with Customs Directorate for solving the problem of illicit trafficking.

In international co-operation, Indonesia has taken all necessary measures to prevent illicit trafficking in nuclear and radioactive material. Indonesia has given full support to the IAEA program on combating illicit trafficking of nuclear material and other radioactive materials. In 1999, Indonesia notified IAEA that it accepted the Database on illicit trafficking on nuclear material and other radioactive material, and gave the name of a person who could be contacted directly by IAEA to obtain information concerning illicit trafficking incident. Indonesia also requested the IAEA IPPAS mission to support BAPETEN in reviewing for implementing effectively the existing physical protection systems at the authority and facilities level. IPPAS preparatory meeting has already held in Jakarta on 15 May 2000 and proposed date for the mission agreed on 5 - 16 February 2001.

DEVELOPMENT OF MEASURES TO DEAL WITH ILLICIT TRAFFICKING OF NUCLEAR MATERIALS IN GHANA.

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The world has now become a global village as such no country can isolate itself from global trends. Reported cases of illicit trafficking in nuclear materials have focused international attention on ways to combat an emerging phenomenon of the 1990's. Of the 324 confirmed cases of illicit trafficking nearly 130 involved individuals trying to illegally sell radioactive materials used in medicine or industry whose unauthorized use or movement poses a danger to public health. Some other cases have involved samples of weapon-grade materials confiscated from individuals[1]. These incidents have raised public and governmental concerns. This has prompted stronger efforts to prevent illicit nuclear trafficking by state authorities, including collaboration and co-operation with international organizational such as the IAEA[2].

IAEA has established the Illicit Trafficking Database Programme and is encouraging all Member States to participate and to report all incidents of illicit trafficking in nuclear materials and other radioactive materials and other radioactive sources that come to their notice[3].

From the data available from the Regulatory Authority Information System (RAIS), Ghana there are 344 highly enriched uranium fuel elements (998.2g) in use in the 30kW Research Reactor, (GHARR-1) and 80 radioactive materials in use in medicine, history, research and teaching. The reactor has been subjected to safeguards inspections by IAEA on regular basis. Additionally there are about on the average nine authorized imports of radioactive into the country for the past seven years.
Unlawful use of nuclear materials, through criminal or terrorist activities, may pose a proliferation treat, while unlawful use of radiation risk to the public.

Ghana has therefore decided to established an effective counter measures against illicit trafficking in nuclear and other materials which might pose both proliferation threat as well as radiological risk to the public and the environment.

Ghana seeks to build upon the established regulatory control programme for the control of ionizing radiation and radiation sources[4,5,6] and to expand it to cover combating of illicit trafficking of nuclear materials of socio-economic importance. The prevention of strategy will involve developing a national system for the accountability, control and security of nuclear materials

Technical measures to detect Illicit trafficking of nuclear materials and other radioactive materials and response to illicit trafficking will be developed. The programme will include screening of vehicles and individuals at borders to;

(i) detect smuggling of these materials;

(ii) locate, measure and characterize the source of radiation; and

(iii) fully characterize any confiscated materials.

An effective countermeasure will be established through a system of

(i) Prevention

- Establishment of national system of accounting and control of nuclear materials
- Legislation and regulations
- Physical Protection
- Export/Import control

(ii) Response to illicit trafficking through

- Establishing anti-trafficking infrastructure, which includes responsible authorities such as customs, civil aviation authority, police, nuclear regulatory authority, military intelligence and defense agencies, and district assemblies coordinating and collaborating in combating illicit trafficking:

(iii) Provision of detecting equipment for nuclear materials and

(iv) Training which will cater for,

- Response personnel and
- The Public

Training opportunities provided by IAEA will be fully utilized**.**

International collaboration with our near neighbors, Togo, Cote d'Ivoire and Burkina Faso will be established to ensure cross border control.

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RADIOACTIVITY IN SCRAP RECYCLING: MONITORING, DETECTING AND REGULATORY ISSUES

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The province of Brescia is the most important metallurgic hub in Italy: 5 million tons of metal scrap (steel, brass, copper, aluminium, etc.) are recycled every year in more than a hundred foundries and in 13 steel mills. One third of the scrap used is imported. Unfortunately in the recent past (since 1990) numerous cases of contamination occurred in Brescia and they involved: two steel-mills, one aluminium foundry and the associated facility, some plants producing copper alloys, one authorized and one unauthorized landfill, the goods-stations in Brescia and in a nearby town, and a scrap collecting factory. None of the events caused significant esposure and/or contamination of the workers, but nevertheless they caused concern among the population living close to the plants and among the foundry workers. The damage in terms of recovery costs, shutdown and market loss has been serious.

The Italian Law on Radiation Protection, passed in 1995, imposed the monitoring of metal scrap on users and traders, starting from 1996, but there was a lack of compliance because a decree on specific application was not issued. After the latest accident in a steel plant in Brescia, in May 1997, due to the melting of two different sources (Co60 and Cs137), the Lombardy Region issued an urgent ordinance, ordering smelting plants and scrap collecting factories to check for the presece of the contaminated materials in metal scrap prior to use. The Lombardy Region also defined protocols for the monitoring of metal scrap from arrival at the factory to the end of the melting process: the protocol requires radiation measurements outside each truck, wagon or container with fixed detection systems positioned at the entrance gate or with portable detectors, radiation measurements and visual inspection of the metal scrap after unloading, gamma spectrometry of test castings, slag and furnace ash dust. The protocol also specifies the characteristics of the intruments to be used at each stage of the control process. The control of scrap, before it enters the production cycle, does not guarantee complete protection against accidental melting, but in our experience it decreases the probability of such an event and allows the correct disposal of radioactive materials. In many cases the monitoring systems were so sensitive as to enable the discovery of contaminated materials with low activity and shielded radioactive sources.

Monitoring also prevents the contamination of slag and dust (mainly due to Cs137, Ra226 and Am241), by-products often utilized in other industries or disposed of in waste facilities. Although the control of test castings and by- products cannot prevent contamination of the plant and machinery, it allows immediate detection of the incident and action to control the spread of contamination. Any discovery of radioactive materials must be reported to the local Health Authority (Table I) and to the Police; investigation of the origin of the radioactive materials revealed that 50% is Italian or, at least, the last trader is Italian, while only 11% is from non-EU countries. In Table I the words "contaminated materials" indicate any types of contaminated object not specifically identified as a source.

Radioactive Objects	Radioactive Isotopes	Range of Estimated Activity (MBq)	Total Estimated Activity (MBq)
lightning-rods (n.29)	^{226}Ra ^{241}Am	from 0.33 to 40 from 15 to 40	390
smoke detectors (n.26)	^{226}Ra ^{241}Am	from 0.3 to 1.4 from 0.06 to 2.1	35
luminescent dials (n.147)	^{226}Ra	from 0.005 to 0.63	20
"Radium Trikkur" [1] (n.9)	226Ra	from 0.04 to 5	15
radioactive sources (n.25)	^{137}Cs ^{226}Ra ^{60}Co ^{85}Kr ^{90}Sr ^{241}Am	from 0.07 to 516 from 0.07 to 740 from 2 to 55 from 50 to 370 from 0.03 to 166 240	2238
contaminated materials (n.337)	^{226}Ra ^{60}Co ^{137}Cs	from 0.3 to 5 from 0.05 to 19.3 from 0.01 to 10	>162
Total n.573			>2.86 GBq

Table 1: Radioactive objects found in metal scrap loads from 28/5/97 to 30/04/2000

Lightning-rods come mainly from France (15 out of 29) and "Radium Trikkur" from Germany (6 out of 9). According to the type of production, 60% of the contaminated objects were found in iron scrap, 20% in brass scrap and 20% in aluminium scrap. In steel-mills the contaminated materials are normally detected at the entrance gate before being unloaded, while in other smelting plants contaminated items are often found by monitoring systems on the conveyor-belts where the scraps are more spread out.

For the reasons given above, the accurate control of metal scrap before recycling has become essential. This practice prevents the contamination of factories and the environment and ensures the safety of workers and the general public.

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[1] *for Radium water treatment*

PROTECTING FACILITIES AGAINST TERRORISM AND SABOTAGE IS JAMAICA PREPARED TO DEAL WITH THIS POTENTIAL THREAT?

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Jamaica, a developing Caribbean country, is presently experiencing an economic recession. This has lead to the government having considerable difficulty in acquiring much needed financing, even financing that is necessary to protect the county's resources and facilities from terrorist and sabotage.

Essential national facilities includes our International Airports, Embassies and High Commission, Hospitals, Utility Plants- Electricity, Water and Telecommunications, Oil-Refineries, Government ministries, Parliamentary Houses and Educational Facilities. These facilities are vulnerable to terrorist attacks and sabotages. Terrorist acts and acts of sabotage can come from internal as well as external sources, they can be commandeered form the air, land or sea. They can be politically, socio-economically or otherwise motivated.

As a third world developing nation, Jamaica does not have the capability or the resources necessary to secure all its assets, the government must prioritize on such resource allocation. With it's high level of debt servicing, dealing with recurrent and capital expenditure and addressing other Social Issues, some important issues will be placed on the back burner, dealing with terrorism and sabotage will fall in the category.

One contributing factor, is the fact that, to date the incidents of terrorism and sabotage have been few to non-existent. This has encouraged the government to become somewhat complacent, subscribing to the belief that acts of terrorism and sabotage will never happen. This practice can be detrimental to the country, as one cannot under estimate the threat of terrorism and sabotage.

With the steady increase in drug related incidents, and, with the deportation agreement the government has with some first world countries such as the USA. and England, this threat is very realistic. Drug "Lords"\"Dons" are known to promote terrorism and sabotage as revenge mechanism against government for unfavorable decision handed down by the courts of the land.

Our Airports, Oil refinery and some utility facilities are located in close proximity to the sea. This is very accessible to attack from the sea. Our other essential facilities are not as easily accessed as they are located inland and may be more difficult to access. All these facilities have security protection, but none is equip to deal with any level of terrorism. No security equipment currently been used has the capability to combat, detect and or prevent any terrorist attacks or acts of sabotage.

The nation needs to expand resources to set up units to focus on this potential threat. This unit should focus on analysis of threats from:

- Terrorism
- The proliferation of weapons of mass destruction

- Vulnerabilities attended on increasing economic and societal dependence on information technologies.

There is a wide variety of novel attack available to the terrorist today, it would advised that the unit, through constant training and workshops be aware of as many these attack methods as possible. There should b collaboration between several entities to analyze and plan for the potential threats. The army and Police forces will have to be complemented by scientists who have expert knowledge on this subject area. Experts could be drawn from:

i. Information and Communications centers
ii. Banking and Finance entities
iii. Utility entities
iv. Environment Protection agencies
v. Land, Air and Sea transportation agencies
vi. Fire services
vii. Law enforcement agencies
viii. Defense (Army & Police)
ix. Health services
x. Oil and gas refineries
xi. Disaster preparedness program

This group would examine issues such as:

- How to reduce the vulnerabilities of their institutions to terrorist attacks (Threat /vulnerability management)
- How to respond to terrorist acts? Guideline or rules to follow when faced with the problem of terrorism. (Crisis management)
- How to deal with the aftermath of terrorist attacks, including providing essential aids, services and emergency relief for the victims of these terrorist acts.
- (Emergency Management)

Given the level of sophisticated weaponry available to terrorist today, Jamaica needs to seriously consider the threat of terrorism and sabotage. Our countrymen need to see these threats as real and develop a real sense of urgency where dealing with terrorism and sabotage is concerned.

Therefore in concluding I must say that as far as protecting our national facilities and essential services from the threat of terrorism and sabotage, my country is totally ill-prepared as we have no plans in place to deal with the very real threat of terrorism and sabotage.

ESTABLISHING DESIGN BASIS THREATS FOR THE PHYSICAL PROTECTION OF NUCLEAR MATERIALS AND FACILITIES

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In the area of nuclear energy utilization Republic of Kazakhstan follows the standards of international legislation and is the participant of Nuclear Weapon Non-proliferation Treaty as a country, that do not have nuclear weapon. In a framework of this treaty Kazakhstan provides for the measures to ensure the regime of nonproliferation. The Republic signed the Agreement with IAEA on the guarantees, that was ratified by the Presidential Decree in 1995. Now in the Government of the RK the Convention on physical protection of nuclear materials is under consideration.

Kazakhstan legislation in the area of nuclear energy utilization is represented by a set of laws; the main of them is the Law of the Republic of Kazakhstan "On the utilization of atomic energy", dated on April 14, 1997. According to the law, the issues of physical protection are regulated by interdepartmental guideline documents.

Nuclear science and industry of RK includes:

- Enterprises on uranium mining and processing;
- Ulba metallurgical plant, manufacturing fuel pellets of uranium dioxide for heat release assemblies of RBMK and WWR reactor types, with the enrichment on U235 1.6-4.4%;
- Power plant in Aktau for heat and power supply and water desalination, based on fast breeder reactor BN-350;
- Research reactors of National Nuclear Center:
  - WWR-K - water-water reactor, with 10 MW power, uses highly enriched uranium (up to 36% of U-235);
  - IVG.1M - water-water heterogeneous reactor of vessel type on thermal neutrons, maximum power is 35 MW;
  - IGR - impulse homogeneous graphite reactor on thermal neutrons, with graphite reflector;
  - RA - high temperature gas cooled reactor on thermal neutrons, 0.5 MW power.

Establishing of design basis threats for nuclear objects of the Republic of Kazakhstan is urgent problem because of developing military-political situation in the region.

It is necessary to specify important elements, affecting on the specific features of the design basis threat:

- Military operations of government troops of neighboring countries on the west and east of the Republic of Kazakhstan against extremist and terrorist groups, that have a goal to come to power in separate regions and to establish terrorist regimes. This factor is an essential issue because of high level of training and equipment of terrorist groups, that repeatedly accomplish terrorist actions within the territory of Russia and Uzbekistan, with grave consequences for the population.

- High mercantile interest to the uranium pellets, including the production of Ulba metallurgical plant, of the groups, that want to have high profit due to steeling of these materials and their resale to third parties. This tendency is confirmed by the recent statistic data, because only during the period from July 1999 to March 2000 three criminal groups were captured in the RK, that had nuclear fuel pellets with enrichment on U-235 up to 4.4% for resale to third parties.
- As it was registered by international agencies, through the territory of the RK, because of its geographic location, the ways of illegal drugs transfer are passing. It is also possible in respect to illegal transit of nuclear and radioactive materials.

Stages for Establishing of Design Basis Threat

Training

- In 1998, jointly with Nuclear Regulatory Commission of the US, training seminar on assessment of physical protection system of research nuclear reactor WWR-K of NNC was carried out;
- In 1999, jointly with the national security agencies, practical training on assessment of physical protection system of commercial nuclear plant BN-350 in Aktau was carried out;
- In May 2000, jointly with the German Society of nuclear reactors and facilities security, training seminar on establishing of design threat for hypothetical research reactor and creation of physical protection conception;
- Seminar on establishing of design basis threat according to IAEA methods, with attraction of international expertise (USA, Germany, Great Britain, France) is preparing.

Practical measures:

The activity on establishing of design basis threat in the RK is going on within the following strategy:

- Required methodology documentation for analytical work on the elements of design basis threat has been prepared;
- Main responsible agency for gathering and analysis of sensitive information and performing of organizational measures with law-enforcement ministries and interested agencies is determined;
- Required activity on gathering and analysis of information is carrying out. Special attention is paid to examination of situation in the surroundings of nuclear objects.

Now all the nuclear objects of Kazakhstan are guided by the information on local threat model and perform the assessment and revision of physical protection measures of nuclear materials in accordance with received data on the threat.

Upon the completion of the activity for establishing of the threat in the RK, the document on establishing design threat on state level and on the level of particular nuclear facility will be issued These documents will have legislative power.

Because of special danger of illegal circulation of nuclear materials Kazakhstan is interested in expansion of regional cooperation with the countries of Central Asia and Caucasus to develop joint measures to control illegal circulation of nuclear and radioactive materials. Two international seminars are carried out in the RK on this problem, two more seminars in 2001 are preparing.

PROGRESS IN THE ACTIVITIES ON PREVENTION AND COMBATING OF ILLICIT TRAFFICKING OF NUCLEAR MATERIAL IN LITHUANIA

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The paper gives a general overview of the progress, which has been done in the activities on prevention and combating of illicit trafficking of nuclear material in Lithuania. It describes the measures, which were taken to strengthen nuclear material accounting and control and physical protection. The current status of the national legislation and the functions of institutions involved in control of nuclear material and combating of illicit trafficking are discussed.

Lithuania similar to many countries did not avoid a new type of a crime – smuggling of nuclear materials, which has been observed in 1990's. Most serious case in Lithuania happened in 1993 when fresh fuel assembly was stolen from Ignalina NPP. This assembly contains approximately 124 kg of UO_2 (enrichment 2%). 100 kg of the pellets from this assembly was found later in several pieces at different places. This case served as a strong stimulus to strengthen prevention measures of Illicit trafficking.

The legal basis was created and governmental institutions were obliged with special duties related with nuclear material. The laws and regulations set the order for the shipment and handling of nuclear material. The penalties for violation of these laws and regulations specified in Penal Code and Administrative Code were made stricter.

The State system of accounting for and control of nuclear material (SSAC) is very important element in prevention of the illicit trafficking. The Regulations of Accounting for and Control of Nuclear Material at Nuclear Facilities and LOFs [1] was issued by State Nuclear Power Safety Inspectorate (VATESI) on 10 December 1997 following the provisions of the Law on Nuclear Energy. Lithuania extended its international obligations by ratifying Protocol Additional to the Safeguards Agreement (entered into force on 5 July 2000). The fully computerized nuclear material accountancy system was created at Ignalina NPP. The system gives possibility to find the concrete location of each fuel assembly in minute. The responsible person coordinates all operations of the movement of the nuclear fuel.

The physical protection of nuclear material and nuclear facilities is another important element in prevention of illicit trafficking. The national requirements of physical protection are formulated in Regulations for Physical Protection of Nuclear Facilities [2] passed by VATESI on 12 February 1997. The State system of the physical protection in Lithuania was improved significantly following the INFCIRC 225/Rev.4 [3]. The most significant improvements were made at Ignalina NPP. A new alarm and CCTV systems were installed at the perimeter, the important organizational and technical measures have been taken to strengthen the defence in depth. To evaluate the State System of Physical Protection the Lithuania requested and the IAEA organized the IPPAS mission to Lithuania in 1999. The implementation of the recommendations of the mission is going now.

The extensive co-operation of the State authorities and coordination of their activities is very important in prevention and combating of illicit trafficking. The main document, which regulates handling of illegal material and activity of various governmental institutions, is the Order of Handling of Illegal Radioactive Materials and Contaminated Objects. Summarizing provisions of this document and other laws and regulations, one can define the main functions of institutions involved in control of nuclear material and combating of illicit trafficking: VATESI, Ministry of Environment, Radiation Protection Center, Police Department, Clandestine Proliferation Intelligence Center – branch of Police Department, Border Police Department, Fire Protection and Rescue Department, Civil Protection Department, Institute of Physics, Prosecutor's office, State Security Department and Ministry of Economy.

The technical and instrumental capabilities for the radiation control on the borders and for the analysis of seized material were increased. The four stationary control systems (Ludlum 3523 type) for the vehicles were installed on the main border crossings and, in addition, border police has 130 hand-held devices (Ludlum 12SA). Ministry of Environment and Radiation Protection Center have gamma dosimeters, mobile gamma spectrometers, neutron detectors and stationary alpha and beta spectrometers. Clandestine Proliferation Intelligence Center is equipped with dosimeters, mobile gamma spectrometer. In each Police Commissariat, there is at least one person responsible for activity related to illegal transportation of radioactive and nuclear materials. The Institute of Physics, the only scientific institution in Lithuania where experimental nuclear physics is a subject of scientific research and of practical application, purchased the gamma and alpha spectrometers of leading Canberra and EG&G Ortec companies and extended capabilities of the nuclear spectroscopy.

The aforementioned progress was achieved owing to very important assistance from Finland, Norway, Sweden, UK, USA, and other countries, which was coordinated by IAEA or provided on bilateral cooperation basis.

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ASSESSMENT OF THE THREAT FROM DIVERTED RADIOACTIVE MATERIAL AND "ORPHAN SOURCES „- AN INTERNATIONAL COMPARISON

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Multiple international activities have been undertaken to contain the trafficking of weapons-usable material in order to reduce the risk from the proliferation of such material. In addition, over the past decade the issue of unintended handling and transport of radioactive material has become increasingly important. Concurrent with the growing number of radioactive sources in industry, medicine, agriculture and research, the probability for losing control over such sources increases as well („orphan sources"). The potential impact on society and the environment from these two categories of threat has been documented extensively in the literature (1, 2, 3).

In this study representatives from 11 countries in the Americas, Europe and Asia-Pacific formed a network to exchange information concerning nuclear and other radioactive material on the following topic areas:

- Legislation and regulatory practices for the production, processing, handling , use, holding, storage, transport, import, and export
- History of site-specific non-compliance and enforcement actions, as well as punitive actions
- National approach for handling the issue of orphan sources
- The role of national security forces
- Managerial and technical procedures to ensure material inventory control and accountancy
- Aspects of physical protection on-site and during transport
- Technical/scientific expertise and equipment available at the national level to detect, identify and quantify such material in the field
- Level of practical implementation of technical equipment to detect such material at border crossings, airports, rialway stations, and mail distribution centres
- Cases of seizure of nuclear and contaminated materials, illegal sales and fraud
- Training programmes available for preventing, detecting and responding to the loss of control

The results of the analysis show that, despite several international consensus documents and supporting legislation, in several cases major additional efforts are needed for strengthening the national state's capabilities and jurisdiction for combating the illicit flow of such materials.

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RUSSIAN SPENT MARINE FUEL AS A GLOBAL SECURITY RISK

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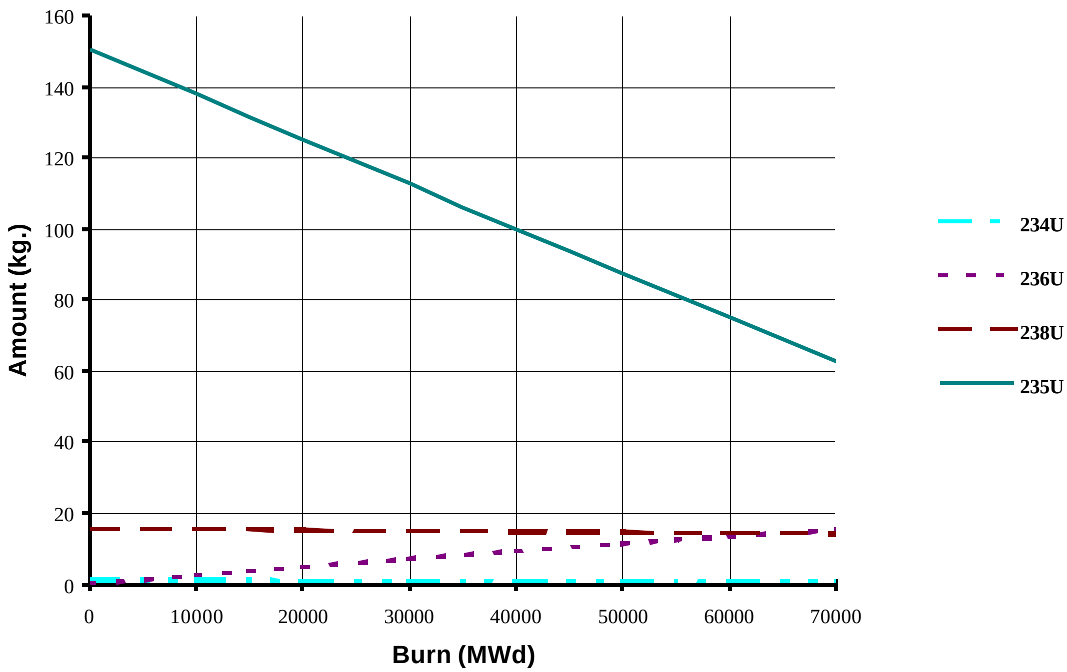
Russian marine fuel is a trans-national security concern. This paper focuses on specific technical properties of Russian marine nuclear fuel especially relevant for evaluating different aspects on nuclear proliferation, in addition to risks associated with regional environmental degradation and illegal diversion of radiological substances. Russian fresh fuel for marine reactors has been involved in several significant cases of illicit trafficking of special nuclear materials. The amount and quality of nuclear materials in Russian spent marine fuel give also reason for concern. Not less than 200 marine reactor cores are ready for having their spent fuel unloaded and preliminary stored on shore in the Far East and North West of Russia, and large amounts of spent naval fuel have been stored at Russian military bases for decades. [1]

In order to assess the security risks associated with Russian spent marine fuel, this paper discusses the material attractiveness of spent fuel from all types of Russian marine reactors. The calculations are based on a model of a light water moderated Russian icebreaker reactor. The computer tool HELIOS, used for modelling the reactor and the reactor operations, has been extensively qualified by comparisons with experimental data and international benchmark problems for reactor physics codes as well as through feedback from applications. Some of these benchmarks and studies include fuel enrichments up to 90% in Russian marine reactors. [2]

Several fuel data cases are discussed in the paper, focusing especially on 1) early fuel designs with low initial enrichment, 2) more modern fuel designs used in third and fourth generation of Russian submarines probably with intermediate enriched fuel, and 3) marine fuel with initial enrichment levels close to weapon-grade material. In each case the fuel has been burned until k_{eff} has reached below 1. Case 1) has been evaluated in [3], the calculations made as basis for this paper have concentrated on fuel with higher initial enrichment of ^{235}U as put forward in case 2) and 3), and to compare and discuss the data taking into account the assumed presence of each of the groups of material in the Russian marine fuel cycle.

The calculations show that in fuel with initial enrichment close to weapon grade, i.e. 90 %, the enrichment of a burned core may be as high as 75 % and the amount of ^{235}U some 63 kg as seen in FIG 1. The amount of ^{239}Pu reaches in this case 0,4 kg before the consumption rate passes the production rate in the reactor. Further evaluations of the weapons quality of the special nuclear materials are included in the paper. Included in the paper are also more extensive graphical description of the amounts of isotopes of U, Pu and other actinides in the different types of marine fuel, including initial enrichments levels from 20-97%, initial loads of ^{235}U from 100 to 200 kg, also including different kinds of fuel and absorber material. The results include a ranking of the proliferation risk for different kinds of Russian spent marine fuel. The most serious proliferation concerns in this context are related to spent fuel with particular low and particular high initial enrichment. Other, more general security concerns exist when considering spent fuel removed from the vessels with little or no indication of operation history and isotopic concentrations. The results show also that, after more than 30 years storage after decommissioning, the fuel assemblies can hardly be regarded as being self-protected. This fact has not been taken into account when international protective measures at the Russian bases have been implemented, a major flaw in the efforts to increase physical protection at the Russian naval bases.

FIG 1. Seleted isotopes in a Russian marine reactor with fuel enriched to 90%, initial load 150 kg. U-235



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MEASURES AGAINST ILLICIT TRAFFICKING OF NUCLEAR MATERIALS AND OTHER RADIOACTIVE SOURCES IN NIGERIA

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Introduction : Background Information

The concern worldwide over the dangers associated with illicit trafficking of nuclear materials and other radioactive sources is shared by the Federal Government and people of Nigeria. In order to protect its territories, the government in the second quarter of 1998 gave a directive that Nigeria should be registered as a participating nation in the Illicit Trafficking Database Programme being organised by the International Atomic Energy Agency (IAEA), Vienna, Austria. Immediately, a National Committee (NC) was established comprising of all relevant ministries and government agencies, particularly the ones involved in the control and use of radioactive materials such as the Federal Radiation Protection Service (FRPS), Nuclear Research Centres, Federal Environmental Protection Agency (FEPA), Energy Commission of Nigeria, the Nigerian Police Force, the Customs and the Ports Authority. By August 1998, the committee got Nigeria duly registered with the IAEA as a participating nation and presented a proposal to the Federal Government on how to monitor our ports of entry, borders and the entire country in order to participate effectively in the programme.

In other to check illicit trafficking of nuclear materials effectively and efficiently within and across the Nigerian borders, the National Committee gave priority to proper organisational structure, manpower training and development, and the provision of adequate and necessary facilities and infrastructure for nationwide radiation monitoring programme.

Organisational Structure

In Nigeria, there is a Nuclear Safety and Radiation Protection Decree No. 19 of 1995 which established Nuclear Regulatory Authority (NRA) and an Institute of Radiation Protection (IRP). The decree empowers the NRA to regulate the production, possession, transfer, import, export, trade, use, transportation, storage and disposal of radioactive materials and radiation equipment in order to ensure radiation safety of the general public, radiation workers, properties and the environment. Pending the time the NRA and IRP are brought to operational existence, the FRPS has been mandated to perform the role of the Regulatory Body while the existing three Energy Research Centres and FRPS are jointly saddled with the responsibilities of the IRP. All these government agencies and the research centres play major roles in the National Committee on Illicit Trafficking and form the core of the Technical Committee of the National Committee.

Six institutions which are strategically located round the country have been selected as Illicit Trafficking Data Collection Centres taking into consideration competence in terms of personnel and monitoring equipment. The institutions are located in Zaria, Ile-Ife, Ibadan, Abuja, Warri and Enugu. In all the institutions, there are Radiation Physicists that can competently take care of the nation-wide radiation monitoring and participate effectively in the programme. One of them, the Sheda Science and Technology Complex, Abuja is the coordinating centre and Point of Contact pending the time the NRA is properly constituted and becomes fully functional. Reports on illicit trafficking in Nigeria from the Data Collection Centres as well as reports from the Illicit Trafficking Database at the IAEA are to be sent to the Point of Contact in Abuja.

Manpower Training and Development

The Technical Committee (TC) is to provide adequate supervision for the programme, guide the personnel involved in the monitoring of our territories at the seaports, airports, border posts and hinterland, and develop a sound training programme for all the participants. In addition, members of the TC are to pay regular visits to the monitoring centres particularly at the ports. During each visit, Seminars/Lectures are to be organised for the personnel of FEPA, Police, Customs, Immigration and the Ports Authority. This is to increase awareness at the ports of entry and for capacity building of manpower for radiation monitoring at the ports. The responsibility of the TC also includes presentation of progress report and the IAEA reports to the National Committee at the quarterly meetings.

Provision of Adequate and Necessary Facilities and Infrastructure

In order to establish the necessary infrastructure, 6 seaports, 4 international airports and 5 land border posts were selected as monitoring stations to be equipped with radiation monitoring equipment. The six data collection centres are to be upgraded with all necessary modern radiation monitoring facilities. Presently, three of the centres have facilities to detect and determine the type of radionuclides, type and quantity of radiation and provide further testing of any radioactive materials intercepted from unauthorised persons.

Conclusion : Problems and Areas of Need

There is a good organisational structure in place despite the absence of a national nuclear regulatory authority. In fact, the Nuclear Regulatory Authority, when properly constituted and becomes fully functional, has to work with the relevant ministries and government agencies that constitute the present National Committee. We do have well trained and qualified personnel that can properly manage the programme. In addition, there are some existing infrastructure that are presently being used. There are laboratories, office spaces and monitoring equipment at some centres in the country.

Our problems are :

(i) Lack of radiation monitoring equipment at our seaports, international airports and the border posts for quick check for radioactive materials carried into and out of our territories. Consequently, it has been very difficult to successfully track the illicit traffickers.

(ii) The National Committee does not have enough fund to carry out the committee's programme. This has inhibited the committee from expanding its scope of work.

Assistance is required from the IAEA to enhance efficiency and effectiveness by :

(i) providing radiation monitoring equipment for use at the ports of entry; and

(ii) personnel training, particularly, the Police, Customs and State Security Service in the tracking of illicit traffickers of nuclear materials and other radioactive sources.

STEPS TO IMPLEMENT THE LEGAL AND REGULATORY INFRASTRUCTURE FOR PHYSICAL PROTECTION OF NUCLEAR MATERIAL IN PERU

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The signature of Peru to become part of the Convention of Physical Protection of Nuclear Material in 1995 has implied an obligation to formalize the legal and regulatory infrastructure for this purpose. As first step, physical protection measures were formalized on the two nuclear facilities: one critical assembly of cero power (RP0) and another research reactor of 10 Mw thermal power (RP10). Both of them installations uses low enriched uranium nuclear fuel (Material and Testing Material – MTR type).

In the other side, even thorium was put in perspective to control, currently it is being used for non-nuclear purposes and has not been included inside the physical protection measures. Its physical and chemical form and its little quantity do not warrant for applying the Convention.

The physical protection measures implemented in the research reactor were well depicted in ref. [1] where was concluded that the physical protection system met the recommendations of INFCIRC/225/Rev.3. The critical facility (RP0), as having nuclear material categorized III, has implemented a less restrictive system but enough to meet the requirements.

In 1999 an evaluation of all physical protection system was performed over these two nuclear installations. This evaluation took into account the recommendations of INFCIRC/225/Rev.4 [2]. The general conclusion was that the performance of physical protection system was suitable to the Categories of nuclear material – II and III – and that the installations where nuclear material is used were suitably protected against non-authorized or illegal removal of nuclear material and sabotage. However, some of components of the system were not appropriately working and could make weak all of the system.

Another of the identified problems was the lack of a rule on physical protection and also the lack of the Design Basis Threat, although this fact was well known due the social conditions in the country.

The second undertaking has been to prepare the rule on physical protection where competency and requisites in physical protection of nuclear material are established.

The proposed rule was first written taking into account the recommendations of INFCIRC/225/Rev.4 and then also the recommendations by an IPPAS mission in 1999.

In order to cope with all of this subjects the projected rule – currently under review – has included both legal and technical aspects. The main parts include the objective and purpose, the responsibilities for the organizations engaged in the physical protection, categorization of nuclear material as established in the Convention on Physical Protection [3], requisites for transportation and storage an use of nuclear materials, requisites for nuclear installations, coordination levels between State authorities, and enforcing and sanctions.

As the Instituto Peruano de Energía Nuclear (IPEN) is the national competent organization in nuclear energy the proposed rule has also established that national competent authority on physical protection as being IPEN.

The proposed rule foresee the participation of Ministry of Defense and Ministry of Internal Security . In order to achieve a good level of participation and engagement of these authorities the document is going to be reviewed by these two state organizations.

Additionally, pursuant the Convention, in the rule has been stated specifically that non-authorized removal or sabotage of nuclear material and installations will be punished by Civil and Penal Code.

If some offenses related the physical protection would happen, the current Penal Code and another Laws make possible to punish them but it could be not easy at all. In order to close the legal circle for a good regulation of physical protection some inclusions specifically related to this matter will be proposed to the Penal Code.

It is expected that the proposed rule will be approved by the early next year, but the additions to the Penal Code perhaps will need more time.

One additional task for IPEN in the year 2000 was to perform inspections, by the first time, on the physical protection of nuclear materials and installations as an advance of the future formalized control of the National Authority.

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PHYSICAL PROTECTION UPGRADE IN AN EXISTING RESEARCH REACTOR

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An IPPAS Mission, with participating experts from France, Germany, USA and the United Kingdom arranged by the IAEA for Poland in 1997, formulated a number of recommendations on how to upgrade the Physical Protection system at the Institute of Atomic Energy in Swierk, Poland. The nuclear materials of interest were categorised as in use or in storage. Some of the recommendations were impossible to implement in short term without outside support because of financial difficulties.

The IAEA and two Member States (United States and the United Kingdom) arranged for a follow-up visit. They made funds available and delegated their representatives to co-ordinate works on the PPS upgrades. Chris Robertson (Sandia N.L.) and Steve Atkinson (DCNSy) proposed a concept of improving the Physical Protection System following IPPAS recommendations and optimising improvements in order to get the most effective upgrades using limited funding. Their Draft Design Document for Upgrades to the Institute of Atomic Energy dated January 1999 initiated works towards improvements.

The concept consisted of enhancing existing layers of defence and providing additional layers against would be adversaries in the area of the targets. Adding layers of defence is consistent with the multi-zone approach recommended by the latest revision of the basic recommendation INFCIRC/225 rev. 4. These enhancements included:

1. Building a Guard Station close to the target and equipping the Station with hardened walls, doors, and windows.
2. Providing alarm detection and video assessment equipment.
3. Providing a modern computerised access control system to allow entry of only authorised persons to designated areas.
4. Hardening of the vault.

The vault containing fresh fuel was equipped with hardened walls and doors as well as sensors to detect unauthorised entry and CCTV for assessment. Two man principle for door control involving authorisation from the access control system create a real obstacle for any unauthorised entry. Additionally, a set of tie-downs immobilising each fuel containers was designed and built to add delay for any theft action. The locking tie-downs provide a mechanical layer of defence, which is a formidable barrier for the adversary. In addition, it provides for two man mechanical control when special procedures are written and enforced.

The tie downs are located close to the target, are of relatively low cost, and are easy to maintain. The tie-downs were locally designed and manufactured at the Institute. Both the design and construction were highly rated by specialists from Sandia National Laboratories.

The response force consists of specially trained guards who operate the new alarm station located within the reactor building. Access to the reactor alarm station is controlled by electronic equipment configured to allow entry using required cards and codes. Alarm detection, assessment, and response are co-ordinated from this location. This station is manned 24 hours a day seven days a week where the operators work in shifts. The armed response force team members are positioned in several locations throughout the Institute. The alarm station operators and guards were also provided with portable radios and base stations to enable them to communicate between themselves and with the local and national police.

All of the physical security upgrades were procured installed and built during 1999. The radio communication equipment and spare parts for the security system were provided during February 2000. Where possible, local contractors were used. They were selected on the basis of experience on similar installations in places like the banking sector. The system was designed with sustainability in mind. Future cost and resources to maintain the system were considered throughout the design and implementation stages. Additionally, the system was engineered to enable the Institute to expand their current security configuration in accordance with potential changes in threat and target definitions defined by the Polish security organisations.

DOMESTIC COOPERATION IN COMBATING ILLEGAL NUCLEAR TRAFFIC – EXPERIENCE OF THE EMERGENCY SERVICE CENTER.

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Poland's experience in combating illicit trafficking in nuclear and radioactive materials dates from the end of 1990 when the government decided to expand detection capabilities at the border check-points and initiated a gradual deployment of the portal radiation devices to detect all attempts of imported commodities with raised radiation level. Although the country had already had well-developed regulations in place as well as accountability and control systems over nuclear material, radiation sources and devices, the need to enforce the control activities and to strengthen cooperation among the nuclear safety and radiological protection bodies and the law enforcement authorities appeared. Then, besides the importation of the post Chernobyl contamination transports Poland experienced from:

- the lost and vagabonding nuclear materials or radioactive sources from the former Soviet/Russian military bases deployed in Poland
- the tourism trafficking in radioactive materials

The task of combating illegal radioactive traffic has been entrusted to:

- the Border Guard and Customs services - at the borders
- the Police and State Security services - mainly within the state

Some contribution to that action have had also the recycling metallurgical scrap plants, which decided to install fixed radiation control devices to protect their products from the presence of radioactive isotopes.

The duty of the coordinator as well as providing an immediate assistance in case of a seizure or a suspicion about the seizure of unknown radioactive material, fulfils the Emergency Service Centre (ODSA) at the Central Laboratory for Radiological Protection (CLOR). ODSA has been established in the mid-60s and its fundamental responsibility is to collect notifications on radiological emergency events and to organize help to liquidate consequences of a radiation incident with involved sources. All users of radiation sources and the law enforcement officers are obliged to inform ODSA about incidents with involved radiation sources. The Emergency team is on duty around the clock and serves as a source of advice or first aid to the users of radiation sources and the law enforcement officers in case of any radiation hazard with involved radioactive sources. When circumstances require of an immediate response, the officer on duty arrives at place, where an illicit event happened and he takes action in accordance with the requirements of nuclear safety and radiological protection.

ODSA / CLOR activities in that respect are supervised by the National Atomic Energy Agency (NAEA), the regulatory and control body for peaceful use of nuclear energy in Poland.

Since the first inter-agencies initiative for combating illicit trafficking in radioactive materials, the NAEA has concluded agreements on mutual cooperation with all law enforcement bodies: the Border Guards, the Customs Board, the Police and the State Security Office. The scope of those agreements is dependent on the range of interest and kind of involvement in those activities of the contracting parties. The main intention was to recognize the need for cooperation in matters related to the enforcement of the domestic law and to establish the mutual assistance between the contracting parties as well as their subordinate services. From technical point of view the authorized unit to perform assistance under the concluded agreements is mainly ODSA / CLOR. All assistance and services under the cooperation agreements are performed free cost by ODSA / CLOR.

The chief agency looking for an advice, consultations, expertise, support in detecting and response activities and many other services in that respect is the Border Guard, which operates the portal radiation devices deployed at the border checkpoints.

An undeniable aid in some seizure actions of 'orphan' sources was an available information from the database on all licensed radiation sources and their users established and maintained by ODSA / CLOR. The law imposes the obligation of keeping records of ionizing radiation sources at facility level and at state level upon data provided by the users of sources and by the licensing and controlling body, which is the NAEA.

As of 2000, the whole action taken for combating illegal nuclear traffic resulted in the following seizures (roughly):

- 21 kg of depleted uranium
- 8 kg of natural uranium
- 1 kg of low-enriched uranium
- 40 sealed sources (Cs-137, Sr-90 and Co-60), the biggest was Cs-137 with activity of 1 Ci. There was registered one incident with stolen and regained Ir-192 source of activity about 4 Ci.

Additionally, ODSA registered a dozen or so of cases with contaminated scrap and other objects. Worth of mentioning are seizures of US dollars, gold and works of art, contaminated likely purposely with J-131 or Zr-95.

All those seizures were carried out by the law enforcement services with ODSA assistance in detection and response actions. The identification of the seized radioactive sources has been performed by CLOR.

ORGANIZATION OF CUSTOMS CONTROL OF FISSIONABLE AND OTHER RADIOACTIVE MATERIALS

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Among the routine inspection tasks of the Sheremetyevo customs office are tasks stemming from international commitments of Russia to prevent proliferation of nuclear weapons and material that can be used for making these weapons. These tasks are:

- radiation monitoring of all vehicles, passengers, their luggage and goods crossing the state border;
- inspection of fissionable and radioactive materials (FRM) legally transported by participants in the foreign trade activities with a view to checking that the declared data fully correspond to the actual radioactive cargo.

(a) Organizational measures

The Sheremetyevo customs office has a department whose personnel is specially trained in radiation monitoring and can operate radiometric and spectrometric instruments. These specialists are included in shifts on duty responsible for customs clearing and inspection and carry out continuous radiation monitoring of passengers and their luggage, vehicles and goods crossing the border. They work on the 24-hour basis, which allows quickly and skillfully localizing the detected radiation source and avoiding direct contact of customs officers, airport personnel, and passengers with the radioactive item.

(b) Technical measures

They include provision and everyday use of radiation monitoring instrumentation, classified as

- stationary equipment of primary radiation monitoring (SEPRM);
- hand-held instruments for additional radiation monitoring (RM);
- spectrometric equipment for control of legal FRM transport.

The customs procedure for monitoring of fissionable and radioactive materials is divided into three stages.

Stage I, primary RM. It is carried out by stationary FRM detection systems Yantar for customs applications installed on the customs inspection line next to the X-ray inspection equipment (XIE). These systems operate on a continuous automatic basis in co-ordination with the other elements of the general customs inspection system. A scheme like this provides comprehensive RM of everything that crosses the customs border and allows radiation sources to be quickly detected in the total traffic of passengers and goods. If the Yantar system produces an alarm signal, the customs clearance of the passenger stops and our officer turns to the second stage of radiation monitoring.

It should be mentioned that at stage I the alarm-causing item is recorded by video cameras fixed on the Yantar racks and automatically switched on in the case of alarm. The recorded picture is then printed out (with the number of the monitor, date and time of the event) and can be used for ensuing legal procedure.

Stage II, additional RM. It is carried out by our officer who uses hand-held instruments. His tasks are:

- to find out the cause of alarm produced by the SEPRM;
- to seek and localize the radiation source in the passenger's luggage;
- to measure the maximum exposure dose rate (EDR) on the luggage surface and to assess the situation in terms of radiation hazard for the surrounding people;
- to check the passenger's luggage for surface contamination;
- to perform primary identification of the detected radioactive source.

Stage III, profound radiation examination. It is carried out by licensed expert organizations to draw final conclusions about the detected radiation source.

This scheme is used to fulfil the first of the above nonproliferation tasks. As to the other task, i.e. control of legal FRM traffic, the scheme is as follows: stage 1, check of documentation followed by standard customs clearance and inspection procedures, and stage 2, direct inspection of the FRM.

Check of documentation consists primarily of checking the permission documents (licenses, permits of State Atomic Inspection), certificates permitting transport of FRM, certificates for container design, quota papers, and other documents required for customs inspection.

In the course of customs inspection with spectrometric instruments without opening the containers the correspondence of the declared radionuclides, their amount, uranium enrichment level to the transport documents is verified and compliance with the FRM transport safety regulations is checked. In addition, packages with FRM are weighed and X-rayed with the X-ray inspection equipment. If any discrepancy is found in the parameters of the goods, customs clearing is suspended and a statement of customs regulations breaking is made up. The regulations-breaking item is handed in to one of the appropriate licensed laboratories for expert's examination and based on the expert's conclusion a decision is taken to start legal proceeding against the regulations breaker.

This is the scheme of customs radiation monitoring at the international airport Sheremetyevo.

The efficiency of the scheme is illustrated by the following figures. In 1997, when appropriate technical means and trained personnel were lacking, there were only 2 events of detecting items with a rather high radioactivity level in the luggage. In 1999, after the entire radiation monitoring system was fully deployed (i.e. the flight checkpoint was equipped with technical means of RM, personnel was trained, special technologies and algorithms were developed), there were 61 events of radiation detection, and in 2000 there have been 90 events, including breaches of legal FRM traffic regulations through disagreement of declared and actual parameters.

We believe that the above-considered organization of radiation monitoring allows effective and quite reliable control of and adequate response to possible illicit transport of FRM through the airport Sheremetyevo to other countries, including CIS.

In the near future we plan to increase the efficiency of the radiation monitoring by integrating the currently operational customs-used stationary FRM detection systems into a single information network capable of providing simultaneous video-aided continuous nuclear monitoring at three terminals (Sheremetyevo-1, Sheremetyevo-2, Sheremetyevo-Cargo) with display of information at the workstation of the duty customs inspector.

MEASURES AGAINST ILLICIT TRAFFICKING OF NUCLEAR AND OTHER RADIOACTIVE MATERIALS IN THE SLOVAK REPUBLIC

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This presentation contains description of measures used in the Slovak Republic to combat illicit trafficking of nuclear and other radioactive materials. The main goal of these measures is to allow safe and effective utilization of nuclear and other radioactive materials under surveillance of responsible state authorities as well as recover materials that were removed form legal utilization despite the preventive measures.

Prevention is the most effective and the cheapest way how to overcome problems. An important precondition for prevention is existence of a national (or state) system for controlled utilization of nuclear and other radioactive materials completed by an effective physical protection of these materials and facilities involved and supported by sufficient low enforcement.

A state system of accounting for and control of nuclear materials in Slovakia is based on the IAEA INFCIRC/153 requirements. A fact that the IAEA inspectors never have recognized any unaccounted nuclear material could be the best proof of its quality.

Physical protection system in both Slovak NPPs is based on principles applied in development of advanced physical protection systems used in western NPPs. Technological systems and nuclear materials are categorized into three categories – first one is most sensitive. Barriers of each category zone are equipped with sufficient detection systems and are monitored by TV system. The system is operated by NPPs operators. Entrances are guarded by private security guards. Response forces are created by the Police.

A legal support provides the Act No. 130/1998 on Peaceful use of nuclear energy and regulations on Accounting and control of nuclear materials, on Physical protection of nuclear facilities and nuclear materials and on Transports of nuclear materials and radioactive wastes.
The Criminal Code of the Slovak Republic has been amended and an illegal possession of nuclear and radioactive materials is treated as a crime.

Response follows when preventive measures have been broken (either inside of state or in neighbor countries). Its purpose is to detect illegally owned material and return it back to a legal owner or its safe disposal.

After first few trafficking incidents on the territory of the Slovak Republic a group of experts from involved ministries elaborated system of measures how to cope with this phenomena.

This system covers

- detection of illegally transferred radioactive material at the border or inside of the territory of the Slovak Republic
- handling and processing of confiscated material
- radiation protection of involved persons

- improvement of analytical instrumentation in laboratories of the Ministry of Interior and Ministry of Health

The measures were applied in two steps. Within the first step some detectors were installed at the border with Ukraine, some police and custom officers were equipped with handheld and personal dosimeters. As the second step detectors has been installed at all border crossings with Ukraine and two border crossings with Poland. Police and customs officers were equipped with handheld and personal dosimeters at all border crossings.

After detection by customs or police officers a special group of the Civil Defense is addressed which carries out the basic identification of the material and together with the officers applies necessary radiation protection measures.

Confiscated material is transported by a specialized group of the Slovak Power Plants (SE) to its facility specialized on decommissioning, radwaste treatment and spent fuel handling (SE VYZ) where the material is stored and prepared for disposal.

According to real experience the effective combating could be done only in co-operation of all involved state authorities

- the Customs authorities and the Police co-operate on investigation of the event,
- the Civil Defense co-operates with the ÚJD SR (nuclear materials) and the Ministry of Health (other radioactive materials) on identification of confiscated material.

On the base of an agreement between the Ministry of Interior (Police, Civil Defense) and the company SE the facility SE VYZ will carry out transport, storage and preparation of confiscated material into a form suitable for disposal.

Special form of co-operation is co-operation between the Police of the Slovak Republic and police authorities of surrounding states and INTERPOL. This is the most effective way how to detect trafficked material inside the state territory (in the case of alpha emitters maybe the only one).

Certain form of international co-operation is participation of the Slovak Republic in the IAEA programs in this field, mainly contribution to the IAEA database on illicit trafficking of nuclear and other radioactive materials.

EVALUATION OF EFFECTIVENESS OF PHYSICAL PROTECTION SYSTEMS AT NUCLEAR FACILITIES IN THE SLOVAK REPUBLIC

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Abstract

This paper contains short presentation of the state supervision in approach to the evaluation of physical protection systems at the nuclear facilities as one kind of measures used to prevent combat illicit trafficking of nuclear and other radioactive materials in the Slovak Republic.

Introduction

The state supervision of the nuclear safety in the Slovak Republic is performed by Nuclear Regulatory Authority of the Slovak Republic (UJD SR). Its main objective is to ensure that the nuclear power is utilized in accordance with valid legislation and relevant international agreements in the Slovak Republic.

The utilization of the nuclear power in Slovakia is based upon the Act No. 130/1998. According to this act, physical protection of the nuclear facilities and nuclear materials is an integral part of measures necessary to ensure the nuclear safety. It is the nuclear facility operator who is responsible for the construction, operation, and physical protection of the nuclear facilities.

Physical protection system and evaluation of its effectiveness

Every organization which intends to begin construction or operation of the nuclear facility can do so only on the basis of the permission issued by the UJD SR. So-called "physical protection plan" is part of the reviewed documentation necessary for issue of the license. The plan must take into account all requirements imposed upon the physical protection system as stipulated in the UJD SR's Regulation No. 186/1999 which details the physical protection of the nuclear facilities, nuclear materials, and radioactive wastes.

The physical protection of the nuclear facilities and nuclear materials is defined as a system of the technical and organizational measures which are aimed to prevent unauthorized manipulations with the nuclear facilities and nuclear materials mainly to prevent their abuse or damage. At the same time, it represents a set of measures for vetting of the capability and trustworthiness of the persons being assigned to the working activities inside the nuclear facilities, manipulating with the nuclear materials, or having access to the information on the physical protection of the nuclear facilities and nuclear materials. For this purpose, the physical protection systems are used, forming of which have been being subject of national and international interests for long period.

The government of former Czechoslovakia decided that there was a need to create a new physical protection system which would increase the level of the nuclear facilities physical protection, back in nineteen eighties. It was decided that the physical protection would be preferably provided using an Automated Complex of Security Protection of NPPs –

AKOBOJE. After the split-up of Czechoslovakia, the Slovak Republic decided to continue in further enhancement of the physical protection, and in cooperation with western companies, it improved the existing AKOBOJE system to the level comparable with the one of the industrially developed countries.

The inspectors of UJD SR perform the inspections aimed at an evaluation of the physical protection systems levels in accordance with the valid legislative regulations. The main objective of these inspections is to assess conditions of the physical protection system and its changes since the previous inspection, assess the training and qualification programs of the physical protection team members, evaluate the plans and procedures to be applied during events at nuclear facilities. At the same time, fulfillment of remedial measures imposed upon the nuclear facility operator is checked. In these cases, they are so called routine inspections performed in accordance with an UJD SR's Inspection Plan. In case of exceptional events, the inspectors perform unplanned so-called special inspections which are UJD SR's response to the applicable event in the responsible organization.

When inspecting the level of the physical protection system, compliance of the system equipment conditions is compared with the ones described in the relevant physical protection plan for the applicable nuclear facility. With regard to the fact that the AKOBOJE system represents technical solution of the whole physical protection system, and it is designed so that any uncontrolled access of persons into individual categorized areas (i.e. into guarded, protected, and inner areas) and into the buildings, where categorized equipment is located, is prevented, the attention during its inspections is focused on the following:

- check of the persons and vehicles entries into individual areas of the nuclear facility
- check of the guarded, protected, and inner areas barriers
- check of the detection elements in the individual categorized areas
- check of the AKOBOJE control center
- check of the performance of the examinations, maintenance, and compensation measures including proper installation, examinations, and maintenance on the equipment

Part of the security system is also physical protection teams which comprise of the own employees of the responsible organization, private security service employees and police response forces of the Slovak Republic.

In case of the inspections aimed at evaluation of the required level of training and qualification of the security service employees, the inspectors focus on verification whether the employees are sufficiently qualified and whether they have sufficient knowledge and skill for performance of the assigned duties and responsibilities including procedures at the response action and use of special tactics during these action.

During the assessment of the total effectiveness of the physical protection system, the inspection is aimed at the detailed examination of the physical protection systems, and determines if these systems are functional and operational in accordance with the regulations and obligations stated in the relevant physical protection plans.

Assessment of the total system efficiency is carried out by simulation of an incident and inspection of the individual physical protection elements procedures and capability to act in the shortest possible time when delaying the intruder's progress towards the predefined intrusion target. The attention is paid during such an inspection to the following:

- functionality check of the AKOBOJE systems in service
- vigilance check of the AKOBOJE control room staff and preparedness of the physical protection elements to cope with the incident – barriers defeat and intrusion into categorized areas
- check of connection and effective communication between individual physical protection elements during response
- check of response management system and activities coordination of all involved elements.

The inspections of this type take place under strict precautions, and must be in compliance with existing plans for incidents management.

In case of the changes influencing the total effectiveness of the nuclear facility physical protection system, it is necessary that the operator asked UJD SR for issue of the permission of these changes before their implementation. UJD SR then verifies the effectiveness of the proposed changes and their total impact upon the physical protection system by its inspection activities. The main focus is that the conceivable changes should not impair the physical protection system level.

Conclusion

Based on the inspections performed up to date, it can be satisfactorily stated that the automated security system AKOBOJE installed in the nuclear facilities in Slovakia is fully functional and reliable and it complies with even highest requirements imposed upon the systems of this type in the develop countries.

TECHNIQUES AND ROUTINES TO DETECT AND RESPOND TO ILLICIT TRAFFICKING IN SWEDEN – A SURVEY

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The national capabilities to detect and respond to illicit trafficking of nuclear material in Sweden has been investigated. The study has been performed on behalf of the Swedish Nuclear Power Inspectorate (SKI). The talk will include a description of the main results of the study, together with suggested recommendations for improvements.

Measures taken in Sweden in order to prevent illegal transfer of nuclear weapons material (highly enriched uranium and plutonium), as well as radiation sources and contaminated material, have been studied. The focus of the study is put on technical issues such as radiation detectors and other analysis capabilities, but also includes a survey of the present routines that are applied in a case of illicit trafficking. The survey has been performed through interviews with representatives from the Swedish customs, radiation protection Institute (SSI), SKI, and other relevant organizations. Furthermore, visits have been performed to border crossings and metal scrap companies.

Sweden has a 2200 km land border to Norway and Finland, and the 2800 km sea border includes several large harbours, both in the Baltic sea and in the Nordic sea. Until the beginning of the 90´s the border control have had no resources to detect material emitting ionizing radiation (in this case only gamma - and/or neutron radiation is relevant). As a result of the increased number of cases involving radioactive and even nuclear material, the border guards were equipped with hand-held gamma dosimeters a few years ago. In total 63 instruments has been distributed along the Swedish border line. This is the only detector equipment available today. If a radiation dose of more than twice the background or 0.7 μSv/h is detected, the border guards are advised to contact the Swedish Radiation Protection Institute (SSI), which is the authority responsible for the first handling of the goods. If the material is found to be nuclear material, SKI is contacted. The border control has no fixed installed systems for cars, trucks, boats or trains. The experience of such systems in Sweden can however be found at several private steel scrap companies, which have installed fixed installation equipment on their own initiative. There are today no official regulations forcing to control imported metal scrap with respect to contamination from radioactive substances.

The Swedish border control has no resources for detection of neutron radiation. The detection of neutron radiation is especially important in the case of plutonium (weapons grade plutonium emits about 50000 neutrons/second/kg, while weapons grade uranium emits approximately 1 neutron/second/kg). Regarding the specific topic of forensic analysis of a sample of nuclear material, the study finds a need for introducing routines involving national and international institutions with advanced analysis capabilities. It might be difficult to find motivation for a relatively small country like Sweden to keep the analysis capability for all kind of nuclear forensic investigations. A formalized contact with international laboratories would therefore be of great value. It is, however, important that certain analysis techniques, such as identification of isotopic and elemental composition, is performed nationally.

In summary, the study finds that Sweden has certain capability to detect and respond to an event involving illicit trafficking of nuclear material. There is, however, room for improvements, in particular in the area of fixed installed detector systems, neutron detection, and the establishment of formal routines and enhanced national capabilities for forensic analysis. The possibility to equip the border controls with hand-held (or pocket) neutron dosimeters should be investigated. Furthermore, a pilot study involving fixed installed systems at one or several selected border crossings would give useful national experience in this area.

PHYSICAL PROTECTION AT NUCLEAR POWER PLANTS IN SWEDEN

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Extended synopsis

The paper will discuss the issue of physical protection from the view of the power plant security manager. The full paper will elaborate on the issues indicated under each heading below.

The Swedish Nuclear Power Inspectorate, SKI as the normative regulatory authority

SKI directions are based on a unique Swedish situation taking into account our tradition of civil persons being unarmed.

SKI ambitions forms the basis for our security level.

Physical protection issues are discussed with SKI both in an informal and formal dialog.

SKI and the plants have established a mutual confidence based on co-operation and a clear understanding of roles.

Physical protection and reactor safety

The physical protection is part of the reactor safety, but we were given requirements from two different offices at SKI.

We make use of reactor safety systems to guarantee cooling of the core long enough for the response force to arrive at the plant and to take appropriate measures.

Responsibility for an effective physical protection at the plants

The roles of:

- *the management* as being responsible for the physical security at the plant
- *the staff* as policymakers and controllers
- *the operating personnel* who are obliged to follow given instructions
- *all the employees* in contributing to the security by recognising unknown persons and reporting risks

Security barriers and balanced protection in depth

The Swedish nuclear power plants are provided with security barriers, Limited, Supervised, Protected and Vital areas with checkpoints at the boundaries between the different areas.

Mechanical safety will stop intruders and security equipment will give us information and initiate the response by guards and the response force.

Unarmed guards and response force by the police

Unarmed guards are part of the fundamental philosophy at our plants.

We use guards for early warning and follow up at incidents.

Threat handling by the prepared and trained police officers from the Swedish police force in co-operation with the plant management.

Experience from 25 years with physical protection at Swedish nuclear power plants

The challenge to maintain security awareness and to explain the necessity of security preparations for a potential threat, that by many is deemed to be unlikely. The importance of getting general acceptance for the threat.

All co-operations need preparation and co-operation between the plant and relevant authorities such as SKI is a vital part of the physical protection of Swedish nuclear power plants.

During the last years we have had trouble with demonstrations at Swedish nuclear power plants. This kind of events is not defined in the SKI directions.

REVISING NATIONAL PHYSICAL PROTECTION REGULATIONS FOR NUCLEAR FACILITIES

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Extended synopsis

The Swedish Nuclear Power Inspectorate, SKI is the competent nuclear regulatory body in Sweden and therefore responsible for the supervision of nuclear activities. In the directives to SKI, the Government specifies performance goals. One of these goals is that nuclear facilities and nuclear material under Swedish jurisdiction must be given adequate protection against terrorist attacks, sabotage and theft.

Furthermore SKI should establish regulations that are clear and transparent. The requirements in the regulations should be sufficiently general so that the licensees' responsibility for safety and security is not negatively affected or assumed by SKI. Moreover SKI should through activity-oriented supervision control how the licensees meet the requirements.

In addition to this the international physical protection recommendations, published in INFCIRC/225/Rev. 4, were recently revised to better reflect modern requirements.

During the build up of the nuclear power program in the late seventies SKI early recognised the need for physical protection measures at nuclear facilities. It took SKI a couple of years to arrive at a suitable concept for protection which then led to the publication of regulations requiring operators to take proper measures. The regulations have remained unchanged and served its purpose well but due to changes in the supervisory policy of SKI and requirements to modernise regulations there is now a need to rewrite also the physical protection regulations.

The present regulations are by nature very detailed but in the light of the new supervisory policy of SKI, to clearly put the full responsibility on the licensee to take appropriate measures, the objective is to have transparent regulations laying out general functional requirements which the licensee has to meet. The licensee should then have the obligation to show SKI how the regulatory requirements are met.

In order to achieve this a process to revise the physical protection regulations for nuclear facilities was initiated in 1999.

The process that has been established by SKI to develop regulations can be divided into the following formal steps:

- Development or review of the existing design basis threat, to be co-ordinated with other national authorities.
- Proposed regulations, first draft
- Review of the internal regulatory group at SKI
- Comments from relevant offices within SKI
- Proposed regulations, second draft

- Information to the Director General and the Board of SKI
- Request for informal comments from operators, police authorities and other relevant bodies
- Meeting with interested operators and other relevant bodies to review comments
- Proposed regulations, final draft
- Formal request for comments from operators, police authorities and other relevant bodies
- Proposed regulations presented by the Director General to the Board for approval
- Regulations in force

As shown above the process is quite lengthy but it gives the opportunity to include external comments into the final regulations. Furthermore there is a greater possibility that the final regulations will meet a better acceptance by the licensees given that they have had the opportunity to influence them. SKI has had very good experiences using this process in developing regulations during the last years.

The full paper will in more detail discuss the process to review the design basis threat, the challenge to draft general requirements without loosing focus on important issues. Furthermore the interaction with safety specialists at SKI and the dialog with the licensees and relevant authorities will be discussed. Finally the paper will elaborate on the cornerstones of the revised regulations.

NATIONAL INFRASTRUCTURE FOR DETECTING, CONTROLLING AND MONITORING RADIOACTIVE MATERIALS

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The Atomic Energy Commission of Syria (AECS) has the direct responsibility to assure proper safety for handling, accounting for and controlling of nuclear materials and radioactive sources which based on a solid regulatory infrastructure , its elements contains the following items: preventing, responding, training, exchanging of information.

Based on the National Law for AECS's Establishment no. 12/1976, a Ministerial Decree for Radiation Safety no. 6514 dated 8.12.1997, issued by the Prime Minister. This Decree authorizes the Syrian Atomic Energy Commission to regulate all kinds of radiation sources. It fulfills the basic requirements of radiation protection and enforce the rules and regulations.

The Radiation and Nuclear Regulatory Office (RNRO) is responsible for preparing all the draft regulations. In 1999 the General Regulations for Radiation Protection was issued by the Director General of the AECS, under Decision no.112/99 dated 3.2.1999. It is based on IAEA, s publication, Safety Series no. 115 (1996), and adopted to meet the national requirements.

Syria has nine Boarding Centers seek to prevent unauthorized movement of nuclear material and radioactive sources in and out side the country. They are related to the Atomic Energy Commission (AECS), and are located at the main entrances of the country. Each provided with the practical tools . Each provided with the practical tools and equipments in order to assist Radiation Protection Officers (RPO) in fulfilling their commitments, by promoting greater transparency in legal transfers of radioactive materials and devices. They apply a complete procedures for the safe import, export and transit of radioactive sources. The RPOs, provide authorizations by issuing an entry approval document, after making sure that each concerned shipments has an authorized license from the Syrian Regulatory Body (RNRO) before permitting shipments to leave , to arrive or transit across their territory and enables law enforcement to track the legal movement of shipments to prevent theft, diversion or misuse.

A high technique for radiation monitoring were established in four boarders centers. Each of these centers has a Radiological Control for Vehicle loads (multi channel system) RCVL. This system allows radiological control for vehicle loads at each access of the Syrian boarders: Syrian-Lebanon, Syrian-Turkey Syrian-Jordan and Syrian-Iraq borders.

At the time being, our new updating regulations enforce medical practices, their quality and operational characteristics and the patient protection provisions – to have and implement a proper Medical Exposure Control for radiological patients.

Syria has a national Secondary Standards Dosimetry Laboratory (SSDL) at AECS which is managed by a well qualified and trained team.

REFERENCES

[1] National law and Regulations

EFFORTS OF TURKEY IN COMBATING WITH ILLICIT TRAFFICIKING OF NUCLEAR MATERIALS AND OTHER RADIOACTIVE SOURCES

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Illicit trafficking of nuclear materials and other radioactive sources creates both Non-Proliferation problem and also a radiation hazard risk for the law enforcement officers, public and the environment. Since the illicit trafficking and trading of nuclear materials and other radioactive sources have been increasing over the past years, it is very important to take immediate measures for preventing these actives.

Turkey, as a country having a unique position at the crossing points of the two major routes. One connecting the Black Sea to the Mediterranean and the other connecting Europe to Asia and the Middle East, is situated on the routes of illicit trafficking. Thus , Turkey attaches great importance in combating with illicit trafficking and strongly supports all efforts in this field.

After the IAEA resolution GC(XXXVIII)RES/15 requesting Member States to "take all necessary measures to prevent illicit trafficking in nuclear materials" had been adopted. Turkey gave full support to the IAEA Programme on Combating Illicit of Nuclear and the other Radioactive Materials and also took some measures for combating such trading.

Regulatory activities regarding nuclear and radiological safety, including safeguards and physical protection in Turkey, are under the responsibility of the Turkish Atomic Energy Authority (TAEA). The TAEA ensures that the licensed activities do not cause any unreasonable risk to the public and to environmental safety and they do not impair the common defense and security interest of Turkey

TAEA was established by the Act No.2690 of 9th July 1982 and replaced the Turkish Atomic Energy Commission created by the Act No.6821 in 1956. The Act No.2690 Authorizes the TAEA to carry out the activities connected with the fulfillment of Turkey's obligations arising from international agreements of in the field of safeguards and physical protection.

This paper covers the efforts and coordination role of the TAEA's planned activities and the measures planned to be taken to prevent uncontrolled movement of such materials are presented. The co-ordinative work of TAEA with other relevant organizations such as customs officers, police and ministries, is also introduced.

ABOUT ROLE OF HUMAN FACTORS IN THE BUILDING OF PHYSICAL PROTECTION SYSTEM

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The most serious forms of the illicit turnover represent crimes against the mankind. We can defeat this evil only by paying our common efforts and establishing a protection against this disaster based on the international, national and facilities levels, with preventing any attempt of such a crime or participation in it at the earlier stages.

In our opinion, our contribution into the fight against the illicit turnover has to be focused on ensuring the safe keeping and integrity of nuclear material and radiation sources and on creating powerful and highly efficient physical protection systems.

A special role in establishing the physical protection system (at all levels) pertains to the human factor.

It is necessary to specify a place of this matter within the overall security system.

The nuclear energy sector security (as well as of other national industry sectors) is based on the people: developers, personnel, different level management responsible for decision - making process, the representative of regulatory, controlling and legal structures, and therefore, in general, the role of the human factor can be considered to be significant.

After having analyzed, even in a general way, the status of affair we can see:

- the stage of designing and development of facilities is actually completed.
- The existing concept of protection does not meet current requirements of the physical protection.
- the next period - is the operation when it is necessary to adapt with using capabilities available to the today requirements and to establish conditions under which the human factor could compensate technical backwardness.
- the final stage - the ChNPP decommissioning, the Object Shelter problem. It is obvious that the ChNPP decommissioning process will increase acuteness of the problem related to the physical protection of this facility.

The operative situation while being formed during the physical protection ensuring, first of all, is affected by the following factors:

- political factors: changes in the geopolitical situation caused by fundamental changes, formation of a national state based on a principle of democracy and law, and etc.
- social and economic factors: difficulties originated during the period of transition towards the market economy, decrease in the standard of living; increase in the crime rate and criminalization of social relations and others.
- spiritual wealth and cultural factors: state ideology crisis, deformation of norms of behavior and spiritual values, and etc.

In addition, a new problem suddenly appeared related to the safety and security of the energy complex, that is: uncontrolled processes such as: non-payments, debts on salary for several month period; all these factors affect negatively the level of safety and security.

It is clear, that in such a difficult situation the role of an individual is increasing. Actually, when there is no money for repair, fuel purchase, the biggest thereat is resulted from the situations when it is necessary to make a right decision, i.e, to trip the equipment if any deviations occurs in its functioning or to continue operation regardless the hazard.

Ignorance of the above factors or their non-objective (incomplete, partial ignorance) accounting (consideration) finally can lead to the negative and irremediable consequences.

Thus, the content and the extent of the security of a society, in general, and every person, in particular, directly depend on the functioning of all society's structure, and first of all, on the economic, social, political and legal structures.

As a result, the physical protection system acquires a complex or comprehensive structure.

The given data are very important while explaining the meaning of the notion - physical protection. This term, as you know, allows for functions to ensure the safe operation from the point of view of its resistance to sabotage acts, including a very important function as the guarding, that is : prevention of unauthorized access to the protected territory, to the nuclear installation premises, prevention and minimization of potential negative impact that can directly or indirectly cause a hazard for the environment, life and health of a human being resulted from radiation influence.

The status of security of nuclear installations fully depends on the activities performed by an individual having criminal intentions as well as by another one who is standing on his way.
There is a sufficient number of arguments to affirm that the ensuring of the physical protection from the point of view of a human factor, lays the basis for the successful solution of security problem, in general.

The fundamental documents regulating the nuclear material non-proliferation aspects, i.e., Convention on physical protection of nuclear materials, the revision of which is being conducted now under he IAEA's aegis, and the finalized IAEA's Recommendation INFCIRC /225/Rev.4, are used as the standard against which the physical protection level is assessed. The above documents also cover all the nuclear installation and materials.

The Convention suggest to consider as criminal offence the certain actions on illicit use or threat of illicit use of nuclear material for the purpose of damaging the population.

This document also foresees the development of a national system of physical protection and evaluation by the State of thereat related to the unauthorized nuclear material removal. The State should continuously analyze the treat and assess consequences of any changes in this thereat for the physical protection level and methods.

With regard to the nuclear installation that can be subject to sabotage the appropriate physical protection measures should be implemented regardless the category of containing nuclear material. The act of nuclear sabotage can lead to the radiological hazard for the population.

The convention and IAEA' Recommendations pay particular attention to the human factor considering it as a basic executor of functions related to the unauthorized actions or activities on their prevention.

Taking into account the nuclear terrorism has not statistics, while reviewing either options of thereat we proceed from the tentative scenario of the terrorists' actions. Probable nuclear leg-pull that can not cause a real damage to the equipment, if it is well-presented can lead to the panic and disturb a normal operation of an enterprise or cause other negative impact.

The most of terrorist acts including the nuclear compulsion represent the influence upon the public opinion. Even in a case of premeditated sabotage this can result in an unscheduled but normal shut-down of a reactor without any dangers to equipment and environment, that prevents the radioactivity release.

The cases such as: protection perimeter violation, calls with nuclear threats, shooting at guards or equipment, will obviously affect the operation. However, the main purpose will be the propaganda (for instance: to demonstrate that neither plant management nor the government is able to ensure appropriate safety and security level, and thus, to destroy the hopes of receiving more favorable, better opinion of population concerning the NPPs), and not the destruction, takeover or harm to anybody. Such a demonstrative assault can not be prevented in full, however, they are also significant and threaten the security.

At the same time the existing experience shows that terrorists as well as other blackmailers try do not to do a threat. The internal activity and determination make the terrorists groups improve their tactics, and increase the violence.

The scenarios of hostage taking by terrorists can present potential harms, as this repeatedly occurs during the aircraft-related blackmails.

None of organizations can work without confidence in people at all levels. The hiring, guarding, monitoring and registration of people that are performed due to the security reasons, could become so burdensome that will hamper the normal operation of equipment. The full or absolute security can not be achieved.

In order to make a comprehensive evaluation of the terrorism significance we have to take into account political, moral and practical considerations. However, due to the lack of opportunities to assess the treat, the following approach is applied: we do not know if this represents a threat, but it is better to considered it as a threat. Therefore, during structuring of the physical protection system in many countries (France, Canada and others) the guards are not even armed.

Recently, during solution of the physical protection problems the scale inclines to the need to see, first of all, a specific person, to look for measures and ways preventing potential manifestation and preventing conditions for negative actions, and not to count on the force that should be used as an ultimate or extreme measure.

PHYSICAL PROTECTION AS THE MOST IMPORTANT PART OF THE NATIONAL SYSTEM OF COMBATING ILLICIT TRAFFICKING.

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First of all I want to express my gratitude to the organizers of the seminar for having invited here experts on accountancy and control, on physical and radiation protection, on export control, health care as well as representatives of Customs and Border and law enforcement institutions. During this meeting everyone will be given an opportunity to express his or her opinion on the subject matter , to explain the role and capacity of their activities as an integral part in the system for combating illicit trafficking. The meeting will enable all the participants to share their experience in solving problems in accordance with "The Problem on Combating of Illicit Trafficking" adopted at the G7 meeting held in Moscow in 1996 and with the Resolution of the General Assembly of the IAEA "Measures of Illicit Trafficking…" as well as facilitate the development of joint approach towards practical implementation of strategies and methods of non-proliferation of nuclear weapons and assess possible ways to eliminate nuclear threat.

Hereby I would like to present the view of the Department of Nuclear Energy at the Ministry of Energy and Fuel of Ukraine at the issue in question.

It is now obvious today that illicit trafficking, including its most dangerous manifestations proliferation of nuclear weapons, smuggling of nuclear materials and equipment – present a serious threat to the international community. To defeat this evil is possible only by joint efforts, by undertaken protective measures on national and international level.

Joint efforts should be directed at fulfilling three main tasks as follows:

1. safe and reliable handling of nuclear material, effective measures of its physical protection, accountancy and control in order to prevent proliferation;
2. Joint activities of intelligence customs and law-enforcement authorities directed at prevention of international trafficking and marketing of stolen goods;
3. Joint activities directed at identification and prevention of illegal supply and demand of fissionable materials counteracting thereby various criminal structures;

We believe that in order to solve these problems an international regime should be established. Such international regime will make the states implement the existing international agreements that will strengthen their postings regarding non-proliferation of nuclear weapons, ensure combat of illicit trafficking as well as facilitate Cupertino between national and international data bases on non-proliferation of nuclear weapons, bilateral agreements between state authorities and international organizations regarding joint investigation procedures of the cases involving illicit trafficking. Such regime will define a number of criteria and demands to be met by the states to ensure effective combat illicit trafficking.

We believe that these goals of international regime against illicit trafficking can be achieved by one organization only- IAEA, an authority respected by the international community and presently responsible for nuclear safeguards. Recommendations and guidelines on physical protection including the Convection on Physical protection have been developed under its auspices. IAEA enjoys great respect and has extensive contacts including those with Interpol; it renders services related to physical protection and illicit trafficking to member states as well as is setting up the database and data-processing systems on illicit trafficking.

The international regime should be based on National systems of combating illicit trafficking which include measures for prevention, detection and response regarding illicit trafficking in each specific state or across its borders.

When undertaking these measures one should take into account specific characteristics of the state, its unique features and its geography, political and economic situation, as well as different types of potential threat of proliferation of nuclear weapons, availability of materials subjected to illicit trafficking in this state, general situation of criminal trafficking in this state, general situation of criminal trafficking with radioactive materials, potential consumers and suppliers, market features , possible incentives for crime etc.

Vital components of National systems for combating illicit trafficking are:

- legislation;
- state control systems;
- operator responsibilities;
- physical protection of nuclear and radioactive materials and equipment;
- export/import control of nuclear and radioactive materials and equipment;
- clear definition of goals and responsibilities of national legislative authorities;
- co-ordination of activities between national authorities as well as with international organizations;

Within the framework of the National system an inter-departmental authority should be established with the task of combating illicit trafficking. This authority should provide co-ordination between authorities and institutions be empowered to undertake effective and quick measures for prevention of serious crimes and for detection of offenders and their accomplices when the crimes have been committed. This authority should provide efficient and flexible co-operation between all interested parties in order to achieve specific results.

The gravest types of illicit trafficking are regarded as a crime against of humanity. This is the reason why every attempt of committing or facilitating such crime should be suppressed at the initial stage.

Measures for prevention of illicit trafficking especially the safeguards on physical protection and export control of nuclear materials are corner stones of the system of non –proliferation of nuclear weapons. In view hereof all measures of combating illicit trafficking should be focused on nuclear installations and other sites of utilization, storage or transportation of nuclear materials.

Eighty percent of all nuclear and radioactive materials in Ukraine is concentrated at the companies and institutions supervised by the Ministry of Energy and Fuel. In view hereof we see establishment of powerful and efficient systems of physical protection, accountancy and control directed against theft and unauthorized transportation of nuclear and radioactive materials as well as against acts of sabotage at nuclear installation performed by individuals or groups , as our contribution to combating illicit trafficking.

These activities are based on Convention on Physical Protection ,IAEA Guide lines and Recommendations on Physical Protection of Nuclear Materials and Nuclear Installations as well as "Basic Safety Standards for Ionising Radiation", practical application of which facilitates the development of National System for combating illicit trafficking of radioactive materials and sources of radiation. These documents will assist in creating basic national legislation. For example for drafting Ukrainian Law. "On Physical Protection…". Much work has been done at nuclear installations of our Department in order to improve their safety and physical protection, namely;

- to minimize chances of unauthorized transportation of nuclear materials and acts of sabotage;
- to undertake comprehensive measures aimed at detection and retrieval of stolen material;
- to minimize consequences of acts of sabotage

My colleagues from "Energoatom", Chernobyl NPP, are going to dwell upon these issues in their presentations in greater detail.

I want to point briefly possible ways of its improvement

The System of Physical Protection is working within the general safety system. Its specific feature is integration with the system of accountancy and control of nuclear materials which implies not only informative contacts between the Systems of Physical Protection and the System of Accountancy and control, but also their deep interconnection. Development of computerized systems of Accountancy and Control will delete the line between the line SPP. And SAC, as both are actually fulfilling the same task – providing safety. Difference is in methods and speed of information processes. Introduction of objective methods of accountancy and control will unable to strengthen the Systems of Physical Protection and will supply the latter with relevant information. In view hereof an integrated approach should be provided for the improvement of the System of Physical Protection.

These are main provisions of the Concept of Integration of the System of Physical Protection with the System of Accountancy and Control of Nuclear Materials.

Goals:

- earlier detection of theft;
- to improve accuracy of accounts, to strengthen objectives and integrity of control;
- to ensure personnel's safety;
- to reduce dependence on human factor;
- to speed-up detection and retrieval of stolen or lost material

The system is based on;

- national norms and regulations for accountancy, control and physical protection of - nuclear materials and installations;
- existing control and management structure for nuclear materials and nuclear installations;
- senior officials and companies responsible for organization and quality assurance regarding work on accountancy, control and physical protection;
- new principles of accountancy and control;
- methods for supervision of working procedures, response to any abnormal event;
- model of life circle of nuclear materials;
- zone classification of nuclear materials etc;

Establishment of single integrated system for accountancy, control and physical protection will undoubtedly lead to handling illicit trafficking of nuclear materials more efficiently and to eliminating unauthorized distribution of nuclear materials.

UKRAINE-JAPANESE-SWEDISH PROJECT: UPGRADING OF PERIMETER PROTECTION SYSTEM AT KHARKOV INSTITUE OF PHYSICS & TECHNOLOGY (KIPT)

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Since the Ukraine voluntarily accepted the status of a non-nuclear-weapon State and concluded a Safeguards Agreement with the IAEA, the Kharkov Institute of Physics & Technology (KIPT) as a nuclear facility using the nuclear material of category 1, has become a Ukrainian priority object for the international community's efforts to ensure nuclear non-proliferation measures and to bring the existing protection systems to the generally accepted security standards

In March 1996, at the meeting held under the auspices of the IAEA in Kiev, the representatives from Japan, Sweden and the USA agreed to provide technical assistance concerning improvement of the nuclear material accountancy and control, and physical protection system (MPC&A) available at KIPT.

The Technical Secretariat of the Japan-Ukraine Committee for Co-operation on Reducing Nuclear Weapons and Swedish Nuclear Power Inspectorate undertook to solve the most expensive and labour-consuming task, namely the upgrading of the perimeter protection system at KIPT. This included that the current perimeter system, comprising several kilometers, should be completely replaced.

Besides the above-mentioned problem, the upgrading should be carried out with the institute in operation. Thus, it was not allowed to replace the existing protection system by a new one unless KIPT was constantly protected. This did require the creation of a new protected zone that to a large extent was occupied by the communication equipment, buildings, trees and other objects interfering with the work. All these difficulties required very comprehensive development of the project design as well as a great deal of flexibility during the implementation of the project. These problems were all successfully resolved thanks to a well working project organization, composed of experts from KIPT, JAERI and ANS, involving the highly qualified Swedish technical experts who played a leading role.

In the framework of implementation of the project a lot of equipment manufactured in Sweden, Japan, and partly in the USA was procured by funding of Japan and delivered to KIPT. Completion of the work was schedule to take about one year. However, despite the selfless work of the KIPT personnel and other exports, the upgrading of the perimeter initiated in October 1998 was completed, due to difficult weather conditions and custom problems etc., by the end of 2000.

The project included installation of more than 6 kilometers of the standard external fencing along the perimeter of protected area of the nuclear facility, microwave and other for intrusion detection, system for cable TV alarm assessment and control (CCTV), diesel-generation to serve as an emergency power supply source for the entire physical protection system.

The center alarm station (CAS) integrated the control equipment for the perimeter protection system provided by the Sweden and Japan as well as for the storage delivered by the USA. The CAS was tested and came into operation as an integral part of the entire physical protection system at KIPT in December 2000

The successful completion of the project has lead to a significant improvement of the protection level at KIPT. Thereby it has significantly reduced the possibility for unauthorised withdrawal of the special fissionable material that is available at KIPT in quantities and forms attractive for nuclear terrorists and saboteurs.

The commissioning of a new modern physical protection system specially designed for KIPT point at some future problems, in particularly, as regards training of operation and engineering personnel, providing service and maintenance, and providing necessary spare parts. The Japan Technical Secretariat and the Swedish Nuclear Power Inspectorate has undertaken to provide necessary support for service and maintenance, including spare parts, until the end of 2002.However, for a longer period of times the KIPT Management needs to focus on this issue.

AN INTELLIGENCE LED APPROACH TO INTERCEPTING THE ILLICIT TRAFFICKING OF NUCLEAR AND OTHER RADIOACTIVE MATERIAL.

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Some aspects of nuclear material illicit trafficking detection and its interception

Recognizing the actuality and importance of nuclear material illicit trafficking problem, the Security Service of Ukraine pays great attention to the security and theft prevention of nuclear materials in Ukraine.

For this purpose the State system which include organizational and legislative measures has been established and is functioning.

Within the frame of this system the detection and perception of illicit trafficking of nuclear materials and radioactive substances take the important place in the work of law enforcement authorities in Ukraine including Security Service.

The Laws of Ukraine Nuclear power utilization and radioactive safety, Sanitary and epidemiological population control, the respective articles of the Criminal Code of Ukraine (art. 228-2, 228-3, 228-4, 228-5), the statement of the Cabinet of Ministers of Ukraine #207 on 04.03.1997 which determines the Interaction procedure between executive authorities in case of illicit trafficking of radiation source detection are its legislative basis.

The analysis of the situation shows that this problem became the most pressing after USSR collapse in 1991 due to some objective and subjective causes. Some criminals and common staff of the enterprises and organizations which were responsible for above mentioned materials and the former military men were involved into illegal activity associated with illicit trafficking of nuclear materials and radioactive substances.

Although after USSR collapse the Ukraine had the nuclear arsenal which was the third in the world, it did not become the source of weapon nuclear material proliferation. It shows the effectiveness of the measures undertaken by the government within the system of nuclear material physical protection provision. It is evident that nuclear weapon removal from the territory of Ukraine was performed without any case of its loss or theft. Therefore, currently in Ukraine there is only necessary amount of nuclear material with sufficiently less enrichment level that used in NPP reactors or for scientific purpose. These materials are under IAEA safeguards within 5 years.

In all cases of nuclear material illicit trafficking detection they had non-Ukrainian origin; that is these materials were imported to our state from outside and the final goal of the criminals was the attempt of their illegal transportation through the boundary of Ukraine in various directions and the marketing to illegal buyers.

Thereby it should be concluded that the criminals used or suppose to use the Ukraine as the transit area and the illicit trafficking of nuclear materials is principally performed in the direction from the east to the west.

According to the available data on the frequency of attempts or facts of nuclear material illicit trafficking the most intensive process was registered in 1993-1995, but currently due to specific measures undertaken by Security Service of Ukraine and other law enforcement authorities this process was stabilized.

In the last few years 5 cases per year of loss, theft or detection in illegal handling of radiation sources based on nonfissionable radioactive isotopes, which are widely used in different industrial, scientific and medical branches were registered.. There were the cases when the goal was not only the radiation source theft but the theft of lead containers in which they were stored or transported (the containers should be delivered to the receiving center for non-ferrous metal).

On expert opinion, the most dangerous situation is when transnational criminal groups are involved into nuclear material illicit trafficking process. These groups have considerable funds and established channels for illegal transportation of different goods, which can be used for illegal transportation of nuclear materials and radioactive substances. Such situation is the subject for further bilateral discussion between the experts of law enforcement authorities from the states involved into activity on prevention of nuclear material illicit trafficking. It should be mentioned, that currently such data are not available in Ukraine.

Some points of practical activity on perception of nuclear material illicit trafficking should be considered.

When the law-enforcement authorities receive the initial information on the possible illicit trafficking of such materials, determination whether it is real radioactive material is the most significant action for the farther legal classification of the criminal action. During the preliminary inquiry this information is verified by means of special equipment and requirements made by the law-enforcement authorities to this equipment somewhat differ from the conventional ones (dimensions, sensitivity, availability of sound or light signaling).

Correct determination of the material physical characteristics will affect the farther actions on its withdrawal from illicit trafficking and degree of legal liability of infringers.

There was the case in the Ukrainian Security Service preliminary inquiry practice to suppress the illicit trafficking of nuclear material. The increased level of radiation from the particular subjects showing its physical nature was not only determined by the portable spectrometer, but was identified as the exact fissile nuclear material (mixture of U^{238} and U^{235} isotopes).

What about the subjective part of the criminal activities, that is the motive for illicit trafficking of the nuclear material and radioactive substances, that in many cases, according to the available information, it is the hunger for “mythic” commercial profit but not actions of terrorist, Mafia or other Radical groups.

In conclusion we consider it necessary to notice the role of mass media that, in our opinion, have to create public perception for impossibility to get rich when marketing the stolen nuclear materials or radioactive substances. It has constantly create the public concept of the potential danger appearing during the unauthorized handling of the radioactive substances.

THE UK NATIONAL RESPONSE PLAN: AN "ALL-RISK" APPROACH

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The UK has been using and regulating radioactive materials for many years. The law, and the regulatory systems to implement it have develop over time, to meet the perceived need.

More recently, the threat of inadvertent movements of, and illicit trafficking in radioactive materials has become apparent. This relatively new challenge cannot be met by a single U.K. law enforcement body.

There will be Police and security services interest in any cases that arise of deliberate trafficking in fissile materials, and there will be statutory concerns for Customs and Excise. At the operational level, they do not have radionanalytical services and radiation protection support immediately available, as the frequency of occurrence of such incidents is extremely low

However, the typical case is an inadvertent movement. These usually involve orphaned sources, where none of the above law enforcement bodies have a statutory locus. In such cases, it is the UK environment agencies that take the lead. (as regulators of radioactive substances) , together with Health and Safety Executive as regulators of radiation safety. However they do not have all the statutory powers needed to intervene. This is in contrast to the position in some other countries.

The UK paper at the International Conference of Regulators in Buenos Aires in December 2000 described the UK's co-ordination work to create synergies between law enforcement bodies and potentially affected industry groups. This was described as an "All Risk Approach". This is seen as the best way to manage an effective response to the challenge, given that the legislation cannot at present provide all the necessary powers.

This new paper will describe the UK Response Plan and how it is designed to cover all risk: radiological and socio-economic. It will also describe how the Plan is being tested and validated as a project.

The plan draws on UK Emergency Planning policy, as well as IAEA guidance on the Prevention, Detection and Response to inadvertent movements of, and illicit trafficking in radioactive materials.

Finally the paper will review other areas of operations and policy that are being explored to combat inadvertent movements of, and illicit trafficking in radioactive materials.

THE CONCEPT OF RISK IN THE DESIGN BASIS THREAT

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Mathematically defined, risk is a product of one or more probability factors and one or more consequences. Actuarial analysis of risk requires the creation of a numeric algorithm that reflects the interaction of different probability factors, where probability data usually draws on direct measurements of incidence. For physical protection purposes, the algorithms take the general form:

Risk = Probability of successful attack x Consequence

where the overall probability of a successful attack will be determined by the product of, amongst other things, the probability of there being sufficient intent, the probability of there being available hostile resources, the probability of deterrence, and the probability that a hostile act will be detected and prevented.

Deliberate, malevolent acts against nuclear facilities are rare. In so far as it is possible to make an actuarial type of judgement, the probability of malevolent activity against a nuclear facility is almost zero. This creates a problem for a numerical assessment of risk for nuclear facilities where the value (consequence) term could be almost infinite. As can be seen from the general equation above, a numerical algorithm of risk of malevolent activity affecting nuclear facilities could only yield a zero or infinite result.

In such circumstances, intelligence-based threat assessments are sometimes thought of as a substitute for historic data in the determination of probability. However, if the paucity of historic data reflects the actual threat - which by and large it should - no amount of intelligence is likely to yield a substantially different conclusion. This mathematical approach to analysing risk appears to lead us either to no risk and no protection or to an infinite risk demanding every conceivable protective measure.

The Design Basis Threat (DBT) approach offers a way out of the dilemma. Firstly, it allows us to eliminate from further consideration all zero or near zero probabilities. Secondly, it allows us to categorise consequences. Where the consequences would be less serious, a higher probability can be allowed before protection becomes necessary. For those consequences that would be severe, strong protective measures are justified because we have eliminated the zero probabilities. Furthermore, the protective measures can be specifically focussed to reduce those probabilities to a tolerable, near zero, level.

The presentation discusses the relationship between risk assessment, threat assessment, and the Design Basis Threat. The paper argues that criteria-based judgement at the level of Regulator is just as responsive to circumstances as criteria-based judgement at the facilities level, and, in addition, offers a more coherent method for determining priorities and for considering intangible assets at risk.

REGULATORY CONTROL AND SAFETY OF RADIATION AND RADIOACTIVE SOURCES IN BANGLADESH

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SYNOPSIS

The application of ionizing radiation and radioactive sources in different fields such as, medicine, industry, agriculture, research and teaching is constantly increasing in Bangladesh. Any system enacted to control exposure to ionizing radiation has an primary objective the protection of health of people against the deleterious effects of radiation. Establishing the appropriate level of radiological protection and safety of radiation sources used in practice or intervention attains this objective. The regulatory program governing the safe use of radioactive and radiation sources in Bangladesh is based on the legislation enacted as Nuclear Safety and Radiation Control (NSRC) Act-93 and NSRC Rules-97 and its implementation by the competent authority.

The radiation control infrastructures and procedure are described as well as their functioning for the implementation of relevant activities such as licensing, regular inspection, personal dose monitoring, emergency preparedness, etc. The issue of security of radiation source is dealt in cbse relation with the preparation and use of the inventory of all radiation sources in the country.

The NSRC Act-93 and NSRC Rules-97 promulgated under the Act forms the basis of radiation safety in Bangladesh and chairman of BAEC is the competent authority to enforce the regulatory provisions of the NSRC Act and Rules, for safe use of radiation sources in the country. As the competent authority responsible for the radiation safety of the public and environment, Nuclear Safety and Radiation Control Division of the Bangladesh Atomic Energy Commission is responsible for licensing the use of radioactive and radiation sources in Bangladesh. Applicants are obliged to provide all necessary information and to take all needed steps to maximize protection. Guidelines for applicants are based on the BSS-115 (1996) recommendations for public and environment.

The main regulatory elements required for control of radioactive and radiation sources in Bangladesh are:

- Authorization to posses radioactive and radiation sources
- Authorization to transport of radioactive sources
- Import and export of radioactive sources
- Disposal of radioactive sources
- Physical security of radioactive sources
- Accountability of sources and records
- Location of sources
- Inspection
- Periodic checks of inventories and notification of loss of control

The Rules have already been notified and put to force on September 18, 1997. It, however, took considerable time to shake off the inertia and motivate people towards licensing and for compliance of the safety and regulatory requirements. The licensing activities have been geared up from the middle of 1999 and are gradually gaining momentum, as may be seen in Fig. 1.

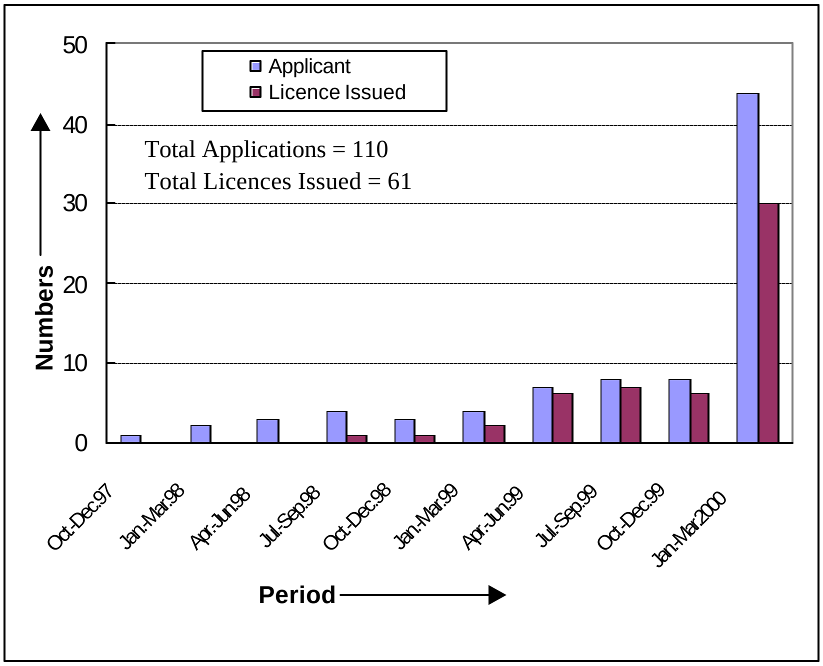

Fig. 1. Status of license applications received and number of licenses issued for the period of Sept. '97 to March 2000.

This paper outlines the methodology of regulatory control exercised by BAEC for safe use and control of the radioactive and radiation sources in the country.

METHODOLOGY FOR EVALUATING PORT VULNERABILITY TO NUCLEAR SMUGGLING

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Background: Fueled by an increase in intercepted nuclear smuggling events, the threat of nuclear smuggling has received increased attention in recent years. This attention has resulted in a focused effort to improve the ability to deter or detect smuggling attempts through border crossings, including seaports, airports, and rail & road crossings. These efforts have primarily been focused on installing SNM detectors across vehicle and pedestrian gates entering these ports. However, the effectiveness of this application in deterring or detecting events has not been carefully evaluated.

A recent effort was undertaken to evaluate in detail the susceptibility of an international seaport and airport to nuclear smuggling. The evaluation considered a range of adversary profiles to match these against existing and proposed port security measures and equipment.

The evaluation was pursued using path analysis methodologies, which were adapted to the port environment. As a result of limited data concerning the effectiveness of patrol, search, and access control procedures at the port, an assessment methodology was developed to estimate these in a standardized fashion.

The methodology considers a detailed list of tasks each type of adversary must successfully accomplish for any particular smuggling scenario and path through the port. Within these tasks, locations or times of potential detection are identified. From a look-up table, a detection level (Low, Medium, or High) is assigned to each detection potential based upon the type of detection possible and considering the possible access or authority of each adversary. The overall detection potential in determined as a sum of these individual detection potentials according to the equation:

$$P_t = \{1 - \sum (1 - P_n).$$

Where: P_t is the total detection potential for an adversary path, and
P_n is the individual detection at a particular location or time.

The evaluation revealed that the current process of installing portals at perimeter gates ignores several plausible adversary scenarios, and that these scenarios can be addressed through a combination of procedures, minor physical security upgrades and relocation of portals.

The presentation will discuss the adversary profiles used for the analysis, will detail the analysis methodology and discuss the results of the analysis.

"JOINT U.S.-RUSSIA COOPERATION TO ENHANCE PROTECTION OF WEAPONS USABLE NUCLEAR MATERIAL IN RUSSIA"

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Synopsis

The current status of joint nuclear material security efforts initiated in mid 1990's at sites having large inventories of weapons usable nuclear material will be described. Improving the protection of desirable Russian nuclear material is the mutual goal of the United States and the Russian Federation risk reduction activities. Assurances are required to provide evidence to the President, Congress, Department of Energy (DOE), and the public that improvements are cost-effective and are meeting United States national security goals. To date, there has been a range of successes relative to negotiations between the DOE and the Ministry of the Russian Federation for Atomic Energy. The Material Protection, Control and Accounting Program (MPC&A) is actively seeking to initiate MPC&A work at sensitive facilities throughout Russia in joint cooperation with MinAtom site managers.

A 'TUBELESS' PORTABLE RADIATION SEARCH TOOL (PRST) FOR SPECIAL NUCLEAR MATERIALS

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Nuclear Safeguards and Security Systems LLC (NucSafe) has produced a briefcase packaged Portable Radiation Search Tool (PRST) for the IAEA Safeguards Group (Figure 1). The PRST detects Special Nuclear Materials (SNM) by measuring neutrons and gamma rays. Neutron sensors are comprised of scintillating glass fibers, which provide several advantages over conventional ^{3}He and $^{10}BF_3$ tubes. These ^{6}Li glass fiber sensors offer higher neutron sensitivity, increased dynamic counting range, eliminate transport and operational hazards, and have significantly less microphonic susceptibility than gas tubes. Bismuth Germanate (BGO) is used as the gamma detector due to its higher intrinsic efficiency relative to Sodium Iodide (NaITl) detectors. Since gamma spectrometry *senso stricto* is not a system requirement, gross gamma counting in six regions of interest was designed for the PRST search functions.

The system must be as light as possible and is now ~8 kg with an overall size of 46 x 36 x 15 cm. The unit uses smart lithium ion batteries that may be exchanged with a fresh pack or recharged during operation. Operating time with fully charged batteries is 8 to 10 hours. The PRST does not require an external computer for operation. Onboard electronics allows the system to integrate data over multiple counting times and provides over-sampling and peak detection and hold for short alarm events. Users can independently adjust a number of parameters including set points for neutron and gamma channel alarms, but system operation is very simple.

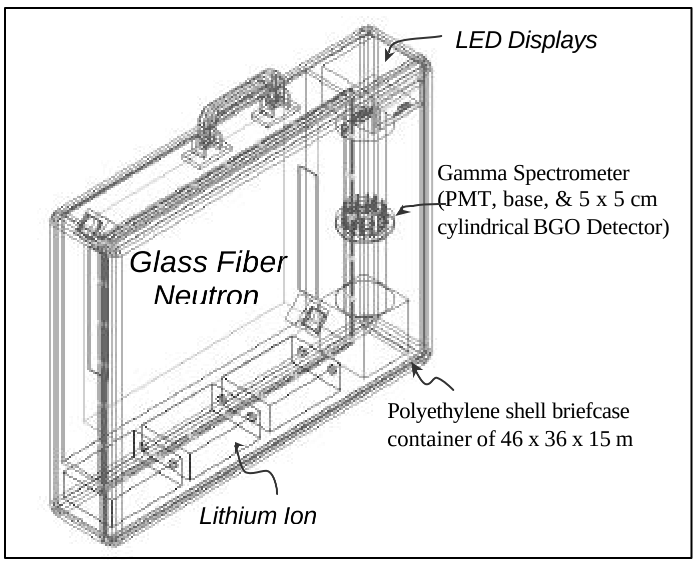

Figure 1. Modified 3D CAD drawing of the NucSafe PRST. The system has been designed to be as modular as possible. Neutron and gamma ray sensors are removable and easy to replace with alternate sensor / detection sub-systems.

PRST neutron sensors contain 5 layers of glass fiber ribbons *vice* the 3-layer glass fiber panels used in NucSafe SNM monitors for vehicles, portals, and freight. Five layers provide the additional sensitivity needed since detector areas are limited by portability requirements for the PRST. Monte Carlo (MCNP) modeling has demonstrated that moderation is more important than detector active area in attaining the highest intrinsic efficiency for a given mass of neutron glass fibers. These and other Monte Carlo and first principal calculations used to determine SNM detection limits shall be presented; *e.g.*, assuming a 0.014 n-cm^{-2}-sec^{-1} nominal neutron background, the intrinsic neutron efficiency is 20% for this 506 cm^{2} glass fiber sensor.

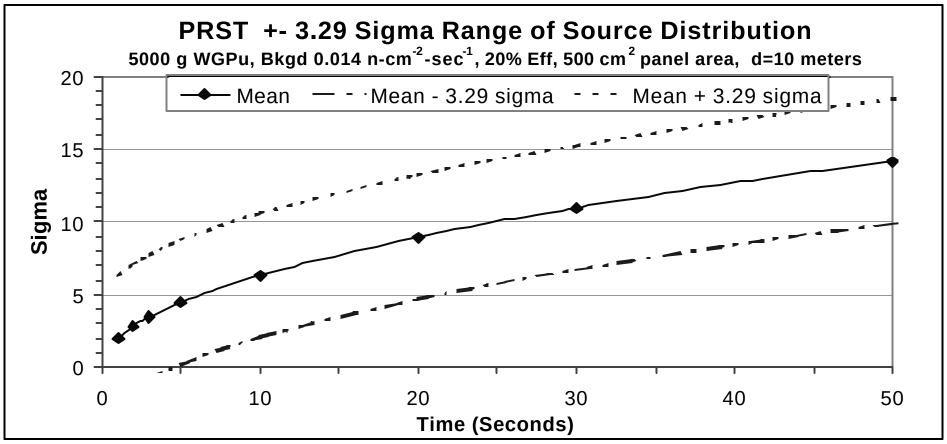

Figure 2. A plot of net counts divided by background standard deviation (Sigma) *versus* time shows that 5 kg of WGPu can be detected at 10 meters within seconds.

Figure 2 shows that the glass fiber PRST detects neutrons from 5 kg of Weapons Grade Pu (WGPu) at a distance of 10 meters within seconds. Accounting for Poisson variability of data and an alarm set point of 4.4 sigma over background, required for setting a reasonably low false alarm rate, WGPu is unquestionably detected at 10 meters within 18 seconds. These models have been validated with empirical data collected using WGPu and ^{252}Cf sources.

Neutron measurements of 4 WGPu sources acquired with the NucSafe PRST and also with a ^{3}He tube system are plotted in Figure 3. The glass fiber and tube systems were packaged in nearly identical briefcases, but the fibers can be better moderated. The glass fiber sensor is about twice as sensitive to neutrons as the ^{3}He tube system for equivalent detector masses.

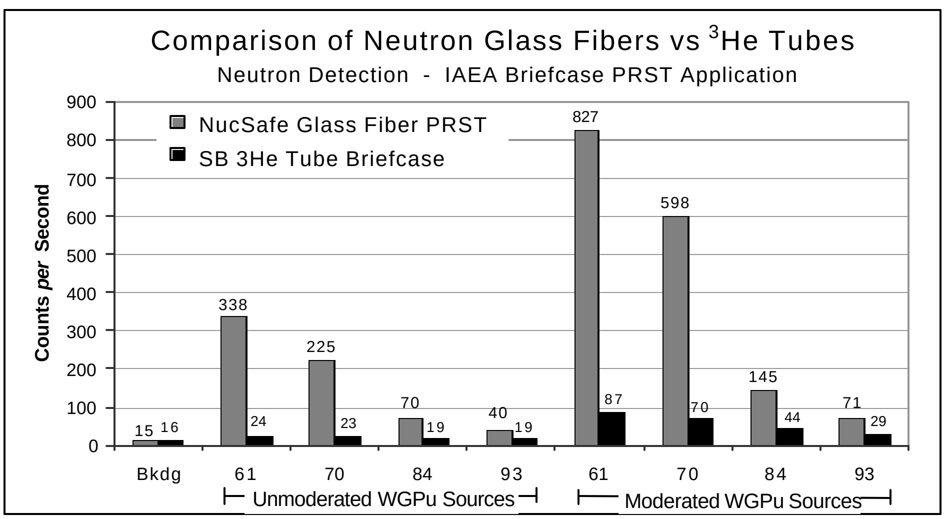

Figure 3. Comparisons of data collected with a glass fiber neutron sensor with those from 5 ^{3}He tubes at 3 atmospheres measuring 25 cm in length by 2.5 cm in diameter.

In summary, the NucSafe PRST offers improved performance, reliability, safety, and may be transported on commercial carriers. This new solid-state sensor system provides the ideal tool for IAEA and UNSCOM inspectors, as well as other law enforcement and customs agencies.

THE NUCLEAR SMUGGLING INTERNATIONAL TECHNICAL WORKING GROUP: MAKING A DIFFERENCE IN COMBATING ILLICIT TRAFFICKING

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The ITWG was first formed in 1995 for the purpose of fostering international cooperation for combating illicit trafficking of nuclear materials. The initial focus for the ITWG was on the development of nuclear forensics to help answer attribution questions regarding nuclear materials of unknown origin. More recently, the ITWG has also expanded its focus to include detection of nuclear materials during transit. This paper presents some of the key developments by this group and their potential impact for combating nuclear smuggling.

The initial focus of the ITWG was to write a status report on international cooperation on nuclear smuggling forensic analysis. This 26-page report summarized previous work on nuclear forensics and gave an initial analysis on prioritizing techniques and methods for forensic analysis regarding source and route attribution. This report was submitted to the G-8 countries, and shortly thereafter, nuclear forensics was endorsed at the Moscow Summit in April, 1996, as part of an illicit trafficking program. The work of the ITWG has also been noted at subsequent summit declarations, e.g. Cologne.

The ITWG's primary goal is to develop a preferred approach to nuclear forensic investigations that is widely understood and accepted as credible. The technical elements include: 1) development of protocols for a) collection and preservation of evidence and b) for laboratory investigation, 2) prioritizing of techniques for forensic analysis, 3) development of forensic databanks to assist in interpretation, 4) executing inter-laboratory exercises, and 5) facilitating technical assistance to countries upon request.

The development of protocols has been conducted jointly by law enforcement officials and laboratory scientists. A major focus during much of the past five years has been the development of a model action plan for nuclear forensics of seized nuclear materials . This action plan lays out the elements that are needed in the instance that illicit nuclear material is uncovered, e.g. incident response, crime scene analysis, collection of evidence (both radioactive and "traditional" forensics, transportation to a nuclear facility, subsequent laboratory analysis, and then development of the case. The action plan recommends categorizing the SNM material (i.e. weapons-grade, weapons useable, or reactor-grade) in the field by national services and characterising the SNM by international cooperation upon request.

The ITWG meetings also include reports on scientific studies that help to advance nuclear forensics. For example, at the most recent meeting (ITWG-6 held in Vienna) the following topics were presented: age-dating and source attribution for Pu production, verification of assumptions in age-dating of nuclear materials, a follow-up study on the Pu sample that was used in a round-robin experiment, the initial results of an investigation of the material characteristics of nuclear materials that might be used to identify the location of fabrication plants, and the ITRAP study conducted by the IAEA on detection at border crossings.

Many potential forensic clues cannot currently be interpreted due to the lack of appropriate databases. Several years ago, this need led to a joint effort by Russian and the European Commission (at ITU) to develop a forensics databank. They have developed a structure for the database that naturally complements the questions that are raised during an investigation. Some of the data in the databank are jointly shared, while other data entries are accessible by only the one party with the appropriate authorization to answer queries for each other. In addition to such a formal databank, the ITWG recognizes a future need to develop a network of experts with each having appropriate access to its own databases in order to jointly assist others in interpreting the results from a nuclear forensics investigation.

International exercises have been instrumental in helping the ITWG to assess the value of various experimental techniques for answering attribution questions. A companion paper at this meeting will discuss in detail the results of the first such exercise that involved a Pu sample. These exercises give a concrete focus to discussions of the pros and cons of various forensics measurements and their interpretation. The goal is to learn together how to better do nuclear forensics, rather than qualify and hence serve as a competition between laboratories.

Numerous examples can be cited for how work by the ITWG has provided assistance to countries that are developing programs for combating illicit trafficking. Again using the ITWG-6 meeting as an example, reports were given at that meeting by Latvia, Hungary, and Ukraine on recent progress that specifically drew upon earlier work by the ITWG. In the latter two countries, exercises were held that included a test and demonstration of the ITWG's model action plan for nuclear forensics. In another talk, Bulgaria reported on a case of intercepted HEU that was subsequently analyzed by another country with the necessary specialized laboratory facilities.

The ITWG recently began to address the issue of detection of SNM during transit. This topic frequently arises due to the technical linkage between nuclear forensics and radiation detection, plus many of the ITWG participants are directly involved in detecting transit of nuclear materials. One product was an evaluation of a survey of border detection systems. This evaluation helped to summarize the information provided, plus recommendations were made for possible future improvements.

Because the ITWG is a highly informal group, the regular meetings (at least annually) are the principle means of communication. Increasingly, however, it is using task groups to continue work between meetings. Examples of the subjects of recently formed task groups are: Pu isotopics of reactors, HEU detection research needs, identification of databases and knowledge experts for nuclear forensics, and IAEA/ITWG cooperation.

RISK MANAGEMENT AND THE VULNERABILITY ASSESSMENT PROCESS OF THE UNITED STATES DEPARTMENT OF ENERGY

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Risk management is an essential element in influencing how the United States Department of Energy's safeguards and security mission is executed. Risk management exists as a function of a target's attractiveness, along with the potential consequences associated with the unauthorized use of that target. The goal of risk management encompasses the fielding and operating of appropriate, cost-effective protection systems generating sufficient deterrence to protect sensitive programs and facilities.

Risk mitigation and risk prevention are accomplished through the vulnerability assessment process. The implementation and continued validation of measures to prevent or mitigate risk to acceptable levels constitute the fundamental approach of the Department's risk management program.

Due to the incomplete knowledge inherent in any threat definition, it is impossible to precisely tailor a protective system to defend against all threats. The challenge presented to safeguards and security program managers lies in developing systems sufficiently effective to defend against an array of threats slightly greater than can be hypothetically postulated (the design basis threat amended for local conditions). These systems are then balanced against technological, resource, and fiscal constraints.

A key element in the risk assessment process is analyzing the security systems against the Design Basis Threat (DBT). The DBT is used to define the level and capability of the threat against the DOE facilities and their assets. In particular it defines motivation, numbers of adversaries, capabilities, and their objectives.

Site Safeguards and Security Plans (SSSPs) provide the basis and justification for safeguards and security program development, budget, and staffing requirements. The SSSP process examines, describes, and documents safeguards and security programs, site-wide and by facility; establishes safeguards and security program improvement priorities; describes site and facility protection philosophy and strategy; and provides an estimate of resources required to accomplish improvements.

Two major parts comprise a SSSP. Part I, the Safeguards and Security Management Report, contains information describing protection strategies, site/facility safeguards and security programs, approved deviations from policy, as well as plans and procedures designed to manage and maintain safeguards and security programs. Part II, the Vulnerability Assessment Report, reflects the results of Vulnerability Assessments; the validation of Vulnerability Assessment results by performance tests; currently existing protection programs; and any required corrective actions.

The SSSP process can be a complex and resource intensive process. The responsibility for the steps in the current SSSP process can be directly attributable to the various Departmental organizations with an interest in safeguards and security risk management within the Department.

Vulnerability Assessments form the basis for the Safeguards and Security Planning Process. The Vulnerability Assessments are performed by a process summarized in following six steps: 1) Threat and Target Identification, 2) Facility Characterization, 3) Protective Force and Systems Characterization, 4) Risk Determination, 5) Risk Validation and Verification, and 6) VA Approval and Concurrence.

Threat and target identification are accomplished through the application of the DOE Design Basis Threat against targets prioritized based on Material Category, Attractiveness and Desirability.

The facility characterization is a process that models a facility to determine material, system and protective force dispositions. The model relies heavily an the operations personnel, maintenance personnel and the protective force personnel for accurate information.

The protective force and systems characterization determine, model and quantify the operations, capabilities and performance as applied against potential adversaries. The characterization is evaluated through the use of performance tests, Force-on-Force exercises and observation.

Risk determination is the process of quantifying and evaluating the aggregate protection afforded the targets based on the protective force and systems characterization. The risk is assessed and reviewed to ensure that all targets are protected in a cost-effective manner while maintaining an appropriate level of security.

Risk validation and verification involves performance tests, operational reviews and protection systems evaluations. Validation is the hand-on assessment of the capabilities and performance characteristics of the protection systems. Verification is a review of the Validation to ensure that all interests are covered.

The approval and concurrence is the acceptance of the Safeguards and Security Management Report and the supporting vulnerability assessment as an accurate depiction of a facility's protection posture, philosophy and operations.

The DOE federal operations office responsible for the specific facility in question has the lead role in ensuring each of these activities occur. It is assisted by the contractor who actually manages the facility as well as the DOE headquarters which funds the activities and the Office of Safeguards and Security which develops the Design Basis Threat.

THE PREVENTION OF ILLICIT TRAFFICKING OF NUCLEAR AND RADIOACTIVE MATERIAL IN VIETNAM

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I Introduction

Vietnam has signed Safeguard Agreement under NPT in 1989 and is preparing to joint the Convention on Physical Protection of Nuclear Material.

To enhance the fulfillment of commitment in the beginning of 1993 a joint group of experts from VAEC, Ministry of Defense and Ministry of Security.
was set up to:

- Search the current situation of illicit trafficking of nuclear and radioactive material and
- Prevent the illicit trafficking

Activities were carried out during four years with modest resources and results achieved are remarkable, no case of illicit trafficking is detected from 1997 until now.

II Searching the illicit trafficking situation

The objectives of searching are following:

- What is material in the illicit trafficking.
- What is the motivation of illicit trafficking.
- What is the illicit trafficking ploy .

1. Material in the illicit trafficking

End of seventies and during eighties, there were rumors on black trade of precious and mysterious metal with unbelievable high prices, higher many time than gold price. Rumors said the name of metal as uranium, black copper or osmium . We have collected all material confiscated during that time and during our activities and the study shows:

- 516.56 kg of confiscated material is depleted uranium with U-235 mass content ranging from 0.2% to 0.32%, uranium mass content(U-235+U-238) ranging from 80% to 99%.
- Mostly pieces have a mark Made in USA. The masses of pieces are ranging from 0.3 kg to 150 kg. By geometry and structure they are some mechanical parts of still unidentified machines.
- All pieces can be considered as radioactive material, the radioactive dose rate at their surface is ranging from 10μSv/h to 100μSv/h.(Background: 0.2μSv/h).
- 268.65 kg confiscated material is false uranium made of lead.

Its mark is written in very bad English trying to imitate the mark of real pieces. One false osmium body is made of silver.

2. Motivation of illicit trafficking and trafficking ploy

Our searching results show that there is no-proliferation motivation, it was only a swindle trick mainly among least intellectual circle. The trafficking has no organization system and only few case foreigners were involved.

III Prevention of illicit trafficking

Through analysis of material and motivation of illicit trafficking, our effort is concentrated in following measures:

1. Public information

By media, we inform the public:

- The results of our study
- The meaningless of the trafficking, due to valueless of metal
- The swindler trick
- The radioactive hazard
- The legal violation

2. Training on simplest method of detecting uranium

Due to the lack of resources, almost all remote policy posts and customs points have not adequate equipment for detecting uranium, as the frequent item of illicit trafficking. The following simplest method is given to responsible personnel at these points:

- Hardness test: Take a small iron stick (like a nail) and strike the surface of suspect piece then observe a trace. Item made of lead or iron will have a noticeable trace. Due to hardness of uranium metal, the trace is not clear.
- Oxidization test: Strike again stronger and faster surface of suspect piece and observe a spark. Spark from uranium piece is richer.
- Density test : Make a first weigh: a dry weigh (weigh as usual) and write down the weight: G1. Then make a second weigh: a wet weigh: put piece into water (the carrier must have a negligible volume like nylon net) and write down the result: G2. The density of the material of piece is :

$$D = G1/(G1-G2) * D(H_2O)$$

For rough approximation, D(H2O) is taken as 1g/cm3. If the suspect piece has a density larger than 13g/cm3 it may be an uranium mix material.

- In the case of dosimeter available one can carry out a measurement of dose rate on surface, if the rate about or more than 1µSv/h, it may be considered as a certain uranium piece.

After such training, we always got right information on trafficking and the confiscated material send to us for further analysis and storage is only the real uranium pieces.

IV Conclusion

The paper is a kind of the story rather than a scientific paper, but after the measures are being taken, no case of illicit trafficking was reported.

THE WORLD CUSTOMS ORGANIZATION (WCO)'S PARTNERSHIP CONCEPT

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Illicit trafficking in nuclear and other radioactive materials is recognized as a new enforcement phenomenon, and international and national reactions to this problem are being questioned despite the number of seizures made by law enforcement agencies.

In general terms, law enforcement actions to prevent and detect illicit trafficking of these materials always start with information or intelligence received and become an integral part of the national or international efforts to bring these illicitly trafficked materials under the requisite control.

However, these efforts clearly require a comprehensive and co-ordinated national plan and the inclusion of Customs services as a national, governmental border control agency to stop illegal activity before or as goods leave the country.

These efforts also require each relevant national institution to develop its own-action plan in compliance with the national action plan and to review it on a permanent basis.

The followings are considered key elements of such a plan, legal basis and power, co-ordination, technical and training support, deployment of detection equipment, information and intelligence collection and sharing, risk assessment and profiling studies.

For the Customs community, the challenge is not limited to the prevention and detection of these materials. It has been noted that the international movements of contaminated scrap and other materials also have to be stopped at national borders. In addition, the need for safety measures for Customs inspectors and the lack of internationally accepted investigation standards, even between neighbouring countries, is increasing the scale of the problem.

The Customs community is tasked with facilitating legitimate trade and protecting society and the environment. This requires administrations to achieve a balance between these two global duties, while not interfering with the international flow of passengers, vehicles and cargo.

Within the law enforcement community, we bear witnesses to close co-operation between Customs, police and regulatory bodies and common understanding which is greatly supported by the relevant international organizations, namely the: IAEA, WCO, ICPO-INTERPOL.

The World Customs Organization (WCO) is an independent intergovernmental body with world-wide membership (153 Members, as of 1 December 2000) whose mission is to enhance the effectiveness and efficiency of Customs services in the areas of compliance with trade regulations, protection of society and environment and revenue collection, thereby contributing to the economic and social well-being of nations.

In line with its mission, the WCO secretariat has already developed an enforcement programme to respond to this important enforcement topic and has developed a partnership concept at international level for not only to harmonize but also maximize limited resources by signing a Memorandum of Understanding (MOU) with the IAEA and ICPO-Interpol.

This partnership concept implies solidarity and standing shoulder to shoulder with the relevant institutions and assisting the Customs community to cope with this problem through the inclusion of these partners' technical input.

The WCO has therefore agreed to co-sponsor the IAEA's International Conferences (Dijon, France; Stockholm 2000) and five regional and sub-regional training courses where Customs, police and regulatory representatives have had a chance to come together to discuss various aspects of the programme and share their practical experience.

The IAEA's current efforts to finalize its technical documents on "prevention", "detection", "response", "training" and "radioactive materials" concerning the problem of illicit trafficking have been voluntarily supported by the WCO Secretariat and its Members through the Technical Committee Meetings since 1997.

This co-sponsorship also extended to the ITRAP (The Illicit Trafficking Radiation Assessment Programme) project which lasted from May 1998- September 2000 to support the IAEA programme on combating illicit trafficking in these materials and was a pilot study on border monitoring systems.

One of the new enforcement initiatives taken by the WCO Secretariat is the creation and implementation of a new enforcement communication and co-operation instrument known as the Customs Enforcement Network (CEN).

The new Internet based enforcement network now allows the Customs community to exchange information and an intelligence in encrypted and inexpensive way through a properly authorized computer a without time limit. One database operated through this system is that for nuclear and other radioactive materials seizures.

The Customs community is, without any doubt, aware of its potential role in preventing and detecting this non-financial crime and has always been ready to take part in national preventive action plans with its national and international partners. The WCO, in line with its enforcement mission, will continue to assist its partners in worldwide efforts to prevent this trafficking.

A PROPOSAL FOR AN INTERNATIONAL TAGGING SYSTEM FOR RADIOACTIVE MATERIALS

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In an early paper (1) based on our experience with lost or abundant radiation sources (2), we have discussed the need of an international tagging system for radioactive materials for the purpose of insuring trackability, accountability and safety. In this paper we take our discussion further by presenting a proposal of establishing such an international tagging system for radioactive materials which we call ITS-RM.

The elements of ITS-RM:

- IAEA is to be the international authority in charge of ITS-RM.
- Each "significant" radiation source is to be labeled with a unique number at the point of production. This number is identified as ITS-RM number.
- The term "significant" can be defined in light of current international standards.
- As each source is naturally possessed by some legal notion or international entity, each time this entity is changed (e.g. the source is sold, resold, transported, decommissioned etc.) the process of changing hand is registered at IAEA via the ITS-RM number.
- No source is to change hands without triggering ITS-RM.
- Even if a source finds its way to a waste facility it will remain tagged indefinitely.

The requirement for ITS-RM:

- Legal requirement: this issue needs to be studied to find out weather anew international treaty needs to be established or ITS-RM can be applied under existing treaties.
- Organizational requirements: This can be easily done with the framework if IAEA and national counterparts.
- Consultation requirements; ITS-RM can only work if it is done through complete consultation and cooperation with manufactures.

Old and current sources:

- An effort is to be made to survey and tag current sources:
- Priorities will be given as follows: first to new sources second to current sources the comes last old sources, particularly those in storage facilities.
- ITS-RM is not to compete with any existing safety system, national or internationally, to the contrary is to support safety.

ITS-RM advantages are many but in particular we have:

- Trackability even if somebody does not cooperate.
- Accountability of sellers, buyers, users and waste managers.

- Knowledge about the international holdings of RM's.
- Ultimate Safety from theft from illicit trafficking, lost or abundant sources.

ITS-RM Cost:

It will have only some minimum cost for the organizational aspect since the IAEA framework is already there.

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EXPERIENCES FROM THE ITRAP PILOT STUDY

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Introduction

Illicit trafficking and inadvertent movement of nuclear and other radioactive materials is not a new phenomenon. However, concern about such activities has increased remarkably in the last decade. Although the number of such incidents has risen, the overall extent of the problem is not restricted to Europe and not to nuclear proliferation. A few percent of these incidents involve so-called “special nuclear materials", which may be used for nuclear weapons and therefore cause a threat of nuclear proliferation. The vast majority of these incidents, however, involve radioactive sources, low-enriched, natural or depleted uranium, which are not usable for weapons. There have been instances in which loss of control over radioactive materials has led to serious, even fatal, consequences to persons. Examples include unintentional incorporation of radioactive materials into recycled steel, recovery of lost radioactive sources by unsuspecting individuals, and deliberate purloining of radioactive material.

The ITRAP project – financed by the Austrian Government and executed by the Austrian Research Center in close cooperation with the IAEA, World Customs Organisation (WCO) and Interpol – aimed at finding international consensus on specifications for detection equipment and instrumentation as well as verification of such specifications in laboratory tests and field installations. Under the umbrella of the pilot study, 23 international companies participated in the study and many of them devised improvements of their monitoring equipment.

Objectives of the study

An important element of this study was the harmonized establishment of detection thresholds for practical implementation at borders or similar checkpoints. However, equally important was the verification of agreed specifications in controlled laboratory conditions and in realistic operating environments (field tests). All crucial parameters, as *inter alia* the false alarm rate, were verified by a significant testing effort as compared to approaches based on statistical calculations only.

Assessment program

Details of the assessment program are found elsewhere[1][2]. Specific scenarios have been analysed [3] and another overview is presented in this conference[4]. The core of the testing program was focused on the radiological parameters *sensitivity* (detection probability) and *false alarm rate* with their associated confidence levels in the laboratory evaluation. Close to 200.000 tests were performed on most stationary instruments alone to verify these parameters. The main findings shall be reported here.

Lessons learned

Among other important findings, the experiences gained in reference to the chosen intervention level and the consequences of the statistical specifications adopted shall be presented. The study has profited from the willingness of all manufacturers to cooperate and improve their systems based on these findings.

Investigation level

The *detection limit* is a quantity intrinsic to an instrument and describes its capabilities with respect to sensitivity. The *investigation level* is a term specifically adopted throughout the study to describe the *nominal* radiation level in terms of radiation field strength at the point of detection (radiation intensity) at which an alarm is triggered and subsequent investigation of individuals, vehicles or goods should be established. It is an agreed setting based on analyses of threat potential, possible harm caused, and acceptable false alarm rates. A compromise must be reached in establishing a practical alarm threshold so that illicitly trafficked radioactive or nuclear materials may be detected, yet provide an acceptably high immunity to fluctuations of background radiation or naturally occurring radioactive materials (NORM). A particular investigation level is realized by the actual alarm threshold setting of a monitoring instrument. This setting can be expressed in terms of multiples of background, or as a multiple of the standard deviation of the background countrate.

Specifications and consequences

For stationary monitoring instruments, the following specifications were adopted:

- detection sensitivity (nominal alarm threshold) at 0.3 µSv/h @ 99.9% probability for Am, Cs, Co
- exposure interval 1 sec within 10 sec occupancy interval, 60 second quiet time
- false alarm rate at 0.2 µSv/h not more than 10^{-4} (1 in 10.000)

The requested probability for alarm detection (the nominal investigation level) necessitates an instrument alarm threshold setting much below the nominal value to capture 99.9% of the events (approx. 3? below nominal). On the other hand, the requirement of a false alarm rate not exceeding 1 in 10.000 proved to be a challenging requirement for many instruments, necessitating a lowest allowable threshold setting well beyond 3.8 of the background count rate (which would correspond approximately to an ideal Gaussian behaviour) – see Fig. 1.

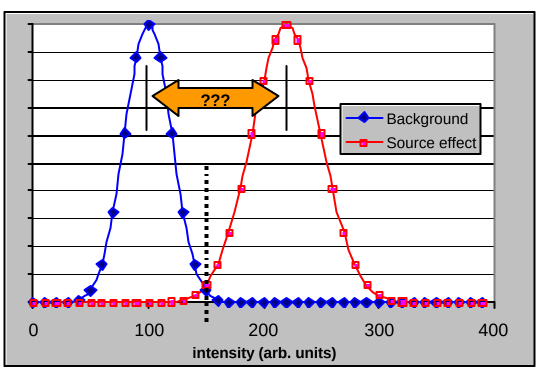

Fig. 1: Schematic diagram of overlapping Signals from background and radiation source.

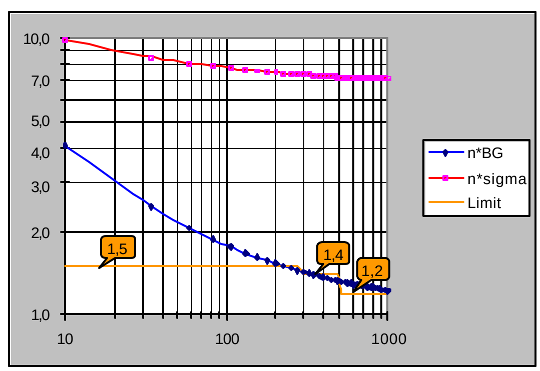

Fig. 2: Minimum nominal threshold setting as function of multiples of Background and sigma.

THE HALLAND MODEL – AN INNOVATIVE MODEL FOR THE PHYSICAL PROTECTION OF A NUCLEAR FACILITY

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The Police Authority of Halland County, Halmstad, Sweden

Halland

Halland is situated on the West Coast of Sweden. The entire West Coast borders on the sea – the Kattegatt and Skagerack. The local population is about 280,000, and is considerably larger during the summer.

The county comprises six municipalities – Falkenberg, Halmstad, Hylte, Kungsbacka, Laholm and Varberg). Halmstad is the seat of the county administration.

Ringhals

Ringhals is Sweden's largest nuclear facility with four reactors. The facility is located near to the sea, several kilometres north of Varberg.

Physical Protection

The Police Authority of Halland County is responsible for physical protection at Ringhals. Officers have been appointed to ensure that there is adequate preparedness and competence within the Police Authority. The Police Authority works in close co-operation with the County Administrative Board and the municipalities involved as well as with the management of Ringhals.

An extensive set of plans exists for work at Ringhals Nuclear Power Plant. The plans relate to *physical protection*, *emergency standby* and *incident response* in connection with technical problems.

The plans for ***physical protection*** are formulated so that they coincide with Ringhals's status with respect to threats. Emergency alerts and measures exist in order to cope with the following events:

- **Demonstrations**

Peaceful demonstrations concern offsite activities that do not have a significant impact on Ringhals's activities and which mainly aim at influencing external opinion.

Threatening demonstrations that concern offsite activities that have a significant impact on Ringhals's activities or which involve masked or armed participants as well as any form of demonstration where the participants enter the Ringhals site.

- **Assault**

Threats that arise if an armed individual or a group of people enter the Ringhals site and/or congregate on the site.

- **Bomb Threats**

The bomb threat must be directed to Ringhals or to Ringhals's activities.

- **Dangerous Objects**

Unknown objects or objects with unknown contents that could be bombs and that could involve a risk to the personnel or the facility.

- **Disturbed Individuals**

An individual who is under the influence of drugs, mentally imbalanced or who is in any other way out of control of his/her actions, who threatens the personnel or facility safety.

An ”assault” will automatically cause an emergency standby to take effect. This means that a combination of alerts/physical protection measures (in the case of a criminal attack) and incident response plans will apply.

Incident Response Plans

If a technical fault occurs – or could occur – this could jeopardise the operational safety of Ringhals nuclear power plant. Therefore emergency alerts and incident response plans exist for:

- **Emergency standby**

An event has occurred at the plant which is or could be important to reactor safety. No radioactive releases have occurred. Essential systems function as intended.

- **Incident alert**

When a radioactive release is initiated or is considered to be imminent.

Measures Undertaken by the Police

Measures undertaken by the police in the event of a criminal attack or an incident situation are handled in co-operation with the Police Authority in Västra Götaland. An agreed plan of action involving both police authorities has existed since 1998.

The plan contains a detailed description of how measures in the situations described above should be managed and implemented. Strategic and operational management levels and staff operations are detailed in the agreement/plan. The plan also describes co-operation with Ringhals Nuclear Power Plant during the work and how liaison, reinforcement, maintenance, personnel reporting and joint training should be conducted.

The Halland Police Authority has the territorial responsibility for the police measures. Upon request, this is reinforced by police troops from the Police Authority in Västra Gotland.

Measures relating to physical protection are implemented on Ringhals's site (inside the fence) by the police reinforcements while the Halland Police Authority's own troops implement the other measures. The police supervisors of the different authorities co-ordinate the measures.

Regular drills, on a small or large scale, are held in order to practice these measures and the management and staff operations.

Training

At different times every year, the Halland Police Authority trains its own resources in co-operation with some of the authorities and organisations involved in the preparedness organisation. The training focuses on the situations described above and it also comprises training in the evacuation of the population living closest to the Nuclear Power Plant in the inner emergency-planning zone.

THE SWEDISH POLICE AS A PART OF THE SECURITY SYSTEMS OF NUCLEAR MATERIAL AND OTHER RADIOACTIVE MATERIALS

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National Criminal Investigation Department, Stockholm, Sweden

In Sweden a special transport system has been developed for transports of nuclear substances and nuclear waste. This system in itself includes a high security level. Extraordinary circumstances can give cause for protective police measures and intervention.

In concerned provinces an incident and emergency response planning take place of the police actions that may be needed at the following types of event:

a) bomb threat

b) attack or threat of attack on transport vehicle

c) demonstrations

If a Swedish nuclear power plant is the subject of a bomb threat or other criminal assault, it is in Sweden, according to the Police Act, the task of the police to intervene, interrupt criminal acts and to restore order and security.

The role of the Swedish police as regards the physical protection is, among other things, to carry out a certain control within protected area by special trained police personnel before a reactor is put into operation or restarted after revision or repair.

Police authorities that have a nuclear power station within its jurisdiction should establish a plan for police actions at the nuclear power station in consultation with legal owner or management of the plant, the Swedish Nuclear Power Administration and the county administration.

Special training and frequent practice of response personnel is crucial as well as co-training with key personnel at nuclear power stations.

The National Criminal Investigation Department coordinates and commands police measures concerning different types of nuclear transports.

Close co-operation with security and operational personnel at the nuclear power stations, operators of the transport system, the Swedish Nuclear Power Administration and the Swedish Radiation Protection Institute is very important.

OPEN SOURCE: INTELLIGENCE: A TOOL TO COMBACT ILLICIT TRAFFICKING

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The purpose of my presentation is to provide some thoughts on Open Sources and how Open Sources can be used as tools for detecting illicit trafficking and proliferation.

To fulfill this purpose I would like to deal with the following points during my presentation:

- What is Open Source? How can it be defined?
- Different sources
- Methods

Open Source information can be defined as publicly available information as well as other unclassified information that has limited public distribution or access to it. It comes in print, electronic or oral form. It can be found distributed either to the mass public by print- or electronic media or to a much more limited customer base like companies, experts or specialists of some kind including the so called gray literature. Open Source information is not a single source but a multi-source. Thus, you can say that Open Sources does not say anything about the information itself, it only refers to if the information is classified or not.

Slide 1

Open Source information is the use of co-ordinated methods:

- The discovery of sources,
- The monitoring of sources,
- Collection of open data and information,
- The structuring of retrieved information
- The communication process with and dissemination of information to the end users.

During the existence of the "Iron-Curtain" and the "Berlin-Wall" the access to and use of Open Sources was rare. Of decisive importance was the question of military and political early warning between the east and the west and different channels to obtain information about the adversary was more or less institutionalized. In a way, the world was more predictable compared with the world today and hence the need to use Open Source information must be regarded as very limited and restricted. Thus, the end of the so-called "Cold World Era" did to a certain extent contribute to the progress of Open Source information as an intelligence source.

Slide 2

The revolution, or more correctly the evolution, in information technology, has made it possible to get quick and global access no matter where you are and no matter where the threat emerges. The Internet with its World Wide Web has made Open Source Information accessible to the public. The World Wide Web made it possible to easily retrieve and to share information without having any special computer skills. Complex databases that were difficult to access were suddenly easy to use for almost everyone. Thus, during the last ten years an increasing bulk of information has been possible to obtain through overt channels.

Open Sources also enables you to get information quickly to a low cost. Even though you actually need to buy the information, which you will need in most cases, it is still a cost-effective opportunity to obtain necessary information at the right time, especially if you compare it with covert sources.

Another reason for using Open Source information is the fact that it provides unclassified intelligence or lower classifications. In many areas classified intelligence capabilities are either not available, or the information cannot be shared. Information sharing both within your organization but also outside your organization, increases your efficiency and enables cooperation with parties that you cannot share classified information with for different reasons.

New threats have emerged, and some threats that had existed for a long time have been upgraded and have received a higher priority. Asymmetrical warfare, terrorism, organized crime, migration, drug dealing, environmental damage, and the reason for why this conference is taking place proliferation and illicit trafficking, demands new and improved methods to get the necessary information. Those threats demand new ways of thinking. Traditional intelligence does not always incorporate civil and political information. Open Sources do.

As mentioned earlier, Open Sources are cost-efficient. Don't send a spy when you can send a schoolboy.

Slide 3

Open Sources are not a substitute for classified capabilities. Confidential information in all its shapes is still in many cases of a profound importance. However, Open Sources can, and should, be used to corroborate/ confirm, refute and deny, i.e. to be used as a sanity-check. It could also be the other way around. Information that comes to your intention through Open Source information could be an early warning sign that bring about a full investigation. It can also enhance and be a supplement to information already known before. A narrow range of classified sources may mislead the analyst into accepting a narrow interpretation of events. Using different sources decreases the risk for misunderstandings.

Last but not least, decision-makers that are dependent on people's opinions react primary on Open Source information. The debate is mostly held in media and most decision makers use media as a way to communicate with the public but also with other parties, national and international.

Slide 4

Open Sources are all non-classified sources and hence it would be impossible and pointless to try to give an extensive overview of all sources included. However, there are some categories that are worth mentioning. The first group are think tanks and other kind of research establishments. In most cases the information that they provide is of an analytical nature and mostly cost free. Most of them also have links to other sites with related information. Federation of American Scientists, SIPRI, Center for Non-proliferation Studies at the Monterey Institute and Nuclear Control Institute in Washington are some examples.

Slide 5

The second group consists of images, maps and web cameras. Open Source images can be divided into two sub categories. The first group is real time images from commercial satellites. These are associated with very high costs, but on the other hand you can get high-resolution images quick. Worth mentioning is that it is more difficult to get images over the so-called 'third world'. One of the providers is Space Imaging. The second sub category is images that are free. These have in most cases poorer resolution and are not real time images.

There are several thousand of maps available for free and they cover all kinds of areas: historical; country; regional; weather; topographic etc.

Web cameras can also be useful. However, the can be tricky to find and there is always a risk of dis-information.

Slide 6

The third group consists of media and it covers everything from a particular newspaper to huge databases such as Reuters Business Briefing and Lexis Nexis. Most newspapers are possible to read without a fee but accesses to databases are in most cases associated with a high cost.

The next group of Open Sources are Governments and International governmental organisation and Non-governmental organisation. Valuable information could be press releases and reports. This information is generally free.

The fifth group comprises of the so-called grey literature, i.e. conference papers, research reports, internal reports, preprints and working papers are non-commercial sources. Although hard to find, they are in most times very valuable sources of information.

And finally, there are a lot of sites on the Internet that covers a special interest group such as different 'liberation Movement'. Today almost every obscure group has their own website.

However, the cheapest way to get relevant information is to ask the person who knows. Internal knowledge networks can save your organisation a lot of money.

Slide 7

The first question you must ask yourself before you start searching for information on the Internet is if you should surf or trawl. The difference between trawling and surfing is if you know what you are looking for and your search is meant to catch the fish or if you with your search just want to see what kind of fish the sea contains.

The Internet contains billions of WebPages and there are mostly no substantive editorial quality control, meta-tags, independent reviews, or other forms of value-added discrimination. Furthermore, most of these WebPages are not properly indexed in some sort of universal directory. There are approximately 2.1 billion online WebPages and 7 more million pages are

added every day. There are at least 330 million Internet users today and the risk for information overload is high. Besides Internet, there are also thousands of online, i.e. Internet based, databases for example Reuters, that produces approx 70 000 articles each day (60 mil in archive) and Dialog that has 9 TB of information in 600 databases.
The reason why I'm mentioning all this statistics is for you to understand how enormous the Internet is and especially how important it is to use the right tools to search for information.

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The questions that follow is what kind of tools can you use?

The first and maybe the most common tool are *Search engines.* They create their listings automatically, crawl the web, and then people search through what they have found. So you are not actually searching the Internet. Size of the database, frequency of update, search capability and design and speed may lead to amazingly different results. Search engines are in most cases very simple tools with less precision. No one has indexed more than 50-60 percent of all WebPages.

Meta-search engines, contains a central place with a uniform interface, where a query can be entered and the search can be conducted simultaneously in as many search engines and directories as necessary, and search results can be brought back and displayed in a consistent format.

There are also four other groups of tools:

Subject directories are often called subject "trees" because they start with a few main categories and then branch out into subcategories, topics, and subtopics. Because humans organize the websites in subject directories, you can often find a good starting point if your topic is included.

Subject guides is similar to a Subject directory but with links only. Specialized Databases are portals from where you can access different sub categories, which are made up of specialized databases, and finally, the last tool is Virtual Reference Libraries, consisting of a compilation of links.

The best way is to try different tools and then chose two, three that suits your needs best.

Slide 9

Even though Internet is said to be global, there are certain geographical limitations. Of all the millions of Internet users in the world almost 45 percent makes up of US based users, followed by Europe's 27 percent and Asia/Pacific on 22 percent. This means that Africa, Middle East and South America only account for altogether 7 percent of all Internet users. In Russia there is approximately 3-6 million Internet users, i.e. between 1 and 2 percent of all users. These figures indicate that, most likely, Internet today is for the western countries and contains the information the western user request.

Furthermore, of all billions of WebPages on the Internet, 75 percent are in English. The fastest growing Internet language is Chinese. Spanish is expected to grow with 550 percent in three years.

Slide 10

Information in relation to intelligence is in most cases not validated. The information needs to be corroborated and confirmed before used as facts. To facilitate the sanity check process primary sources should, if possible, be used, with the ambition to be as closed to the event as possible. Information presented in a local Swedish newspaper about an event in Moldova might be third or fourth hand information. The risk is hence apparent that the information has been distorted on its way to the end source.

Slide 11

There are several different analytical tools for visualizing search patterns and different kinds of information mapping. Diagrams made in the Analyst Handbook can for example show associations between people and transactions. What seem to be hidden relationships suddenly appear clear. When working with a lot of information the problem facing the analyst is not the shortage of information but understanding what that information means.

MODERNIZATION OF THE PHYSICAL PROTECTION SYSTEM OF IPEN-CNEN/SP

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The plans of physical protection of nuclear facilities must be reviewed and updated every two years [1]. A general study of the physical protection system was carried out in order to review and to update the plan of physical protection of IPEN-CNEN/SP. Important alterations accomplished at the institute were considered in the study, as the installation of a cyclotron 30 MeV and the new operation conditions for the nuclear research reactor IEA-R1, that include the increase of its operation power from two to five megawatts and the establishment of the continuous operation by 72 hours weekly.

The area of IPEN-CNEN/SP is 478,000 m^2 (101,850 m^2 built area of 107 constructions). The group responsible for the study investigated the performance of the physical protection system and detected some points that could be reinforced at inner and protected areas. The initial step was the evaluation, *in loco,* of the constructions and physical barriers of inner and protected areas. The performance of the security force personnel on the conventional procedures, as access control to the facilities, control of material flow, area monitoring and patrol, as well as its response for special situation procedures in the case of a physical protection emergency, were evaluated too. The study also focused the communication means used by the security force, as the extension phone lines that are located in each entrance area and in the huts, and the portable VHF radios that are used by the guards.

In order to elaborate a programme of modernization of the physical protection system, using the results of the study as basis, an internal committee composed of specialists in physical protection, nuclear safety, operation of reactors and engineering areas was created. The programme elaborated by the committee strengthens the physical protection system by applying the defense in depth concept [2]. At the same time, it attempts to propitiate a balanced protection to minimize the consequences for the failure of one component of the physical protection system.

Periodic maintenance of physical barriers, as fences, has been performed in order to keep the level of opponent retard. Portable VHF radios have been purchased to improve the security force communication, creating redundancy in the communication channels. The performance of the physical protection system depends largely on the security force personnel. For this reason, the modernization programme dedicates special attention to the training of those professionals. Emphasis is being given to the emergency procedures, because the personnel action in those cases was considered an important point. The specific training on radio communication is also being reinforced.

Nowadays the committee is evaluating the creation of an integrated center of physical protection (ICPP), where the central alarm station will be installed. The ICPP will monitor continuously the intrusion sensors to be installed at the institute. In order to assess the alarms, TV cameras will be installed all around the fences of inner and protected areas. The ICPP will be equipped with redundant communication means with the security and response forces and with the high administration of the institution.

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THE THREAT OF NUCLEAR TERRORISM

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There have always been enormous gaps between the potential of a weapon and the abilities and/or the will to employ it by terrorists. New means and methods of violence with unknown outcomes could be less appealing for sub-national groups. Conventional "off the shelf" weaponry is thus likely to remain the major tools for traditional terrorists.

However, the analysis show that while the risk of nuclear terrorism may be remote, it should not and cannot be excluded. Rigorous standards and means the protection, control and accounting of fissile materials are thus needed.

"Nuclear terrorism" can be defined as acts of violence and destruction where the means applied are nuclear devices, or threats of use of such means, to create a condition of fear, to get attention, or to blackmail to have wider effect on others than the directly targeted victim(s). Nuclear terrorism is a subset of radiological terrorism, were the means (or threats) applied are radioactive substances. While being distinctly dissimilar in terms of technical approaches and damage potentials, many of the features with regards to public threat perception are likely to be similar.

No non-state actors have ever deployed or used a nuclear device, and the number of (publicly known) nuclear bomb treats has been limited. However, there is a disturbing interest among some terrorist organizations in acquiring nuclear weapon capabilities, probably for tactical purposes.

The biological and chemical programs of the Japanese "Aum Shinrikyo" cult that culminated in the Tokyo metro attack is highly publicized. Less well-known is the nuclear weapon program of the group. Nuclear material was acquired from the sect's properties in Australia and markets were explored to purchase nuclear technology via straw trading companies.

Another highly profiled terrorist group with obvious nuclear intentions is the "Al- Qa'ida", the group of bin Laden. The recent trail for the bombings of the U.S. embassies in Nairobi, Kenya and Dar al-Salaam, Tanzania, August 1998, has shed new lights on bin Laden's and his groups' intentions to acquire weapons of mass destruction. Dating back to 1993, the group tried on several occasions to acquire nuclear material – and apparently nuclear weapons – during the 1990s.

The technical hurdles to overcome for making a nuclear explosive should not be regarded insurmountable. The highly differing requirements for performance, safety, and delivery can make weapons meeting the "terrorist standard" less technically challenging than producing state nuclear weapons. The rapid spread of technological knowledge can further boost terrorists' weaponization attempts.

The first generation nuclear weapons, which then represented state of the art technology, is now not only old, but also regarded as highly primitive. Their designs are well known from the scientific literature. To highlight the proliferation dangers and the potential for clandestine nuclear bomb production, nuclear scientists have presented simple, technical outlines of crude gun-type weapons. A yield in the lower kiloton range is probable. At least two types of nuclear weapons can be built and fielded without any kind of yield test, and the possessors could have reasonable confidence in the performance of those weapons.

Acts of nuclear terrorism is likely to set a terrorist organization apart from any other group, and could compel governments to take the terrorists seriously. The attention span would be excessive and immediate due to the manifest and unambiguous nature of a bomb demonstration. Past nuclear explosions and nuclear accidents, limited public knowledge of radiation and the human inability to sense potential exposures may have cultivated (disproportionate) negative perceptions of radiation. Terrorists who capitalize on these connections are likely to have a strong psychological impact.

The primary technical barrier against nuclear terrorism is access to highly enriched uranium (HEU) or plutonium, the essential components of any nuclear weapon. State nuclear weapons programs will usually be supported by large and costly infrastructure for enrichment and/or reprocessing of fissile weapons material. Sub-national groups, however, are more likely to rely on externally acquired weapons-usable materials.

The vast production of fissile materials during the cold war has today left the world with a staggering legacy of three million kilos of weapons-usable material. More than half of the overall production of weapons-usable materials is in excess of national security needs. The huge quantities of fissile materials and the numerous reports of lax security and accountancy of nuclear materials raise concerns over the possibility of a successful diversion of significant quantities of weapons-usable materials, particularly in the former Soviet Union.

Recently declassified U.S. documents reveals that a significant nuclear yield can be accomplished by utilizing reactor-grade plutonium in nuclear explosives. Claims have been made that reactor-grade plutonium is a more appealing option to terrorists. Ever increasing stockpiles of separated civilian plutonium could thus be a reason for concern, and calls have been made to protect the material as if it were nuclear weapons.

The use of crude nuclear weapons provides the opportunity of fairly reliable, distinct, prestigious, novel, and highly visible acts of large-scale terrorism. Preventing any extremist group for achieving their goals of large-scale nuclear violence could only be done by preventing the access to fissile materials through state compliance to rigorous standards of MPC&A.

IAEA PROGRAMME ACTIVITIES ADDRESSING ILLICIT ACTIVITIES INVOLVING NUCLEAR AND OTHER RADIOACTIVE MATERIALS

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Abstract

The Agency's programme Security of Material dates back to 1995. The range of activities and programmes embarked upon by the Agency addressed the wide spectrum of issues associated with nuclear and radioactive materials. Recently, the Agency has increased its level of international co-operation, inter alia, with the World Customs Organization (WCO) and the International Police Organization (Interpol). The resulting collaboration produced a number of highly successful regional seminars and training events addressing prevention, detection and responses to illicit trafficking in nuclear and radioactive materials.

Responding to the requirements of Member States for practical assistance in the areas of prevention, detection, and response to incidents of illicit trafficking, including border monitoring, the Agency provided national training courses to individual Member States, which were hosted by the Agency training team. The recognized success of the two national level courses delivered in the last quarter of the year 2000 provided the Agency with the impetus to go forward with a series of new initiatives in 2001 and beyond.

This paper provides an overview of the Agency initiatives designed to address issues in relationship to illegal activities involving nuclear and radioactive materials. A global perspective on the issue is presented followed by specific responses to the assistance requests of Member States. The programmes described will include the continuation of the national level training courses, as well as training initiatives designed to produce cadres of highly trained officers. The officers will perform tasks in their own States that will range from proper response to radioactive incidents to the development of an indigenous training course for additional officers. The paper also addresses the need for greater sharing of information and more detailed information and reporting on illegal activities. The conclusion will stress the need for closer cooperation between the Agency, other International Organizations and the Member States in order to utilize resources more effectively and sponsor greater levels of cooperation.

INTERNATIONAL CO-OPERATION AGAINST NEW THREATS IN TERRORISM

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[EXTENDED SYNOPSIS NOT AVAILABLE]