UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

Monitoring and Response Procedures for Radioactive Scrap Metal

Proceedings of the UNECE Group of Experts on Monitoring Radioactive Scrap Metal (Geneva, 12-14 June 2006)

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New York and Geneva, 2006

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PREFACE

In 2004, the worldwide consumption of scrap metal was of the order of 440 million tonnes with around 184 million tonnes traded internationally. The proportion of steel products now made from scrap is more than one half. With metal scraps coming from many different sources and melted together, the risk of radioactive contamination, from both artificial and natural sources, entering the recycled metal stream increases. Increased global trade in scrap metal also exacerbates the risks.

Radioactivity can become associated with scrap metal in many different ways: by a radioactive source contaminating the metal scrap, scrap metal becoming activated from exposure to a radioactive source or the metal scrap may also surround or shield a radioactive source. To cover all three cases, we use here the term "radioactive scrap metal". It may include both material that is subject to regulatory control and material that is outside regulatory control.

Concerned about a number of recent incidents across the world involving radioactive scrap metal and aware that an growing global trade in scrap metal could increase such incidents, UNECE published in 2001 a report on the "Improvement of the Management of Radiation Protection Aspects in the Recycling of Metal Scrap" which provides an overview of the processes that could lead to the introduction of radioactive substances into scrap metal and recommends measures to avoid their introduction into the metal recycling stream. In continuation of this work, in April 2004 the UNECE convened the first meeting of an international Expert Group to document the current knowledge and experiences on monitoring, intercepting and managing radioactive scrap metal and to recommend future actions. At this meeting, the Group of Experts felt that three follow-up actions needed to be taken: 1. the development of a protocol or recommendations to increase the capture of radioactive material in scrap metal, to reduce potential contamination and to aid in the disposition of found materials, 2. increased information exchange and 3. training and capacity building.

A Second Expert Group meeting was held in June 2006 to agree on a set of recommendations that could be applied on a voluntary basis to help reduce the risk of radioactive substances appearing in scrap metal and to better monitor and manage this problem. These recommendations are important as they provide guidance to the different sectors and actors involved: Customs' officers, transport agents, scrap yards, the metal industry, regulatory agencies etc. While work has been undertaken by the International Atomic Energy Agency (IAEA), the European Commission (EC), Spain and others, so far there exists no international standards and specific practical measures to monitor, intercept and manage radioactive scrap metal even though large amounts of such recycled materials are traded internationally. More specifically, there are as yet no accepted norms or guidance that cut across the different sectors that are involved in the trade in scrap metal which may potentially exhibit radioactivity. The recommendations drawn up by the UNECE in collaboration with international experts intend to begin to bridge this gap. Their objective is to establish a framework that provides, within existing national and international safety standards, recommendations on the fields of actions to be addressed and mechanisms to be set up in order to effectively monitor, intercept and manage radioactive scrap metal.

It is expected that the use and dissemination of these recommendations will enable a better long-term management of radioactive scrap metal globally.

The UNECE Secretariat would like to put on record its appreciation to the United States of America and in particular the U.S. Environmental Protection Agency (EPA) whose support has greatly facilitated the convening of the Group of Experts and the preparation of this report.

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I. REPORT OF THE UNECE GROUP OF EXPERTS ON MONITORING RADIOACTIVE SCRAP METAL[1] (GENEVA, 12-14 JUNE 2006)

Executive Summary

In 2002, the United Nations Economic Commission for Europe (UNECE) published a report on the “Improvement of the Management of Radiation Protection in the Recycling of Metal Scrap”. As a follow-up, a Group of Experts on Monitoring Radioactive Scrap Metal was convened under the auspices of the UNECE consisting of experts from Governments and concerned industry groups. The subject is of considerable importance considering that more than 50 per cent of the metal used worldwide is recycled, and that much of it originates from a variety of sources and is combined by melting. In some cases the scrap metal may have been radioactively contaminated either through contact with natural materials such as soil or with artificial radionuclides from nuclear facilities or may inadvertently contain discarded radioactive sealed sources used in medicine, industry and agriculture.

Typically, thousands of incidents are reported each year involving the detection of various types of radioactive substances in scrap metal. Undetected sources have been melted down accidentally or shredded with scrap metal, thereby entering the metal stream. While the potential health and safety risks of such incidents are usually not very high due to the relatively low radiation levels involved, they are still often above acceptable levels. The economic and financial consequences of such contaminated scrap metal and metal products for the recycling and metal industries are extremely high as it can frequently result in closure and clean-up of metal production facilities and in a possible loss of trust in the use of recycled metal.

The first session of the Group of Experts (Geneva, 5-7 April 2004) reviewed the results of a questionnaire that had been circulated to countries and discussed policies and experiences in monitoring and interception of radioactive scrap metal worldwide. The session focused on ways and means to facilitate and secure international trade and transport of scrap metal.

The second session of the Group of Experts (Geneva, 12-14 June 2006) was informed of country experiences and progress made since 2004. As its main task, the Group of Experts reviewed a comprehensive document containing Recommendations on Monitoring and Response Procedures for Radioactive Scrap Metal that are based on good practices, industry standards as well as national and international safety regulations and standards. The objective of these Recommendations is to assist Governments, the metal scrap and metal processing industries, demolishers, transport operators and temporary storage companies dealing with scrap metal to counter the occurrence of radioactive scrap metal by monitoring measures and to act jointly, responsibly and effectively in the event of radioactive material being found in scrap metal.

The Recommendations provide a useful framework for action and cover areas of prevention, detection and response to incidents involving radioactive scrap metal. They cover any level of radioactivity in scrap metal that is above background levels where the radioactivity may originate from scrap metal that is activated, scrap metal that contains a sealed source, or scrap metal that is radioactively contaminated. The Recommendations should encourage further cooperation, coordination and harmonization in the fields of prevention, detection and response both at national and international levels.

Following a final review and agreement on the Recommendations by participating experts, the UNECE Secretariat has finalized, published and distributed the Recommendations in English, French and Russian.

[1] It was decided after the 2006 Expert Group meeting to change the name of the Group from “Group of Experts on Monitoring of Radioactively Contaminated Scrap Metal” to “Group of Experts on Monitoring Radioactive Scrap Metal”.

Item 1 Attendance

The session was attended by experts from the following 26 countries: Belgium; Brazil; China; Croatia; Czech Republic; Estonia; Finland; France; Georgia; India; Indonesia; Ireland; Korea, Republic of; Malaysia; Morocco; Netherlands; Russian Federation; Slovakia; Slovenia; South Africa; Sweden; Switzerland; Tajikistan; Turkey; Ukraine; United States of America.

The European Community (EC), the International Atomic Energy Agency (IAEA) and the United Nations Institute for Training and Research (UNITAR) were represented.

The following non-governmental organizations participated: Bureau of International Recycling (BIR) and Eurometaux. Two representatives of metal scrap processing companies in the Netherlands and in Spain also participated at the invitation of the Secretariat.

Item 2 Adoption of the agenda

Documentation: ECE/TRANS/AC.10/2006/1[2]

The Group of Experts adopted the provisional agenda prepared by the Secretariat without modification.

Item 3 Election of officers

The Group of Experts elected Mr. R. Turner (United States of America) as Chairman and Mr. E. Shakhpazov (Russian Federation) as Vice-Chairman of the session.

Item 4 Need for action

Documentation: ECE/TRANS/AC.10/2006/2; ECE/TRANS/AC.10/2006/3

The Group of Experts noted that the appearance of radioactive scrap metal is a growing problem. Following a serious incident with radioactive scrap metal in Spain in 1998, various Governmental authorities, the metal and recycling industries as well as labour unions agreed on a national collaborative approach on prevention, monitoring, response procedures and the sharing of costs in case of radioactive incidents. This so-called "Spanish Protocol" (ECE/TRANS/AC.10/2006/2) inspired the Group of Experts in 2004 and prompted their subsequent efforts.

In view of the high volume of internationally traded scrap metal and in order to avoid the introduction of discrete sources and improperly released radioactively contaminated material into the recycling stream, the UNECE together with the International Atomic Energy Agency (IAEA) and the European Commission (EC) produced in 2002 a "*Report on the Improvement of the Management of Radiation Protection in the Recycling of Metal Scrap*". This report addressed in particular the economic and operational concerns of the scrap metal industry.[3]

In continuation of this work, the UNECE, with the support of the Government of the United States of America, prepared and circulated in 2003 a questionnaire to Governments and the industry with a view to gaining a broad understanding of and documenting the current legislation, knowledge and experience in the monitoring, interception and managing of incidents involving radioactivity in the scrap metal industry worldwide.

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[2] All the documents referenced in this report can be found on the following website: http://www.unece.org/trans/radiation/2ndMeeting.html

[3] See also: www.unece.org/trans/radiation/radiation.html.

In April 2004 an international Group of Experts was convened under the auspices of the UNECE to discuss policies and experiences in monitoring and interception of radioactive scrap metal and to explore ways and means to facilitate international transport and trade of scrap metal. The proceedings of the meeting of the Expert Group together with extensive documentation on national experiences are contained in the UNECE report "*Monitoring, Interception and Managing Radioactively Contaminated Scrap Metal*".[4]

The Group of Experts identified ten issues as a common basis for possible future work and recommended to keep in motion a permanent international dialogue on these issues among Governments and industries. As primary follow-up efforts the Group of Experts recommended to work on the following concrete outputs:

(a) "Protocol": Development of a voluntary international "Protocol" or "Recommendations" to increase the capture of scrap metal presenting signs of radioactivity, to reduce potential contamination and to aid in the disposition of found materials.

(b) Information exchange: Establishment of an international web portal addressing radioactivity issues in the recycled scrap metal industry.

(c) Training: Survey of current training opportunities and preparation of international training and capacity-building programmes covering the fields of action identified in the "Protocol" in order to assist the scrap metal sector.

Recalling these activities, the Group of Experts felt that the use of the term "Protocol" at the international level as recommended under (a), even if applied in conjunction with the word "voluntary", could lead to misinterpretation as to its nature, objective and scope. It was therefore agreed to use the following title for the preparation of such a document:

"Recommendations on Monitoring and Response Procedures for Radioactive Scrap Metal

Report of an International Group of Experts
convened under the auspices of the
United Nations Economic Commission for Europe
(UNECE)"
(hereafter referred to as "Recommendations" in this report).

Item 5 Objectives and scope of the international Recommendations

Documentation: ECE/TRANS/AC.10/2006/3

Inspired by the successful application of the Spanish Protocol, the UNECE, with the continued support of the Government of the United States of America analyzed information and experiences of 55 countries and on this basis prepared a document on the objectives and scope of the proposed international Recommendations for consideration by the Group of Experts.

These Recommendations constitute the advice of an international Group of Experts and provide a comprehensive and consistent framework of recommendations, good practices, and model procedures and examples. The objectives of the Recommendations are to facilitate commerce by minimizing the likelihood of the occurrence of radioactive scrap metal through prevention and detection and to facilitate the safe management of any radioactive scrap metal that is discovered.

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[4] See also: www.unece.org/trans/radiation/pub.html.

The Recommendations are based on and are consistent with existing national and international regulations, codes of conduct, standards and practices related to assuring safety in the management of radioactive materials. Their use should assist Governments and the industry to develop and/or improve their own systems of prevention, detection and response procedures for radioactive scrap metal.

The Recommendations address a large number of multi-sectoral issues and should contribute to developing and maintaining an effective partnership between all parties concerned with radioactive scrap metal, mainly the demolition, metal scrap recycling and metal industries as well as Ministries and Governmental authorities in the fields of nuclear safety, radiation protection, energy, transport, Customs, commerce and the environment. They address all stages of the recycling process, including demolition, procurement, transport, storage and melting.

The Recommendations do not establish legal commitments nor do they oblige countries or industry groups to transpose their provisions into national practice, codes of conduct, formal guidance documents, administrative regulations or law. Rather, they provide a helpful framework to assist relevant parties to improve, where necessary, their actions with respect to the collection, trade, transport, melting, or processing of scrap metal. The application of the Recommendations in a country will always depend on the requirements of national laws and regulations.

Item 6 Overview of key issues

Documentation: ECE/TRANS/AC.10/2006/4/Rev.1; ECE/TRANS/AC.10/2006/4/Add.1/Rev.1

In preparing for this meeting, the UNECE Secretariat transmitted a questionnaire to participating countries with a view to updating the results obtained in 2004 and to obtaining a sound basis for the preparation of recommendations in this field. The assessment, based on replies from nearly 50 countries, focused on the following fields of action: Prevention, Detection and Response. It served to highlight existing best practices and areas requiring further attention.

In the field of prevention the information provided showed that a large number of countries have a relevant regulatory framework, including active enforcement, penalties for non-compliance, and have established exemption levels all relevant to the problem of radioactive scrap metal. In general there have been positive changes in all of these areas in the period from 2004 to 2006. In addition, there has been a significant increase in the number of countries that are using the IAEA Code of Conduct for the Safety and Security of Radioactive Sources. Areas requiring further attention were identified to include the need to:

(a) systematically collect and analyze data on radiation levels from radioactive scrap metal and processed metal shipments;

(b) increase efforts to establish appropriate regulatory mechanisms for controlling NORM (Naturally Occurring Radioactive Material) and TENORM (Technologically-Enhanced Naturally Occurring Radioactive Material);

(c) establish guidelines for identifying and characterizing sources at metal processing facilities;

(d) more effectively monitor imported and/or exported scrap metals for radioactivity;

(e) ensure that contracts include provisions that scrap metal shipments are monitored for radiation; and

(f) more effectively train personnel at processing facilities; and

(g) standardize approaches to defining the location in the processing chain where ownership of scrap metal is transferred from seller to buyer.

In the field of detection, it was difficult to obtain clear trends from the answers to the questionnaires. However, areas requiring attention could be identified as follows and included the need for:

(a) countries to issue detailed technical directives and guidance providing instructions on the proper application of detection systems;

(b) establishing a consistent and fully comprehensive approach to monitoring for radiation in imported and exported scrap metal shipments at border crossings and at points of departure and arrival;

(c) making monitoring comprehensive and mandatory;

(d) having monitoring occur at the beginning of the distribution chain while still retaining monitoring further down the chain;

(e) issuing appropriate regulations and guidelines for radiation monitoring in scrap yards and metal processing facilities;

(f) establishing a standard approach for the acquisition, quality assurance, maintenance, calibration, and use of radiation detectors at monitoring locations; and

(g) possible consistent, worldwide-accepted detection alarm threshold settings**.**

In the field of response, the information provided showed that most countries require Government investigation of all detection/alarm reports, have established protocols defining response actions in the event of a detection alarm, have established clear responsibilities for financial and physical disposition of detected radioactive materials and have specific and detailed processes, regulations or guidance to facilities for disposition of detected sources. Most countries indicated that, when the radioactive source or material is known, they can readily transport it in compliance with established transport regulations. Areas requiring attention included the need for:

(a) developing appropriate forms to guide the reporting and response actions of those involved in detecting and acting upon detections of radioactivity in metals;

(b) developing information brochures, bulletins and posters summarizing steps to be taken in response to an alarm indicating radioactivity in metals;

(c) establishing a formal procedure for defining the reporting process and associated actions for a radiation alarm;

(d) establishing a consistent and comprehensive basis for response to alarms, both by Governmental agencies and by the scrap metal industry;

(e) including in recovery programmes the regulatory method that allows for transporting radioactive material or sources where the radioactive contents are undefined;

(f) establishing an international standard that allows processing facilities to melt contaminated metal, and to accumulate detected materials on their sites, especially if below internationally accepted clearance levels; and

(g) establishing a free-of-charge disposal facility or a return-to-sender policy to facilitate resolution of incidents involving radioactive scrap and metal products.

In addition to these country replies, the Group of Experts also heard during the meeting detailed reports on specific recent experiences obtained in selected countries and of the difficulties encountered in monitoring and response procedures for radioactive scrap metal.

The Group of Experts noted that all of these findings have guided and were the basis for the development of the draft Recommendations.

Item 7 Recommendations on monitoring and response procedures for radioactive scrap metal

Documentation: ECE/TRANS/AC.10/2006/5; ECE/TRANS/AC.10/2006/5/Add.1

The Group of Experts considered in detail the draft Recommendations prepared by the UNECE Secretariat in cooperation with country experts as contained in document ECE/TRANS/AC.10/2006/5 and ECE/TRANS/AC.10/2006/5/Add.1. It accepted the general layout and structure of the Recommendations and the models contained in its annexes focusing on prevention, detection and response procedures in case of occurrence of radioactive scrap metal.

The Group of Experts considered in detail the provisions and models contained in the document prepared by the UNECE Secretariat and decided on numerous modifications to clarify the text and to align its provisions with the agreed nature, objective and scope of the Recommendations.

Critical issues of definition and scope were discussed and the following was agreed:

Definitions:

It was agreed to refer, to the extent possible, to definitions set forth by the IAEA in its Basic Safety Standards (BBS) and Safety Glossary and to ensure consistency with the terminology used therein as these are used internationally. Particular care would need to be given to define, in line with the scope of the Recommendations, the terms "radioactive material", "radioactive substance" and "radioactive scrap metal", or alternatives thereto with a view to addressing: (a) different types of radioactive scrap metal (i.e. radioactively contaminated scrap metal, activated scrap metal and scrap metal with a radioactive source or material contained within it) and (b) materials considered to be within regulatory control and materials which are outside regulatory control.

Objectives and Scope:

It was agreed that the Recommendations cover scrap metal that is activated, scrap metal that contains a sealed source, and scrap metal that is radioactively contaminated. It was noted that the Recommendations would apply to both materials normally under nuclear regulatory control and materials outside nuclear regulatory control. The Recommendations focus more specifically on detection and response than on prevention since these are the areas requiring more attention in the context of radioactive scrap metal. Also, the Group of Experts noted that the emphasis in these Recommendations is on trade and commerce rather than on security and illicit trafficking. The Recommendations describe procedures and mechanisms for the different parties involved (e.g.: transport sector, Customs, scrap yards managers, etc.) to take effective action in their own particular circumstances involving radioactive scrap metal.

With regard to the technical annexes to the Recommendations, it was agreed that while the body of the Recommendations provides a framework for action, the annexes would offer illustrative examples of existing best practices. Experts were invited to transmit further examples to the UNECE Secretariat to be included in these annexes.

Based on the general views expressed and subject to the detailed modifications made by the Group of Experts during the meeting, the UNECE Secretariat was requested to prepare a revised version of the Recommendations and its annexes taking account of the modifications agreed upon and the suggestions made during the session. These revised Recommendations have been circulated to all participating experts in July 2006 to ensure that the modifications agreed during the meeting are suitably reflected in the revised text.

Following this review, agreement was reached on the Recommendations by the experts participating in the June 2006 meeting and the UNECE Secretariat published and distributed the Recommendations in English, French and Russian.

Item 8 Other relevant issues and next steps

Documentation: ECE/TRANS/AC.10/2006/6

On the basis of a document prepared by the UNECE Secretariat, the Group of Experts considered briefly possible follow-up work to be undertaken once the Recommendations have been finalized.

It was noted that it is important for the Recommendations to be widely circulated, particularly to all stakeholders regulating and/or contributing to the metal recycling stream. The general need for training, capacity building and information exchange between all parties involved was stressed, including the need for technical assistance to countries not having the required experience, expertise and sophisticated technical instruments to monitor and respond adequately to radioactive scrap metal. In addition, efforts would need to be made to identify and, if required, to develop user-friendly training material to ensure that targeted personnel were capable of using the Recommendations as an effective tool to prevent, detect and respond to radiation incidents related to scrap metal without jeopardizing commerce and safety.

Thus, future efforts should focus on these areas of work to be undertaken jointly by competent Governmental and industry bodies.

In this context, the experts from the United States of America made available CD-ROMs of training modules developed in the USA on “Responding to Radiation Alarms” and on “Identifying Radioactive Sources at the Demolition Site”.

Also, the Group of Experts was informed by representatives from the United Nations Institute on Training and Research (UNITAR) of their global training programmes, capabilities and networks of specialized bodies and from the European Commission about current work on a platform of training modules addressed to competent authorities and training centres in the 25 countries of the European Union.

The Group of Experts also noted that the Recommendations would need to be reviewed from time to time by Governmental and industry experts that were experienced and competent in prevention, detection and response procedures at national and international levels, in order to reflect the state-of-the-art expertise in dealing with radioactivity in scrap metal. Therefore, consideration could be given to re-convening the Group of Experts at regular intervals, possibly starting in 2008, with a view to monitoring progress made by Governments and industries in dealing efficiently with the issue of radioactive scrap metal.

Item 9 Closing session

The chairman of the Group of Experts invited the UNECE Secretariat to prepare a short report of the meeting that could quickly be made available to all participating experts. In addition to the Recommendations, the report of the meeting has been published by the UNECE Secretariat in English, French and Russian.

All documents, as well as the presentations made during the Expert Group meeting, are available at the relevant UNECE website (www.unece.org/trans/radiation/radiation.html).

Finally, the chairman expressed his appreciation to all participating experts from United Nations member countries, international organizations, the industry and the UNECE Secretariat and noted that they had contributed in a very professional and constructive manner to the successful conclusion of the meeting. He stressed that the Recommendations prepared by the Group of Experts would be an important step forward for all Government departments and industries involved in the scrap metal sector and expressed the hope that the Recommendations would be widely used to deal effectively with radioactive scrap metal.

II. NATIONAL EXPERIENCES

A. Belgian Experience with Respect to Monitoring Radioactive Material in Scrap Metal and Public Waste

Regulatory aspects

According to the data available by the Belgian Federal Agency for Nuclear Control (FANC), 49 companies of the scrap recycling sector (major scrap yards, steel factories, foundries) and 8 companies of the waste treatment sector (incinerators and public waste landfill) in Belgium are currently monitoring the radioactivity of their incoming shipments. Most of these facilities are equipped with one (or several) portal monitors, some of them with grapple-mounted detectors.

FANC issued in 2005 "*Directives for the use of a portal monitor for radioactive substances in the non nuclear sector*" and also a "*technical annex*" to these directives. They describe the various steps that the operator has to follow when an alarm of the portal monitor is triggered; they describe the radioprotection measures that the staff must take and also the information that the operator has to provide to the FANC. These directives allow the operators themselves to intervene up to a certain radioactivity level. Beyond that level, a radioprotection expert must be called. For shipments with naturally occurring radioactive materials (NORM) (for which the distribution of radioactivity is generally homogeneous over the whole shipment), the directives define an action level (approximately three times the natural background) below which no intervention of the operator is necessary. This action level makes the management of these detections much easier for the operators.

These directives are available on the website of the FANC[5]. They have been written in consultation with the various stakeholders: professional federations and regional administrations.

The EU Directive 2003/122/Euratom has been transposed in Belgian law by the Royal Decree of May 23, 2006. Part of this Decree addresses the issue of orphan sources.

As scrap recycling and waste management facilities do not fall under the nuclear sector, it is not only the FANC (federal administration) but also regional administrations that are involved in the regulatory process. Up to now monitoring of radioactivity is only compulsory for some categories of public waste landfills. For the other categories of facilities, the monitoring is done on a voluntary basis. The FANC and the regional administrations are working in collaboration in order to establish a more extended list of facilities for which the monitoring of radioactivity could be made compulsory. In order to do so, a careful study of the flows of scrap and waste is being made in order to identify the nodal points in the scrap recycling network where monitoring would be the most appropriate. The goal is to keep a balance between the need to monitor as much scrap flow as possible without imposing heavy regulations to small facilities.

Incident statistics

In the waste treatment sector, a majority of the detected sources are of medical origin (coming either from the hospitals themselves or from domestic waste) or are industrial waste with NORM materials, such as refractory bricks, waste from the phosphate industry, etc. If one excludes these two categories, the following numbers of detection have been reported to the FANC over the period 2004-2005:

- 27 radioactive sources in the waste management sector
- 53 radioactive sources in the scrap recycling sector

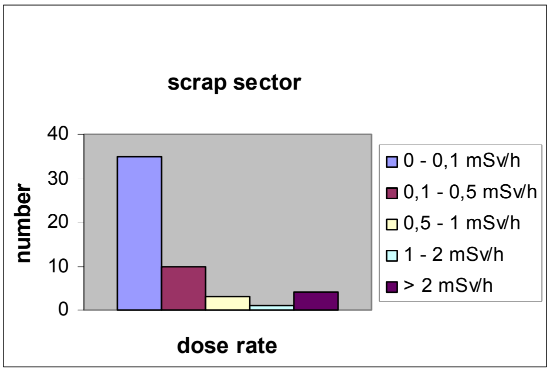
These figures are below reality because currently not all operators report to the Agency the detection of a source.

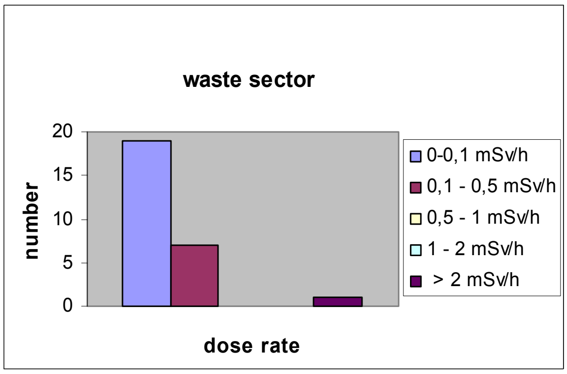
[5] http://www.fanc.fgov.be/fr/portiques_detection.htm

By category of sources, the figures are the following:

- Sealed sources: 5
- Lightning rods: 7
- Radioluminous products: 21
- Contaminated scrap: 20
- Pharmaceutical products (thoriumnitrate, uranylacetate): 11
- Thoriated lenses: 3
- Radioactive minerals: 1
- Others: 2

The charts below show the distribution of the detected sources as a function of their dose rate in contact:





Concerning the waste of medical origin, a systematic follow-up is done by the FANC when the hospital of origin has been identified. This follow-up aims at reinforcing the waste management procedures inside the hospitals.

Financial aspects

- The average cost of a portal monitor is about 50,000 Eur.
- The average maintenance cost is about 1000 Eur/y.
- The average cost of treatment of a radioactive source is about 2500 – 3000 Eur/source.

Based on the data transmitted to the FANC by the operators of waste treatment facilities, one can expect to detect about 10 radioactive sources for 250,000 tonnes of waste. The costs of treatment of radioactive sources amounts thus to some 0.10 – 0.12 Eur / tonne.

Up to now, the whole costs are supported by the individual operators.

The issue of financing is a recurrent issue in the consultations between the FANC and the operators. The operators do not wish to assume the costs of treatment of radioactive sources for which they are not responsible. The operators consider it as a violation of the "polluter-pay" principle. Unfortunately this principle is not easily applicable in this context as the origin of the radioactive sources which have been detected cannot be identified in most cases. The absence of a structural solution to the issue of financing is a major obstacle to the collaboration between the operators and the authorities.

Following the transposition of the European directive on orphan sources, discussions with the national organism for radioactive waste management (ONDRAF[6]) are ongoing to establish a fund which could cover the costs of treatment of some categories of orphan sources.

ONDRAF is preparing a proposal for a regulatory framework according to which the costs of orphan sources could be covered by a new insolvency fund which is still to be created. It is however still premature to give more detailed information.

FANC also asked the concerned professional federations to make concrete proposals with respect to financing (for example, the creation of a solidarity fund between the operators).

Training

In order to respond to the demand from operators for training and information, FANC organised two training sessions in February and March 2006. The programme of these sessions was the following:

- Basic notions of radioactivity (dose and dose rate, relation between dose and risk, …) and basic principles of radioprotection.
- Radioactive sources detected in waste and scrap.
- Radioactivity measurement instruments (dose rate and contamination monitor, scintillator, …): how to use them ?
- Directives of FANC for the use of a portal monitor
- Radiological risk in case of detection

These training workshops gathered 88 participants.

Communication

A workgroup on communication aspects has been set up. This group gathers representatives of the operators and of the authorities. Its goal is to define a common communication strategy over the issue of radioactivity in the concerned facilities; the targets of this communication strategy are among others the neighbouring inhabitants and the staff of the facilities. A list of FAQs has been proposed and general information on the issue has been put on the FANC website.

[6] Organisme National des Déchets Radioactifs et des Matières Fissiles Enrichies.

B. The Procedures for Seizing Radioactive Materials in the Czech Republic

Introduction

The national system to prevent the loss of control of radiation sources should be based on prevention and detection of seizures, captures, response to seizures and co-operation with other state authorities (Integrated Rescue System consisting of Police, Fire Brigades, Custom Service, Emergency Health Care). Internationally, it should also include suitable information exchange.

Prevention includes the existence of an independent Regulatory Authority with the legal obligation to authorize, register and license the practices of accounting for nuclear materials, the national register of radiation sources and the legal system of supervision, inspection and law enforcement.

The detection system involves methodological assistance, support in training custom staff and supervising detection and subsequent processes.

Situation in the Czech Republic

The State Office for Nuclear Safety performs state administration and supervision of the utilization of nuclear energy and ionizing radiation. It also oversees radiation protection. Competencies of the State Office for Nuclear Safety are defined by Act no. 18/1997 Coll. on Peaceful Utilization of Nuclear Energy and Ionizing Radiation (Atomic Act) and also include the duty of keeping a national system of registration and control of nuclear materials, a national registration system of licensees and ionizing radiation sources. The Atomic Act classifies sources as follows:

exempted	no provision
insignificant	free use but production must be licensed
minor	notified use
simple	licensed all types of practise
significant	more sophisticated licensing procedures
very significant	Environmental Impact Assessment (EIA), holding, decommissioning

All data concerning radiation sources from industry, medicine and research are registered and continually updated. Users are obliged to inform the State Office for Nuclear Safety about changes in sources inventory.

The main goals of the national register are:

- to provide a tool for the central registration of sources, to monitor the changes of registered items
- to register each licensee having any relation to the registered source
- to register reports from licensees
- to provide an effective tool for inspectors of the State Office for Nuclear Safety
- to provide an overview of sources in the country and their actual status
- to provide information on the movement of sources
- to provide information for identification in the case of abandoned sources

The application of this registration has been in routine operation since 2000. Currently the central register of sources contains approximately 5800 individual sealed radionuclide sources and about 600 facilities containing such sources.

In recent years, the number of radioactive material seizures has increased (i.e. the materials that contain one or more radionuclides and whose activities or mass activities from the point of view of radiation protection are not negligible). This is mainly due to newly installed technical equipment (i.e. more sensitive detection systems) that monitors metal scrap during its collection and its entry to metallurgical plants and iron works, waste that enters incinerators, and the means of transport at state border crossings (regular measurements to May 2004). Our experience suggests that the majority of events are related to either handling (i.e. collection, sorting and transportation) secondary (metal) raw material or the use of the machines and equipment that are produced from the contaminated metal materials. The minority of events relate to illegal discharge (either intentional or unintentional) of ionizing radiation sources (i.e. import, export and distribution).

The goal of the recommendation for the procedure of radioactive material seizure issued by the State Office for Nuclear Safety is to specify the rules for the procedure in the above-mentioned cases. The Recommendation is not a legally binding document. This Recommendation is mainly intended for Customs' officers, fire fighters, policemen, persons who handle secondary raw materials and municipal waste. However, the principles of this Recommendation can be applied to all other cases of seizure of radioactively contaminated materials. A flowchart is enclosed at the end of the recommendations with the purpose to help workers of the above-mentioned institutions to recognize the objects which might contain suspicious radionuclide content.

The types of operating and transport containers most often used for radionuclide sources, system components and the subjects that relate to the application of radionuclides are described.

In the year 2004 there were 90 confirmed events in the Czech Republic, from these:

- 38 cases of contaminated metal scrap captured in steelworks (14 cases with the natural radionuclides Ra 226, 4 cases Co60 and Sr90, 19 cases returned abroad)
- 6 cases of suspected lost sources

In the year 2005 there were 52 confirmed events, from these:

- 19 cases of contaminated metal scrap captured in steelworks (12 cases with the natural radionuclide Ra226, 3 cases Co60, in 4 cases the metal scrap was returned abroad)
- 4 cases of suspected lost sources

All of these events were evaluated as level 1, since they were not significant from the point of view of radiation protection (ie: they were off the INES scale).

Conclusions

The main problems connected with seizures based upon experience are:

- financial support in solving cases of inadvertent movement of radioactive material (scrap, chemical agents, …)
- lack of licensed persons for performing radioactive material (source) localization, unloading, separation from the load, identification and analysis
- readiness of licensed persons to serve non – stop
- radioactive source in military and defence programmes

There are two levels on which to work to solve these problems – the national and international levels. On the national level it is necessary to establish:

- adequate measuring systems at the border,
- a system of notification of the responsible authorities and persons,
- a decision-making scheme for different types of illicit trafficking.

On the international level it would be necessary to establish a system of information exchange about events and other important data.

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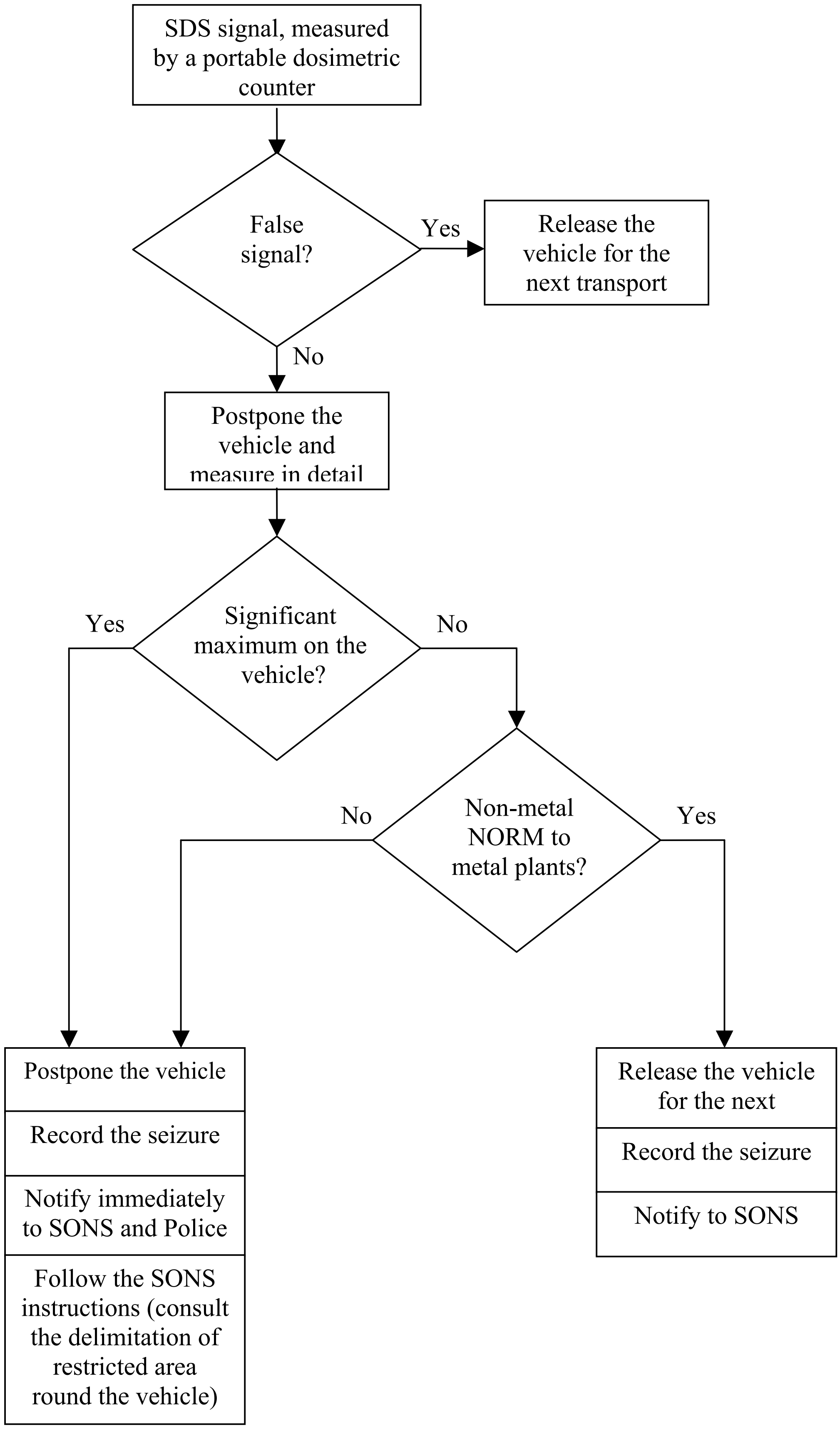
Example of a decision-making scheme

The flowchart shows the radioactive material seizure procedure at the entry point to metallurgical works or plants that handle secondary raw material and waste



C. Nuclear and Radiation Safety Management and its Relations with Metal Scrap Monitoring in Georgia

Region specifications

The South Caucasus region has one of the most complicated transit routes which allows for trafficking between Europe and Asia. As border control installations and infrastructure are, to date, insufficient, illicit trafficking and smuggling of nuclear and radiation materials as well as accidental presence continue to be a considerable problem. The intelligence service, regulatory authority, Customs and border guards are working together in their fight against the threat of smuggling and potential use of hazardous nuclear and radiation materials for criminal purposes.

Nuclear and radiation installations – benefits and threats

As Georgia is currently in a phase of growth, there is a substantial increase in technologies involving radioactive sources and materials. Georgia's transit role in the South Caucasus also creates a need to increase capabilities of different institutions involved in fighting against illicit trafficking of nuclear and radioactive materials – police, border guard, Customs, intelligence services etc. The adoption of international standards and rules must be enforced at a national level but also, good trans-boundary agreements are essential.

National and international legislations on nuclear and radiation safety

The Georgian law on Nuclear and Radiation Safety was enacted on 30 October 1998. By law, the Nuclear and Radiation Safety Service of the Ministry of Environmental Protection and Natural Resources of Georgia is designated as the nuclear and radiation regulatory authority.

The Radiation Safety Norms (RSN) is a standardizing legislation document based on BSS of the IAEA which was adopted and approved by Government in 2000.

The implementation process of the National Plan on Nuclear and Radiation Emergency Preparedness and Response was initiated in 2003. The adoption of the plan was set to aid authorities and decision-makers in defining their obligations and functions until the end of 2006.

Georgia has been a member State of the International Atomic Energy Agency since 1996. The process of becoming a member of IAEA Conventions has already started. Georgia collaborates with the IAEA within the framework of Conventions on Non-proliferation of Nuclear Weapon, Early Notification and Assistance, Safeguards and Additional Protocols.

Main components of country nuclear and radiation safety

All existing regulations are in accordance to international law, requirements, recommendations and Basic Safety Standards of the IAEA. The problem related to storage of radioactive material was solved in August 2005 when such storage was enforced. The key role in implementing construction work was fulfilled by the DOE of USA. All construction was under the control of specialists of DOE, NRC and IAEA. Besides, establishment of cadastre and categorization of radioactive materials and installations, supported by NRC and Sandia laboratories, is underway and will be finished next year.

Stationary radiation monitoring equipment was installed in some Customs' checkpoints and marine ports under the cooperation projects supported by IAEA and DOE of USA. Radiation monitoring is currently not available in airports.

The licensing and inspection of radiation installations on a regular basis is the responsibility of the Regulatory Authority. Besides, concerning legal activities fulfilled by national as well as foreign organizations, once every three months an expert committee on import-export and production of hazardous materials and military ammunition of the National Security Council discusses licensing regime implementation for such activities and conclusions are sent to ministers and the President's administration.

The adoption of a National Plan on Emergency Preparedness and Response is in its final stage. As the Radiation Emergency Preparedness and Response Plan is one part of this general plan, it will be adopted after. In the above-mentioned documents, all roles and responsibilities are described for organizations involved in emergency preparedness.

Considerable gaps in scrap metal monitoring

According to the law on "Transportation, import, export and re-export of recycling materials" endorsed in 1998, transportation, import, export and re-export of metal scrap containing radioactive and chemical hazardous materials are prohibited. State Border Guard of the Ministry of Interior and Customs' Department of the Ministry of Finances are designated as executors of this law.

Gap 1: Internal movement and recycling – Till the year 2004 recycling of metal scrap needed licensing. Licences were issued by the Ministry of Finance based on permissions from the Trade-Industry Chamber of Georgia. This licensing procedure was abolished at the end of 2004. The document covering protection against radioactive contamination of metal scrap is the signed contract settled between the supplier of scrap and the buyer. The result is that metal scrap collectors/suppliers work without relevant licences.

Gap 2: There is no licence – there are no procedures, instructions, guidance on monitoring and detecting of radioactivity in scrap metal;

Gap 3: No monitoring equipment available on site (recycling facility, supplier enterprise);

Gap 4: No surveillance procedures exist due to termination of licensing.

Radiation incidents

In the past 15 years the main threat from uncontrolled radioactive sources has increased.

1989 – Cs 137 – Tbilisi, Co 60 – Kutaisi (no information about victims);
1992 – Ra 226 - Akhali Afoni (2 overexposed, one is dead);
1993 – Cs 137 - Zestafoni (no information about victims);
1996 – Co 60 - Kutaisi (2 overexposed, both are dead);
1997 - Cs 137, Co 60, Ra 226 – Lilo (11 overexposed);
1998 – Cs 137 – village Matkhoji, Sr 90 – villages Khaishi and Laburtskhila (several overexposed among local population);
End of 2001 – Early 2002 – Sr 90 – village Lia (3 overexposed – 2 dead).

In February 2004 a Cs137 source was discovered in a vehicle transporting scrap metal from Georgia to Turkey. Turkish Customs officers discovered high levels of radiation from the vehicle and sent it back to Georgia. However, instead of the Georgian Customs, the information was sent to the IAEA ITDB and eventually reached Georgia via IAEA's channels. As the initial information was incomplete, all relevant agencies in Georgia worked in alarm mode during approximately 24 hours, as there was no indication on the vehicle identification, type, ownership, route, etc.

In December 2004 a Cs 137 source with container (dose rate on the surface of container about 60µsv/h) was discovered in metal scrap at the border checkpoint in Sarp (Georgia-Turkish border).

Conclusions

1. Quality control for the monitoring of metal scrap for contamination or presence of radionuclides and nuclear materials is primarily based on proper national legislation.
2. It is essential to harmonize national procedures and guidelines with foreign, especially neighbouring, countries on assessment, discovery and evaluation of radioactivity in metal scrap, as well as follow procedures related to obligations on decontamination, disposition, transportation etc.
3. Training and equipping personnel on different levels is the next priority.
4. Equipment used in Georgia, as well as in different countries, should follow similar standards in order to increase inter-operability.
5. The National Radiation Incident Notification and Response Centres should be bound by strict international obligations to notify each event to relevant centres (the notification scheme should be implemented and adopted at an international level) as well as to neighbouring countries, however involved in the incident.

What does Georgia need?

1. Improvement and enhancement of legal basis.
2. Training and equipping on different levels – some stationary monitors are established at border crossings and Customs check points but nothing exists at recycling and scrap collecting facilities.
3. Establishment and adoption of instructions, procedures and guidelines harmonized with international ones.
4. Enhancement of notification and response infrastructure.

Annex - Radiation Monitoring Operations Conducted in Georgia up to now

At the end of the "Cold War", the crisis started in the military production sector of the former USSR. Former partners dissolved contracts. The Russian Army became the owner of former Soviet military bases on the territories of former Soviet Republics.

In Georgia, in addition to severe inflation, economic and energy shortages, the country faced the utilization of outdated military ammunition and equipment left after the Soviet army withdrawal, cleanup of territories of Soviet Army bases, which included discovering, collecting and recovering orphan sources etc. Also, hazardous materials such as chemicals, biological agents and radioactive waste produced during normal cycling of industrial and medical facilities raised additional problems. That is why radiological incidents mainly connected to orphan sources of ionizing radiation took place during the years 1996-2002.

The first declared radiological incident took place in 1996 in Kutaisi, western Georgia, in the railway station. Several individuals opened a container of Co-60 source and, exposed to extremely high doses, died shortly after the incident. In 1999, military officers were subjected to different doses of ionizing radiation from the Cs-137 calibration sources in the football field of Lilo military base, near Tbilisi. The most "famous" incidents were connected to sources of Sr-90 with activity of 35 000 Ci each installed in the so-called Radioisotope Thermo Electro Generators (RITEGs). The sources were discovered in the mountainous part of western Georgia, Svaneti. During the years 2000-2002 six such sources were found and recovered. Several individuals were overexposed, two of them died. Besides the incidents mentioned above, many more of lesser importance took place in Georgia. To date over 250 orphan sources with activity more than 1 Ci have been discovered and recovered by the Nuclear and Radiation Safety Service of the Ministry of Environment Protection and Natural Resources of Georgia.

During the years 2002-2003, operations to search for orphan source were undertaken in the hardly accessible regions of Georgia– Svaneti, Samtskhe-Javakheti, Ajara and Kakheti. The operations were supported by the IAEA, and the Governments of France, India, Turkey, USA and Georgia. Operations were separated based on priorities and probabilities of high activity source discovery. Svaneti was considered as an initial region for such operation as RITEGs were discovered there. From the Georgian side, the technical implementation of the operation was fulfilled by the Nuclear and Radiation Safety Service of the Ministry of Environment Protection and Natural Resources, Department for Emergency Situations and Civil Defence of the Ministry of Internal Affairs, Counter-Terrorist Centre of the Ministry of State Security, Institute of Physics of the Academy of Sciences.

The search was divided in two parts: one part carried out the operation on foot, exploring step-by-step the difficult terrain and using up-to-date handheld radiation monitoring equipment. Another part worked with jeep type vehicles equipped with highly sensitive monitors, ARCS based (USA) and AGSS based (India), capable of discovering radioactivity from a distance of up to 80 metres from the road. The pedestrian group was composed mainly of specially trained personnel of the Department for Emergency Situations and Civil Defence of the Ministry of Internal Affairs and worked in regions that were impossible to explore by cars.

Georgian specialists prepared physical maps (approved by the IAEA) in advance for identification of prearranged routes of operation according to priorities. The specialists were equipped with the following radiation monitoring devices: DG-5 (France, IAEA) – 16 pieces; Ludlum-9 (USA) – 5 pieces; Ludlum-19 (USA) – 4 pieces; Portable detectors (Turkey) – 20 pieces; several GPSs, 10 Radio transceivers for groups as well as command post, up to 100 TLDs.

The initial training of groups was carried out by specialists from Germany, USA, France, India and Turkey. Each participant completed a whole programme on discovery of hidden orphan sources.

The first phase of the search operation was conducted in June 2002 in the highest priority region, Svaneti. In this phase, 47 Georgian specialists participated in cooperation with 6 experts from the IAEA. ARCS based and AGSS based groups drove all accessible routes. The pedestrian groups explored mainly forests, mountains and gorges. The territory of Khaishi, Idliani, Lakhani, Ifari, Lakhamura was observed – a total of up to 540 square kilometres.

Basically no abnormalities of radioactivity above background levels were found during this phase. Natural radioactive background levels varied between 15-25 MicroR/h, which is normal for this region. In just one place, near the village of Ifari, a rise above background level was observed, where K-40 and Bi-214 as products of U-238 fusion were found in the soil.

The second phase was carried out during August 2002. 42 Georgian specialists participated. During the operation the towns and villages of Akhaltsikhe, Akhalkalaki, Borjomi, Akhaldaba, Bakuriani, Tsagveri, Tsemi, Vale, Abastumani, Aspindza Vardzia and others (in total more than 40) were tested. According to the inspection, the natural background levels varied between 10-20 mcR/h which is normal. No abnormal rise of background was observed.

On the route to Tbilisi the expedition inspected the Kareli region, as well as the greater part of the city of Tbilisi. The total area inspected was about 1500 square kilometres. No abnormalities of radiation above background were noted.

During the second phase in the military base of Akhaltsikhe, 57 radio bulbs and night vision goggles containing Ra-226 with total dose rates of about 0.1 R/h were discovered. In this military base 17 packages of warning installations NP46 containing Ra-226 with dose rate on the surface of about 0.12 mcR/h each were found. Besides, the search teams came across 3 empty boxes contaminated with Ra-226 and tables for cleaning weapons covered with paint containing K-40. The dose rate on the surface of each table was about 95 mcR/h. Also two metal objects that were impossible to identify were located containing Sr-90 with dose rate about 2mR/h each.

In the military stockpile of Akhaltsikhe radiation monitoring equipment DP-63-A type (11 pieces) containing Ra-226 with dose rate more than 0.1 mR/h were found.

One should note that on the territory a lot of houses and other constructions were inspected and it was noted that the walls contained K-40 with average dose rate 30-40 mcR/h.

The next (third) phase of search operations was carried out on the territory of Ajara during September - November 2002. In this phase 20 specialists from the Nuclear and Radiation Safety Service of the Ministry of Environment Protection and Natural Resources of Georgia and Regional Service for Emergency Situations and Civil Protection participated. Inspection was done in the main towns of Batumi and Kobuleti, and also in the villages of Khulo, Shuakhevi, Kedi, Khelvachauri. The natural background levels varied between 10-20 mcR/h. In high mountainous areas the background reached 30 mcR/h. The Gamma emitter devices safety conditions were inspected on Propane pumping stations in Batumi. In several parts of the territory of Ajara contamination spots were detected, caused by the impact of the Chernobyl accident. Above such spots the dose rate reached 60-90 mcR/h.

The fourth phase of search operations was conducted in Kakheti (eastern Georgia) during October 2002. Twenty specialists from the Nuclear and Radiation Safety Service of the Ministry of Environment Protection and Natural Resources of Georgia, Regional Service for Emergency Situations and Civil Protection and Counter-terrorist Centre of the Ministry of State Security participated. The towns of Telavi, Gurjaani, Signagi, Kvareli, Lagodekhi, Dedoplistskaro and more than 40 villages were inspected.

Boxes contaminated with Ra-226 were found on the territory of the military base in Telavi. The dose rate on the surface was about 60 mcR/h each. In this base, a contamination spot 1 square metre was discovered on the floor of the stockpile with a dose rate of 40 mcR/h. On the territory of the helicopter base in Telavi, devices taken down and collected from dismantled helicopters were stored in detached buildings with a total dose rate of 2 mR/h (average dose rate for each one was about 0.2 mR/h). On the territory of the Air force base in Dedoplistskaro the standard calibrating sources containing Cs-137 were stored in a guarded building due to safety measures.

The next (fifth) phase was conducted in the region of Shida Kartli during the 3rd quarter of 2003. Unfortunately all the equipment supplied by the IAEA was moved back at that time and inspection was carried out using the equipment of the Nuclear and Radiation Safety Service of the Ministry of Environment Protection and Natural Resources of Georgia including the mobile radio spectroscopy laboratory granted by the German Government. Sixteen specialists participated in the phase. The average background levels varied between 10-20 mcR/h. In the village of Osiauri, in Khashuri district, a standard calibrating container with two Cs-137 sources (dose rate 17 and 30 R/h) was found on the territory of a military fuel stockpile base. The container was transferred to the office of the Military Prosecutor for further investigation. In the town of Gori three containers with three Cs-137 sources operated as parts of level-measuring devices were discovered on the grounds of a propane pumping station. According to the technical specifications, the dose rate at the beginning of the operation was 200R/h each. As removal of sources was considered impossible, a deep cave was dug, the containers were buried and covered with a thick layer of concrete. The dose rate on the concrete surface was 20 mcR/h. The place was marked and local staff instructed accordingly.

In the town of Rustavi on the territory of a Chemical Fibre facility, 28 pieces of such containers with Cs-137 sources were located. Unlike the case mentioned above, the owner of the facility disposed all sources together in a detached building and on a guarded part of the facility. At the entrance of the building the dose rate was about 12 mcR/h. Two pieces of the same containers with Cs-137 sources were found on the territory of an abandoned propane pumping station in Iagluja, district Marneuli. After negotiation with local government, the sources were moved to guarded territory. In the hangar of Marneuli Air Force base devices were located containing Ra-226 with a surface dose rate of 120 mcR/h. Staff were instructed on handling and storage of devices.

At present the last phase of orphan source search operation is underway in the Pankisi gorge. Since the gorge is partially populated by Chechen refugees, the inspection was fulfilled during a limited timeframe and in a strictly defined area. The territories of the villages of Pankisi, Duisi, Akhmeta and nearby area of Georgia-Chechnia border were observed and inspected. Due to information disseminated by the Russian Security Services in connection with the presence of Chechen rebels and terrorist bases in the Pankisi gorge, the places inhabited by Chechen refugees were inspected especially. The average background level varied around 15-25 mcR/h.

Thus, during all phases of the orphan source search operation nearly all the territory of Georgia was observed and inspected. The parts of the territory not covered during the operation – regions of Imereti, Guria and partially Samegrelo, have been examined during previous Aero Gamma Monitoring in the year 2000. For all territories observed, a map of radionuclide distribution was established. The last operation was scheduled for July 2006.

D. The Spanish Protocol in Practice

The Spanish Protocol was established in 1999, just after the agreement was signed by the main agents involved in the radiological surveillance of metallic materials:

- The Spanish Recycling Federation, as representative of the recyclers
- UNESID, representative of the iron and steel industries
- Industry Ministry, representative of the civil service
- Infrastructures Ministry, representative of the commercial port
- Nuclear Security Council, superior institution with competence (authority) in nuclear matters
- The National Company of radioactive waste management (ENRESA), institution responsible to handle radioactive waste
- Representatives of other industrial sectors have joined the agreement, such as FEAF (small smelting), UNIPLOM (lead refiners), ASERAL (aluminium refiners)

Up to now, there are 79 recycling companies, 26 iron and steel industries, 2 smelting companies and 2 aluminium refining companies signatories to the Protocol; and the number is increasing.

The Federation of Spanish Recovery (FER) was created in 1982 in order to represent the recycling (recovery) sector in the economic, technical and social fields. The Federation represents the sector before the civil service (Environment Ministry, Industry Ministry, etc) and other private organizations and institutions. Nowadays, more than 170 companies and many regional associations are members of FER.

FER is member of the Bureau of International Recycling (BIR), of the European Ferrous Recovery and Recycling Federation (EFR) and of the European Metal Trade and Recycling Federation (EUROMETREC).

FER advises its members, arranges all the papers requested for adherence to the Spanish Protocol, provides the procedure and protocols to be followed and offers courses. Through free courses, recycling companies are made aware of the problem of radioactivity. They are thus able to assess the magnitude of the problem and to get involved in radiological surveillance.

FER also provides agreements with companies that supply equipment for radiological surveillance and offer radiological protection services. In this way, radiological materials are increasingly being successfully removed from the metal stream. In 1999, there were 54 alarms, in 2000 there were 50, in 2001 there were 47, in 2002 there were 72, in 2003 there were 141 and in 2004 there were 129. It is important to emphasize that those alarms are not always from artificial sources; “NORM” are also included here.

The percentage of sources removed, which entail a potential danger for persons and institutions, is approximately 10%.

Success of the Spanish Protocol

The Spanish Protocol is put in practice in a flexible way and with good judgment by everybody. The performance of the teamwork groups (with representatives of every single sector) is essential. The parties to the Protocol have a clear idea whom to address, what to do and how to do it effectively. It allows them to act quickly not only in case of detection of radioactivity at the entry of a company but also in case of incorporation of a source in the process and its subsequent contamination, thus minimizing the consequences.

The existence of established procedures makes it possible to take immediate actions, improve coordination and reduce the waste and the eventual closing down of a plant. The companies cover expenses of the detectors, and the industry sector has requested subsidies for these acquisitions but to date there is no additional help.

If the companies attached to the Protocol detect a source or NORM, the civil service covers the expenses of the correct treatment of the source, a treatment developed by Enresa. If an incident takes place, the expenses of the treatment are at the cost of the company; these expenses are much higher if the company is not a member of the Protocol.

The civil service and the associations cover the courses' expenses, publication and distribution of posters and informative material. They also cover the expenses of the projects and technical research regarding the radiological surveillance of metallic materials (which are done in collaboration between ENRESA, the Polytechnic University of Pais Vasco and the Polytechnic University of Madrid).

International issues

One of the biggest problems of the application of the Protocol is the importation of sources from foreign countries. Many of the detected sources come from foreign countries. It is often difficult to identify the origin of sources coming from big ports with a large scrap traffic. Companies generally require a certificate of non-radioactivity and in these cases, the sources can be returned to the suppliers and the expenses passed on to them.

Spain is a net importer of scrap metal, so there have been few incidents with exports.

Overall the experience is very positive thanks to the involvement of every single sector affected. They take an active part participating and collaborating, and this is the reason for the positive result. Step by step, other sectors (aluminium, lead, refining companies…) are joining the Protocol, extending its application.

The voluntary character of the Protocol is a great advantage. However, there are always exceptions and there are companies which have not yet joined the Protocol and others that apply the Protocol incorrectly, even if these numbers are low.

E. Radioactive Materials in Scrap Metal: The Situation in Switzerland

About 10 years ago, different events in the Swiss and international metal scrap recycling scene created awareness about unwanted radioactive substances in scrap metal. Italy, one of the main buyers for scrap metals, started systematic checks at its borders, arranged by the authorities. As a consequence, in Switzerland a concept was elaborated with the cooperation of the recycling companies, the Italian authorities, the Federal Office of Public Health (BAG), Swiss Federal Nuclear Safety Inspectorate (HSK) and the Swiss National Accident Insurance Fund (Suva) to fulfil the different requirements.

Individual radioprotection, protection of the environment, protection of scrap yards and machinery as well as quality assurance of the recycled metals and the resulting products require adapted solutions. The main issues are: training, suitable monitoring equipment, intervention and waste management.

F. Monitoring of Radioactively Contaminated Scrap Metal in Tajikistan

Tajikistan faces definite problems in the field of scrap metal trade. The legislation system of Tajikistan covers many aspects of this problem. The Law of the Republic of Tajikistan "On Radiation Safety" (adopted by Parliament in 2003) is being implemented. In accordance with this law, the Regulatory Authority of the Republic of Tajikistan on Radiation Safety is the Nuclear and Radiation Safety Agency which is under the Academy of Sciences of the Republic of Tajikistan. Other Laws of the Republic of Tajikistan are in accordance with the Law on Radiation Safety. For example: The Law of The Republic of Tajikistan "On licensing" mentions that Licensing of the Radioactive sources will be made by the Nuclear and Radiation Safety Agency. The Regulatory Authority works together with different Ministries or Organizations depending on the problems raised.

The control of radioactive scrap metal can be divided into 3 areas:

Situation: (1) Proliferation of scrap metal, (2) Forming markets;

Prevention: (1) Legislation, (2) Inspection system, (3) Enterprise responsibility, (4) Physical protection, (5) Export and Import control;

Detection and Enquiry: (1) National system, (2) International system, (3) Information channels.

G. United States update Report on Monitoring of Scrap Metal for Radioactivity

The United States is continuing its efforts to prevent the loss of radiation sources, thereby reducing the amount of scrap metal and associated facilities from becoming contaminated with radiation. There has been an increasing amount of scrap metal crossing international borders, yet there is still a lack of adequate and effective monitoring at many facilities. The U.S. has imported more than 14 million metric tonnes of scrap metal in 2005, with at least two significant radioactive sources being found in this material. The U.S. has also exported 18 million metric tonnes of scrap metal in 2005. The United States Environmental Protection Agency's (USEPA) Orphan Source Initiative is addressing this problem in a number of ways, including providing guidance and training to the demolition and scrap processing industries, researching non-radioactive gauge and device alternatives and tracking radioactive materials with radiofrequency identification while in transit.

To directly combat the issue of contaminated scrap metal imports, the USEPA has monitored over 7,000,000 metric tonnes of metal using grapple-mounted detectors at two U.S. seaports. The decision of where to monitor is critical to finding radioactive sources. A U.S. study has shown that it is extremely difficult to locate a radioactive source if it is shielded by greater than 20 inches of shredded metal. Therefore a more systematic and thorough approach to metal monitoring would enhance the chances of finding unwanted radioactive materials and prevent an inadvertent contamination. As international trade increases, the need for a standardized international monitoring protocol increases. The U.S. supports the efforts of the UNECE to develop international recommendations, increase communications between countries and provide training to successfully implement these recommendations.

III. ANALYSIS OF EXPERIENCES IN MONITORING RADIOACTIVE SCRAP METAL: SUMMARY OF REPLIES TO A COUNTRY QUESTIONNAIRE

A. Background

In response to the important and increasing problem of radioactive scrap metal, the UNECE has been requested to pursue the work it started in 2001 on this topic. In support of this effort, the UNECE circulated a questionnaire in advance of the first meeting of the Group of Experts in 2004, the results of which were analyzed, presented at the meeting, and included in the proceedings of the meeting (www.unece.org/trans/radiation/radiation.html).

To assess progress that has been made in the intervening two years, the UNECE circulated the questionnaire again in late 2005, with a view to presenting these updated results at the present meeting of the Group of Experts.

This report and its Addendum provides an analysis of the 2006 responses to the questionnaire, compares those with the results of the 2004 questionnaire, evaluates progress made since 2004, considers additional inputs from countries and international organizations, and makes recommendations regarding both "Best Practices" and "Areas Needing Attention" for further discussion at the present meeting.

For the purposes of this report, the questionnaire responses have been grouped in terms of the major fields of action for monitoring, intercepting and managing radioactive scrap metal. Those three fields of action are: "Prevention", "Detection" and "Response".

The report is structured into two parts: The present document provides a top-level set of best practices and recommendations derived from the questionnaire responses. It then discusses the basis for the analysis and describes in detail the recommended "Best Practices" and "Areas Needing Attention" for the three fields of action given above. The Addendum to the document contains three chapters providing a detailed analysis of the responses to both the 2004 and 2006 questionnaires (Appendix A), a brief analysis of existing country practices and experiences (Appendix B) and a copy of the questionnaire (Appendix C).

B. Summary overview of current best practices and areas needing attention

Prevention

Best Practices

(1) All countries have established regulations directed toward preventing loss of radioactive sources and/or radioactive material.

(2) All countries have active enforcement programmes, including penalties for non-compliance that are directed toward preventing loss of radioactive sources and/or radioactive material.

(3) Most countries have adopted the IAEA Code of Conduct for the Safety and Security of Radioactive Sources.

(4) Most countries have established exemption levels for materials containing low levels of radioactivity, while a large number have established regulations allowing the release of very low levels of radioactivity from nuclear facilities.

(5) Most countries have established responsibilities and supporting materials for (a) training, including in the areas of visual inspections and response to detections arising from those inspections, and (b) accounting and storage of scrap metal and waste through contractual arrangements.
(6) Most countries support the "Polluter Pays" principle.

Areas needing attention

(1) Countries should systematically collect and analyze data on radiation levels from scrap metal and processed metal shipments for potential exposures.
(2) Countries should increase efforts to establish appropriate regulatory mechanisms for controlling NORM and technologically enhanced naturally occurring radioactive material (TENORM).
(3) Countries should establish: (a) guidelines for identifying and characterizing sources at metal processing facilities, and (b) regulatory provisions requiring the monitoring of imported and/or exported scrap metals for radioactivity.
(4) The industry should ensure that contracts include provisions that: (a) scrap metal that is procured is radioactive free; and (b) when cleared scrap metal is sold, the origin of the scrap is clearly stated to the buyer.
(5) Metal processing facilities should provide training to personnel in visual inspection and response to incidents.
(6) Countries should agree on a standardized approach to defining the location in the processing chain where ownership of scrap metal is transferred from seller to buyer.

Detection

Best Practices

No examples of best practices have been included as it was difficult to obtain clear trends from the answers to the questionnaires. Thus, the information analyzed is provided below under "areas needing attention".

Areas needing attention

(1) Countries should consider issuing detailed technical directives and guidance providing instructions on the proper application of detection systems.
(2) Countries should establish a consistent and fully comprehensive approach to monitoring for radioactivity of imports and exports of scrap metal shipments at border crossings and at points of departure and arrival; and implementing checks to better control contamination of metals, focussing on: (a) making monitoring comprehensive and mandatory, (b) the location of monitoring, (c) having monitoring occur at the beginning of the distribution chain while still retaining monitoring further down the chain, and (d) issuing appropriate regulations and guidelines for controls on radioactive contamination in scrap yards and metal processing facilities.
(3) Countries should establish a standard approach to the acquisition, quality assurance, maintenance, calibration, and use of radiation detectors at monitoring locations.
(4) Countries should strive for a consistent, worldwide-accepted detection alarm threshold setting.

Response

Best Practices

(1) Most countries require Government investigation of all detection/alarm reports.
(2) Most countries have established protocols defining response actions in the event of a detection alarm.
(3) Most countries have clear responsibilities for financial and physical disposition of detected radioactive materials.
(4) Most countries have specific and detailed processes identified in regulations or guidance to facilities for disposition of a detected source.
(5) Most countries acknowledge that, when the radioactive source or material is known, they can readily transport it in compliance with established transport regulations.

Areas needing attention

(1) Countries should consider developing appropriate forms to guide the reporting and response actions of those involved in detecting and acting upon detections of radioactivity in metals.
(2) Countries should consider developing information brochures, bulletins and posters summarizing steps to be taken in response to an alarm indicating radioactivity in metals.
(3) Countries should establish a formal protocol defining the reporting process and associated actions for a radiation alarm.
(4) Countries should establish a consistent and comprehensive basis for response to alarms, both by Governmental agencies and by the scrap metal industry.
(5) Countries should include in their recovery programme the regulatory method that is allowed for transporting radioactive material or sources where the contents are undefined.
(6) Countries should consider establishing an international standard on allowing processing facilities to melt contaminated metal, and on accumulating detected materials on their site, especially if below internationally accepted clearance levels.
(7) Countries should consider establishing a free-of-charge disposal facility or a return-to-sender policy to facilitate resolution of contaminated scrap and metal product incidents.

C. Basis for and process of the analysis

The basis for the analysis

The analysis presented in this report was derived with a view to providing detailed input into the present meeting of the Expert Group. In addition to what is contained herein, the “Spanish Protocol for Collaboration on the Radiation Monitoring of Metallic Materials” provides valuable input to the meeting. Various Spanish Government agencies and industries have collaborated to develop and implement this protocol.

In the Spanish Protocol, those Government organizations that subscribe to the protocol agree to detailed actions, including the following:

- Establishing, populating and maintaining current a National Register of those subscribing to the protocol;
- Defining the responsibilities for Government agencies, including those relating to control of discovered radioactive material in metals;
- Ensuring that any event is properly resolved;
- Facilitating communication amongst organizations to ensure each is informed of a radiation event;

- Providing inspections of surveillance and control systems;
- Issuing advice on radiation safety;
- Promoting training and education; and
- Providing technical advisory services as needed.

In turn, the companies that subscribe to the Spanish Protocol agree to detailed actions, including the following:

- Performing radiological surveillance of scrap metal and metal products;
- Staffing surveillance and control systems;
- Providing for, and collaborating in, training;
- Requiring suppliers of metal to inspect loads prior to shipment, and to issue a radiological surveillance certificate of inspection;
- Refusing to accept shipments that do not have radiological surveillance certificates of inspection;
- Returning to any foreign source material determined to be contaminated;
- Notifying immediately the appropriate Government agencies in the case of an event;
- Taking actions to prevent dispersal when contamination is detected; and
- Arranging with appropriate Government agencies for the proper disposition of detected contaminated materials.

The topics outlined above in the Spanish Protocol served to guide the development of the "Best Practices" and "Areas Needing Attention" in the current report. As such, provisions in the Spanish Protocol address all three fields of action addressed here, i.e.: prevention, detection, and response.

The process of the analysis

The countries that responded to the questionnaires in both 2004 and 2006 are listed in Table 1. This table shows that:

- 48 countries ultimately responded to the 2004 questionnaire (3 of which responded sufficiently late that the results were not included in the proceedings of the 2004 meeting, but have been included in the current analysis presented here),
- 43 countries responded to the 2006 questionnaire by 1 June 2006, which was in sufficient time to have their results included in the Revision 1 analysis presented in this document and the associated Revision 1 of the addendum, and
- 7 of the 43 countries responding to the 2006 questionnaire did not respond to the 2004 questionnaire.

Table 1. Countries responding to the 2004 and 2006 questionnaires*

Country	2004	2006	Country	2004	2006
Australia	X		Lithuania	X	X
Austria	X	X	Luxembourg	X	X
Azerbaijan	X		Malaysia	X	
Bangladesh	X	X	Mexico		X
Belarus	X	X	Netherlands	X	X
Belgium	X	X	New Zealand	X	X
Bulgaria	X	X	Norway	X	X
Canada	X	X	Paraguay		X
Croatia	X	X	Philippines	X	
Czech Republic	X	X	Poland	X	X
Denmark	X		Portugal	X	
Dominican Republic	X		Romania	X	X
Egypt		X	Russian Federation	X	X
Estonia	X	X	Serbia and Montenegro	X	
Finland	X	X	Slovakia	L	X
France	X	X	Slovenia	X	X
Georgia	X	X	South Africa	X	X
Germany	X		Spain	X	X
Hungary	X	X	Sweden	X	X
Iceland	L		Switzerland	X	X
Indonesia	X	X	Tajikistan	X	X
Ireland	X	X	Thailand		X
Italy	X	X	Turkey	X	X
Japan		X	Ukraine		X
Kazakhstan	X		United Kingdom	X	
Kyrgyzstan	L	X	U.S.A.	X	X
Korea, Republic of		X	Vietnam	X	X
Latvia	X	X	**TOTALS**	**48**	**43**

* Note: In the 2004 and 2006 date columns, "X" indicates response received and included in the 2004 and/or the 2006 analysis, as applicable. In addition, in the 2004 columns, "L" indicates response received after the 2004 analysis was completed, but those inputs have been included in the 2006 analysis. Thus, a total of 55 countries are represented in the analysis which follows. Specifically, when assessing the written responses for "Best Practices" and "Areas Needing Attention", the responses from all 55 were used.

The questionnaire data were provided according to 6 major topics[7]:

- Regulatory Infrastructure – 7 questions identified as QRI-1 through QRI-7 respectively,
- Monitoring – 18 questions identified as QM-1 through QM-8 respectively,
- Dispositioning – 6 questions identified as QD-1 through QD-6 respectively,
- Contractual – 5 questions identified as QC-1 through QC-5 respectively,
- Reporting – 6 questions identified as QR-1 through QR-6 respectively, and
- Experience – 1 opportunity to describe experience.

[7] The detailed questionnaire listing the respective questions are contained in the Addendum, Appendix C to this document.

These six general areas contained in the questionnaire have been transferred to appropriate topical areas based on fields of actions (prevention, detection, response).

In the 2004 analysis, all written responses provided by a country for each question were listed, by country, under that question. For this 2006 analysis, rather than list all responses, the responses from both the 2004 and the 2006 submissions have been used to assist in developing insights into the issues and in defining the "Best Practices" or "Areas Needing Attention" portions of this document. These results are summarized in a graphical form with annotations and discussions, as appropriate in the Addendum to this document.

The results provided in the Addendum are summarized graphically for questions that were to be answered by a "yes" or a "no". For these questions, the summaries were prepared as follows:

- graphic representation of percentage of positive answers out of the total number of respondents; and
- a lack of response (i.e. the responder did not mark either "yes" or "no"), or an "N/A" (i.e. not applicable) were all counted as a "no". In some cases the responders marked neither "yes" nor "no", but provided descriptive text to the query; in these cases the text was analyzed and a "yes" or "no" selected based on that analysis.

Any additional comments provided by the responders for these questions were used to develop, as appropriate, additional insights into the issues. In order to assess the statistical meaning of the results, defining how practices have evolved over the 2 years between questionnaires, graphs showing the same respondents for both years have been used in some cases.

(a) Best practices

The identification of "Best Practices" is based upon the analyses in this report where such practices could assist not only those countries involved in the Group of Experts meetings, but other countries that have not participated in the meeting in addressing the problems associated with monitoring and controlling radioactivity in scrap metal.

The "Best Practices" have been derived from two sources: (a) the analysis of the responses to the questionnaire for both 2004 and 2006, where a large number of countries are utilizing a sound practice in activities associated with radioactive scrap metal; and (b) from individual country inputs and inputs from international organizations that appear to provide an internationally agreed and sound basis for regulatory control of the problem.

Thus, the "Best Practices" identified here should be considered for application by all countries since all countries will have some sources of radioactive material which can potentially be introduced into scrap metal streams. These streams can impact not only the country that is the source of the contamination, but can impact countries through which the scrap may be transported, in which the scrap may be processed, and where processed scrap metal that becomes contaminated may be used.

(b) Areas needing attention

The identification of "Areas Needing Attention" is also based on the analyses in this report. They have also been derived from two sources: (a) the analysis of the responses to the questionnaires for both 2004 and 2006, where some but not a large number of countries are utilizing a sound practice in activities associated with radioactive scrap metal and thus attention should be specifically paid to these issues; and (b) from individual country inputs and inputs from international organizations that indicate a problem may exist that needs to be further addressed to provide an internationally agreed, sound basis for regulatory control of the problem.

Generally, from the results of the questionnaire, if less than approximately 70 to 80 per cent of the responding countries are not following the practice, that practice was then identified as an "Area Needing Attention". More specifically, those practices relate to issues where inadequate attention has been or is being paid by countries, and where additional effort could enhance the control of radioactive material in scrap metal – in the areas of Prevention, Detection and Response – both domestically in a given country, and internationally where countries may be involved in the international market of scrap metal and of products resulting from the processing of scrap metal. Thus, special attention might be given to these areas in future activities at the State and international levels.

D. Prevention[8]

Prevention: Best Practices

Best practices for prevention that can be drawn from the data analysis presented above and from the existing country practices and experience summarized in the Addendum, Appendix B are discussed below.

Prevention: Best Practice No. 1: All countries have established regulations to prevent loss of radioactive sources and/or radioactive material.

Evidence from the questionnaires:
- Essentially all countries responding to both the 2004 and 2006 questionnaires have established regulations directed toward preventing loss of radioactive sources and/or radioactive material (97 to 98 per cent in 2004 compared with 100 per cent in 2006 considering data from both Figures A.1 and A.2 in the Addendum). [QRI-1]

National examples:
- Lithuania has issued a resolution on regulations on handling of illegal sources of ionizing radiation and contaminated facilities. [Addendum, Appendix B.5]
- Switzerland established a programme focused, in part, on intervention and waste management following intervention at border crossing which significantly reduced the number of detections at their borders over a two-year period. [Addendum, Appendix B.7]

Prevention: Best Practice No. 2: All countries have active enforcement programmes, including penalties for non-compliance that are directed toward preventing loss of radioactive sources and/or radioactive material.

Evidence from the questionnaires:
- Essentially all of the countries responding to both the 2004 and 2006 questionnaires have active regulatory enforcement programmes (93 to 94 per cent in 2004 compared with 97 to 98 per cent in 2006 considering both Figures A.1 and A.2 in the Addendum). [QRI-4]
- A large percentage of responding countries have penalties for exceeding regulatory limits (86 to 90 per cent in 2004, increasing slightly to 94 to 95 per cent in 2006 considering both Figures A.1 and A.2 in the Addendum). Figure A.3 in the Addendum further supports this conclusion, which shows that currently countries impose penalties that are: (a) financial (i.e. monetary fines) ranging from unspecified values and/or small amounts to as high as US$ 800,000, (b) penal (i.e. imprisonment) ranging from unspecified duration to as much as 10 years, (c) the suspension of licences, (d) other unspecified administrative actions, and (e) various combinations of these depending upon the severity of the violation. [QRI-5]

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[8] Under "Evidence from the questionnaires" the relevant question as well as references to more detailed information and figures relating to "National examples" are given in square brackets following the items.

Prevention: Best Practice No. 3: Most countries have adopted the IAEA Code of Conduct for the Safety and Security of Radioactive Sources.

Evidence from the questionnaires:

- Since 2004 there has been an apparent significant increase in the percentage of responding countries that have adopted the IAEA Code of Conduct for the Safety and Security of Radioactive Sources (from 63 per cent to 84 per cent using the Figure A.1 data for all countries reporting to date, and from 62 to 81 per cent using the Figure A.2 data for countries reporting in both questionnaires – see Addendum). Although the number of countries using the Code of Conduct is significant and growing with time, since approximately 20 per cent of the countries responding still have not adopted the Code of Conduct, additional attention probably should be paid here. [QRI-3]

National example:

- Lithuania has issued a decree on the control of high activity sealed radioactive sources and orphan sources, and a resolution on regulations on handling of illegal sources of ionizing radiation and contaminated facilities. [Addendum, Appendix B.5]

Prevention: Best Practice No. 4: Most countries have established exemption levels for materials containing low levels of radioactivity, while a large number have established regulations allowing the release of very low levels of radioactivity from nuclear facilities.

Evidence from the questionnaires:

- Essentially all responding countries have established exemption levels (between 97 and 100 per cent considering both Figures A.1 and A.2 in the Addendum). Typically, as summarized in Figure A.4 (in the Addendum), the countries specify exemptions in terms of: (a) specific quantified limits (e.g. specific activities from 0.3 kBq/kg to 70 kBq/kg, exposures to the public of less than 10 μSv/y and less than 1 man Sv/y, to background levels of exposure rates); (b) exemption of naturally occurring radioactive material (NORM) only; (c) specification of compliance with the standards established by the IAEA in its Basic Safety Standards (BSS, SS115), (d) specification of compliance with the EU BSS directive; (e) specification of compliance with nationally established laws and regulation; and (f) combinations of these specification levels. [QRI-6]
- A significant number of countries have regulations for release of materials with very low levels of radioactivity from nuclear facilities (the data varied from 73 to 81 per cent in Figures A.1 and A.2 (Addendum) with no discernable, measurable trend). The methods by which countries allow such releases are through conditional release, unconditional release, or a combination of conditional and unconditional depending upon the radioactivity level (see Figure A.5 in the Addendum). This is viewed as a Best Practice; however, those countries that have not yet addressed regulatory release of materials with very low levels of radioactivity could consider doing so. [QRI-7]
- Establishing exemption levels for radioactivity at levels sufficiently low that it poses no health or environmental hazards allows countries' regulators and also the operators of facilities and those transporting materials to conserve valuable personnel and financial resources that could be applied to those cases when the radioactivity is high.

National example:

- The United Kingdom issued a Code of Practice on clearance and exemption principles, processes and practices for use in the nuclear industry. [Addendum, Appendix B.9]

Prevention: Best Practice No. 5: Most countries have established responsibilities and supporting materials for (a) training, including in the areas of visual inspections and response to detections arising from those inspections, and (b) accounting and storage of scrap metal and waste through contractual arrangements.

Evidence from the questionnaires:

- The data for the 36 countries reporting on both questionnaires indicate measurable increases in training requirements at metal processing facilities; from 50 per cent in 2004 to 67 per cent in 2006 for training in visual inspection and response. [QM-16]
- In the area of training responsibilities, specific responsibilities relate to monitoring and response, and to visual inspections and response. The responding countries indicated that the requirements for training personnel in monitoring and response, primarily focused on Customs' personnel at border crossings, increased marginally from 71 per cent in 2004 to 75 per cent in 2006. [QM-8]

National examples:

- Lithuania has issued a decree on procurement, accounting and storage of base scrap metal and waste. [Addendum, Appendix B.5]
- Switzerland established a programme at its borders that includes, in part, a training programme for Customs' agents that significantly reduced the number of detections at its borders over a two-year period. [Addendum, Appendix B.7]
- The United States of America, in cooperation with its domestic scrap metal demolition industry, has developed a training programme on identifying sources at demolition facilities. By identifying the sources at the front end of the material processing chain, the likelihood of introducing radioactivity into the scrap or the processed material is reduced. [Addendum, Appendix B.10]

Prevention: Best Practice No. 6: Most countries support the "Polluter Pays" principle.

Evidence from the questionnaires:

- In the area of contract responsibility, where the industry has specific responsibilities, more than 80 per cent of the responding countries indicated that they support the "Polluter-Pays" principle. This provides an added incentive to the industry to ensure that they are not the polluter [QD3].

Prevention: Areas Needing Attention

Areas needing attention for prevention that can be drawn from the data analysis and from the existing country practices and experience summarized in the Addendum, Appendix B are discussed below.

Prevention: Area Needing Attention No. 1: Countries should systematically collect, and analyze data on radiation levels from scrap metal and processed metal shipments, for potential exposures.

National examples:

- The results of an analysis of the radiation level data obtained by the Belgian authorities shows that a significant number of the detected shipments probably were made without being in compliance with the Transport Regulations, incurring the radiation hazards commensurate therewith. Had the shipments been assessed prior to departure, these non-compliance and potentially hazardous radiological situations could have been avoided. [Addendum, Appendix B.1]
- A Canadian study provides an estimation of effective dose from radioisotopes in a waste load. [Addendum, Appendix B.2]

Prevention: Area Needing Attention No. 2: Countries should increase efforts to establish appropriate regulatory mechanisms for controlling NORM and technologically enhanced naturally occurring radioactive material (TENORM).

Evidence from the questionnaires:

- As illustrated in Figure A.1 and A.2 (Addendum), less than 70 per cent of the responding countries have regulatory mechanisms controlling NORM and TENORM. The data increased slightly, from 64 to 67 per cent over the two-year period. Those countries that have not yet addressed regulatory control of NORM and TENORM should consider doing so. Some NORM and TENORM can have radioactivity well below exclusion levels, however some naturally occurring ores can have quite high radioactivity levels and proper controls are needed to ensure adequate radiation safety. [QRI-2].

Prevention: Area Needing Attention No. 3: Countries should establish: (a) guidelines for identifying and characterizing sources at metal processing facilities, and (b) regulatory provisions requiring the monitoring of imported and/or exported scrap metals for radioactivity.

Evidence from the questionnaires:

- As summarized in Figure A.6 (Addendum), less than 50 per cent of the responding countries indicated that they have guidelines for identifying and characterizing sources at metal processing facilities. [QM-17]
- Figure A.6 (Addendum) also shows that less than 45 per cent of the responding countries indicated that they have a regulatory provision that requires the monitoring of imported and/or exported scrap metals for radioactivity. In explaining their responses to this question, the approximate 50 per cent of the responding countries that do not require monitoring of imports and exports rely on spot checks (6 countries), voluntary actions at metal processing facilities (6 countries), while another 6 countries indicated they had no knowledge of what occurred in their country or that such a requirement was under consideration. [QM-2]

Prevention: Area Needing Attention No. 4: The industry should ensure that contracts include provisions that: (a) scrap metal that is procured is radioactive free; and (b) when cleared scrap metal is sold, the origin of the scrap is clearly stated to the buyer.

Evidence from the questionnaires:

- Figure A.6 (Addendum) illustrates that only about 55 per cent of responding countries have industry issuing contracts ensuring that scrap metal that is procured is radioactive free. [QC-2]
- Figure A.6 (Addendum) further illustrates that contracts should have a provision that, when cleared scrap metal is sold, the origin of the scrap is clearly stated to the buyer of the scrap. For this contractual provision, the data show that only about 40 per cent of responding countries impose this requirement; and that the number decreased from 42 per cent in 2004 to 37 per cent in 2006. In fact, the data for the 36 countries reporting on both questionnaires indicate that only 33 per cent of these responding countries impose contractual requirements for identifying the source of the scrap. [QC-4]

Prevention: Area Needing Attention No. 5: Metal processing facilities should provide training to personnel in visual inspection and response to incidents.

Evidence from the questionnaires:

- As shown in Figure A.6 (Addendum), a relatively low percentage of the responding countries indicated that they require training of personnel in visually inspecting and responding to incidents at metal processing facilities. The number of countries with this requirement increased from 46 per cent in 2004 to 58 per cent in 2006. The data for the

36 countries reporting on both questionnaires indicate an even greater increase in training requirements at metal processing facilities, from 50 per cent in 2004 to 67 per cent in 2006. Thus, it can be inferred from these data that, although many countries still have not achieved the goal of requiring training, many facilities are providing it voluntarily, and measurable progress is being made in the number of countries requiring training. [QM-16]

Prevention - Area Needing Attention No. 6: Countries should agree on a standardized approach to defining the location in the processing chain where ownership of scrap metal is transferred from seller to buyer.

Evidence from the questionnaires:

- Only about half of the responding countries appear to have requirements that impose ownership transfer at the receiving site after the load of scrap material has been screened for contamination. In some cases the transfer is also required to be approved by the relevant regulatory body. Otherwise, it appears that the point of transfer of ownership varies, depending upon individual contractual arrangements, from when it departs the seller, to when it crosses the final international border, to when it arrives at the buyer's site but before inspection. [QC-1]

E. Detection: Best practices and areas needing attention[9]

Detection: Best Practices

While some best practices for detection could be extracted from the questionnaires, trends were more difficult to obtain so most of the data analysed under "Detection" is listed as "areas needing attention".

Detection: Areas Needing Attention

Areas needing attention for detection that can be drawn from the data analysis and from the existing country practices and experience summarized in the Addendum, Appendix B are discussed below.

Detection: Area Needing Attention No. 1: Countries should consider issuing detailed technical directives and guidance providing instructions on the proper application of detection systems.

National examples:

- Summary information on a Belgian directive and a supporting technical annex to the directive illustrates instructions to be applied by operators of a detection portal for radioactive substance and, for experts who may need to be called upon to support the application of the detection system. [Addendum, Appendix B.1]
- Turkey issued a manual on the application of radiation detection systems at border gates for use when radioactivity is discovered in a shipment. [Addendum, Appendix B.8]

Detection: Area Needing Attention No. 2: Countries should establish a consistent and fully comprehensive approach to monitoring for radioactivity of imports and exports of scrap metal shipments at border crossings and at points of departure and arrival; and implementing checks to better control contamination of metals, focussing on: (a) making monitoring comprehensive and mandatory, (b) the location of monitoring, (c) having monitoring occur at the beginning of the distribution chain

[9] Under "Evidence from the questionnaires" the relevant question as well as references to more detailed information and figures relating to "National examples" are given in square brackets following the items.

while still retaining monitoring further down the chain, and (d) issuing appropriate regulations and guidelines for controls on radioactive contamination in scrap yards and metal processing facilities.

Evidence from the questionnaires:

- Although, as shown in Figure A.7, approximately 70 to 80 per cent of the countries responding (in 2004 and 2006 respectively) were monitoring imports and exports of scrap metal for radioactivity, and that monitoring is occurring both at facilities and at borders, it is not being accomplished in a consistent and comprehensive way. The written responses to this question show a definite need for improvement. [QM-1]
- Responding countries indicated that monitoring varies from "usually", "mostly", and "partially"; to "in process of being developed", and "not routinely, only when a vehicle is suspect". A more consistent approach would benefit the Customs' authorities and scrap metal industry worldwide. [QM-1]
- Responses also showed that more focus is given to monitoring imports of scrap rather than exports. If monitoring was focused consistently at the beginning of the export process rather than at border crossings or at the receiving facilities, potential exposures and problems at the processing facilities could be reduced. [QM-1]
- In addition, Figure A.7 in the Addendum shows that in only about 45 per cent of the countries metal melting facilities (smelters) monitor their outputs for radioactivity, and even those monitoring generally do so randomly, inconsistently or voluntarily. [QM-15]
- The data shown in Figure A.8 (Addendum) illustrate that monitoring occurs most predominantly at the scrap processing facilities, and the next largest response was for monitoring at national border crossings, both of which are downstream in the distribution chain. Less than half of the countries reported monitoring at the beginning of the distribution chain, i.e. at the scrap yard. In addition, 17 countries reported that monitoring is voluntary, undertaken at the initiative of the industry. [QM-3 and QM-5]
- Although Figure A.9 (Addendum) shows that a significant number of countries are working to monitor the import and export shipments of scrap; less than half are monitoring all such shipments and approximately 25 per cent do not have data available on this aspect of detection. [QM-6]
- Finally, at least one country has terminated monitoring of scrap metal at its borders since it acceded to the European Union. [QM-3 and QM-5]

National examples:

- Lithuania has issued a decree on procedures to control radioactive contamination of scrap metal, waste and metal products in scrap yards and reprocessing plants' waste. [Addendum, Appendix B.5]
- The United States of America is conducting a pilot study focused on determining the feasibility of monitoring imported scrap metal for radiation. [Addendum, Appendix B.10]

<u>Detection: Area Needing Attention No. 3</u>: Countries should establish a standard approach to the acquisition, quality assurance, maintenance, calibration, and use of radiation detectors at monitoring locations.

Evidence from the questionnaires:

- A majority of the responders (35 countries) noted that specifications for detectors were (a) qualitative, (b) not standardized, and (c) often established at the discretion of the user. A smaller number of responders (18 countries) provided quantified specifications, either in terms of the manufacturer and model number of devices used, or in terms of specific capabilities required in terms of sensitivities and types of radiation to be detected. [QM-4]
- Figure A.10 (Addendum) illustrates that a consistent approach to quality assurance in the operations of detectors does not exist. [QM-7]

- The frequency of calibration for detectors varies significantly from country to country, with responses ranging from "twice monthly" to "once every three years", to "never", to "unknown" or "not applicable". Some responders reported that calibration is according to the instructions of the detector supplier. [QM-11]
- The method used for calibration of detectors was either by qualified radiological services (20 countries) or according to procedures provided by the detector supplier (13 countries). For 12 countries either the individual responding did not know or reported that it was not applicable. [QM-12]
- Regular sensitivity checks were reported to be made on detectors by no more than 72 per cent of the reporting countries but, again, the processes used were disparate. [QM-13]

National examples:

- A Canadian study provides a listing and discussion of the features of some of the commercially available vehicle radiation monitors. [Addendum, Appendix B.2]
- A document, "Procedure for radioactive material seizure" has been issued by the Czech Republic, which includes a listing of technical equipment needed at border crossing checkpoints. [Addendum, Appendix B.3]
- Switzerland established a programme focused, in part, on measuring equipment at border crossings that significantly reduced the number of detections at their borders over a two year period. [Addendum, Appendix B.7]
- Turkey issued a manual on the application of radiation detection systems at border gates. [Addendum, Appendix B.8]

Detection: Area Needing Attention No. 4: Countries should strive for a consistent, worldwide accepted detection alarm threshold setting.

Evidence from the questionnaires:

- Figure A.11 (Addendum) illustrates that the level at which a detection system activates an alarm to warn of potential radioactive contamination or presence of a radioactive source in shipments of scrap metal or metals processed from scrap is not standardized. Seventy five per cent of the responding countries have specified thresholds, but these vary over a large range. For example, 34 countries specify thresholds in terms of percentage or radiation level above background levels. The lowest values were simply "above background" or "5 per cent above background", and the highest value specified was "800 per cent above background". Radiation levels above background ranged from 0 to as high as 3 μ Sv/h above background". [QM-10]
- The selection of thresholds is delegated to the facilities in 8 per cent of responding countries, and 15 per cent have not specified thresholds or they are unknown to those who prepared the response to the questionnaire. [QM-10]

F. Response: Best practices and areas needing attention

Response: Best practices

Best practices for response that can be drawn from the data analysis and from the existing country practices and experience summarized in the Addendum, Appendix B are discussed below.

Response: Best Practice No. 1: Most countries require Government investigation of all detection/ alarm reports.

Evidence from the questionnaires:

- Figure A.12 (Addendum) shows that a large number of countries (approximately 75 per cent) require Government investigation of all detection/alarm reports. [QR-2]

Response: Best Practice No. 2: Most countries have established protocols defining response actions in the event of a detection alarm.

Evidence from the questionnaires:

- Figure A.12 (Addendum) shows that, of the responding countries, approximately 50 per cent have a formal protocol defining the process an operator (commercial facility or border crossing Customs agents) is to take in response to a radiation alarm. These formal protocols generally call for termination of activities, sequestering the load of scrap metal, verifying the alarm with separate measurements, and notifying Government officials. [QM-18]
- What the protocol contains varies significantly. Responders to QM-9 show that the protocol may range from an informal document, developed by the individual site; to specific legal requirements established by national regulations or laws. [QM-9]

Response: Best Practice No. 3: Most countries have clear responsibilities for financial and physical disposition of detected radioactive materials.

Evidence from the questionnaires:

- Almost all countries impose financial responsibility for disposition of detected radioactive material on the owner, generally considered the consignor, if the discovery of the material is made while in transit. Many countries will impose financial responsibility upon a scrap yard or metal processing facility if the discovery is made at that facility, and then leave it to that facility to recover costs from the original source. [QD-4]
- In contrast, many of the countries accept the physical disposition responsibility for detected material to ensure timely response and adequate public health and safety. [QD-4]

Response: Best Practice No. 4: Most countries have specific and detailed processes identified in regulations or guidance to facilities for disposition of a detected source.

Evidence from the questionnaires:

- Most countries, more than 80 per cent, reported having their process for dealing with detected sources documented in regulations for, or guidance to, facilities. This constitutes a combination of isolation, securing, temporarily storing, and/or transporting to the original consignor, a licensed waste storage facility, or licensed disposal facility. [QD-1]

Response: Best Practice No. 5: Most countries acknowledge that, when the radioactive source or material is known, they can readily transport them in compliance with established transport regulations.

Evidence from the questionnaires:

- Approximately 85 per cent of the responding countries indicated their use of the recognized transport regulations based on the IAEA Transport Regulations [QD-5]

National example:

- A document has been issued by the Czech Republic "Procedure for radioactive material seizures", which includes specifications of safety precautions during the transport of radioactively contaminated metals. [Addendum, Appendix B.3]

Response: Areas needing attention

Areas needing attention for response that can be drawn from the data analysis and from the existing country practices and experience summarized in the Addendum, Appendix B are discussed below.

Response: Areas Needing Attention No. 1: Countries should consider developing appropriate forms to guide the reporting and response actions of those involved in detecting and acting upon detections of radioactivity in metals.

National examples:

- A Canadian study led to the development of an incident reporting form for radiation alarms. [Addendum, Appendix B.2]
- The Canadian study also led to the development of an "estoppel form", which is a tool that may be used to ship hazardous waste when the complete Transport Regulations cannot be met (somewhat equivalent to a special arrangement as defined in paragraph 310 of the IAEA Transport Regulations). [Addendum, Appendix B.2]
- A document has been issued by the Czech Republic "Procedure for radioactive material seizures", which includes charts on the procedures to be followed when an alarm is activated at either a border crossing or at a scrap metal yard or metal processing facility. Three forms have also been issued to assist in this process, including (a) "The record on radioactive material seizure", (b) "The record on radioactive material finding", and (c) "The Protocol on radioactive source tracking in seized or found material". [Addendum, Appendix B.3]
- The above-mentioned Czech document also includes guidelines on tracking and disposal of discovered radioactive material. [Addendum, Appendix B.3].
- Turkey has issued a radiation material notification form for use at border crossings when radioactivity is discovered in a shipment. [Addendum, Appendix B.8]

Response: Areas Needing Attention No. 2: Countries should consider developing information brochures, bulletins and posters summarizing steps to be taken in response to an alarm indicating radioactivity in metals.

National example:

- A brochure and poster have been developed by Canada to enhance communication and education with those who will respond to an alarm indicating the potential of radioactivity in the form of a radioactive source or sources, or of contaminated material in shipments of scrap metal or processed metal or at scrap yards and metal processing facilities. [Addendum, Appendix B.2]

Response: Area Needing Attention No. 3: Countries should establish a formal protocol defining the reporting process and associated actions for a radiation alarm.

Evidence from the questionnaires:

- Figure A.12 (Addendum) shows that only about 50 per cent of the responding countries have established protocols for reporting detected contamination, and only about 65 per cent have established any requirements for reporting alarms at processing facilities. Also, Figure A.13 (Addendum) shows that of those countries with protocols, approximately 1/3 have a formal protocol with detailed requirements; whereas approximately 1/3 only require notification or contact of the regulatory body; and approximately 1/3 have either informal protocols or do not have any protocols. [QM-18 and QR-1]

Response: Area Needing Attention No. 4: Countries should establish a consistent and comprehensive basis for response to alarms, both by Governmental agencies and by the scrap metal industry.

Evidence from the questionnaires:

- Figure A.12 (Addendum) shows that only 50 to 60 per cent of the responders (a) have the metal processing facilities perform their own investigations, and (b) apply procedures for returning or rejecting shipments after they are unloaded. [QR-4 and QC-3]

- Figure A.12 (Addendum) also shows that only about 65 per cent of the responders provide Government follow-up on contaminated shipments; and less than 60 per cent have established national databases on detected materials. [QR-3 and QR-5]

Response: Area Needing Attention No. 5: Countries should include in their recovery programme the regulatory method that is allowed for transporting radioactive material or sources where the contents are undefined.

Evidence from the questionnaires:

- Figure A.14 (Addendum) shows that less than 70 per cent of the responders had knowledge of a regulatory mechanism for transporting contaminated scrap that contains "unwanted and unidentified" radioactive material. Those countries were apparently unaware of the provisions of the IAEA Transport Regulations as they are applied at the international and domestic levels, which allows for transport of unidentified material through the provision of "Special Arrangements". [QD-6]

National example:

- A document has been issued by the Czech Republic "Procedure for radioactive material seizures", which includes specifications of safety precautions during the transport of radioactively contaminated metals. [Addendum, Appendix B.3]

Response: Area Needing Attention No. 6: Countries should consider establishing an international standard on allowing processing facilities to melt contaminated metal, and on accumulating detected materials on their site, especially if below internationally accepted clearance levels.

Evidence from the questionnaires:

- Figure A.14 (Addendum) shows that approximately 25 per cent of responders allow processing facilities to melt contaminated metals, and approximately 40 to 50 per cent are allowed to accumulate detected radioactive materials on their site. [QC-5 and QR-6]
- Figure A.15 (Addendum) illustrates that 13 responding countries allow melting of radioactively contaminated scrap only if it is below clearance levels; while 7 countries allow melting of contaminated scrap if it is above the clearance level, but the melting facilities must be licensed. [QC-5]
- Figure A.14 (Addendum) demonstrates that approximately 40 to 50 per cent of the countries allow metal processing facilities to accumulate detected radioactive material on site. This accumulation is usually allowed only under special radiation protection controls and/or only when the facility is specifically licensed to do so. [QR-6]

National examples:

- Lithuania has issued a standard on clearance levels of radionuclides, conditions for reuse of materials and disposal of waste. [Addendum, Appendix B.5]
- The United Kingdom issued a Code of Practice on clearance and exemption principles, processes and practices for use in the nuclear industry. [Addendum, Appendix B.9]

Response: Area Needing Attention No. 7: Countries should consider establishing a free-of-charge disposal facility or a return-to-sender policy to facilitate resolution of contaminated scrap and metal product incidents.

Evidence from the questionnaires:

- Figure A.14 (Addendum) shows a small number of countries (between 20 and 30 per cent) provide free-of-charge resolution services, or allow or require a return-to-sender policy for contaminated scrap and metal product incidents. However, most of these are handled on a case-by-case basis, and many relate only to orphan sources. [QD-2]

ADDENDUM

Appendix A

This Appendix presents the analysis of the questionnaires in terms of the major fields of action for monitoring of radioactively contaminated scrap metal, which are (1) Prevention, (2) Detection, and (3) Response. Included in the analysis are:

- For the "Prevention" field of action, the areas of the questionnaire are those activities that relate to preventing (a) the loss of control of radioactive material and radioactive sources, and/or (b) the introduction of radioactive material and radioactive sources into the scrap metal processing stream.
- For the "Detection" field of action, the areas of the questionnaire are those activities that countries and/or the scrap metal industry can take to detect the presence of radioactive material or a radioactive source in the scrap metal stream.
- For the "Response" field of action, the areas of the questionnaire are those activities that should be undertaken by countries and/or the scrap metal industry when radioactive material and/or radioactive sources are detected in the scrap metal stream.

In analyzing the questionnaire responses, as noted earlier, when the question required a "yes" or "no" response, the "yes" response generally indicated that a positive action was being taken by the country for that topic. The results of the analyses therefore include presentation of the percentage of responding countries that provided a positive response to the question. These responses have been summarized graphically to assist the reader in evaluating the status, internationally, relative to each of these issues.

Many of the questions, including some with a "yes" or a "no" response, required elaboration. These written responses have been summarized in text and – as appropriate – graphically to assist the reader in evaluating the status relative to each issue.

A.1. Prevention

"Prevention" is directed toward preventing the occurrence of events associated with radioactive sources or radioactive material in scrap metal that could result in radiation hazards to workers, the public and the environment, or to economic or environmental problems. The focus of prevention is on the establishment of sound regulatory regimes to: (a) properly control the use of radioactive sources and radioactive material, (b) identify how to initially address issues when such radioactive material makes it into the scrap metal streams, and (c) focus on the issues of regulation, training and contractual responsibilities.

A.1.1. Regulatory Infrastructure

Seven regulatory infrastructure questions were posed in the questionnaires (identified as QRI-1 through QRI-7) (see Appendix C). All seven of these questions fall into the area of prevention, where key issues relate to regulations, regulatory infrastructure and adequacy of application and enforcement of regulations, etc. Figure A.1 presents a summary of the positive responses to the seven questions relating to regulatory infrastructure, comparing the results of the responses in 2004 to those in 2006 for all countries responding in each case.

With regard to the data analysis presented in figure A.1, it must be remembered that the population of responding countries to the two questionnaires varied. For the two questionnaires, 36 countries responded to both. To provide perspective on how the different populations responding may affect the conclusions, figure A.2 presents the same data in the format used in figure A.1; however, figure A.2 only presents the data for those 36 countries that responded to both questionnaires.

Henceforth in the remaining portions of this report, the data from the 36 countries responding to both questionnaires will only be referred to where the conclusions are measurably different for the two cases.

The data in the figures illustrate that a large number of countries have a regulatory regime, including active enforcement, penalties and exemption levels addressing contaminated scrap metal; whereas fewer countries have a regulatory mechanism for NORM and TENORM and allowing release of very low levels of radioactively contaminated materials. Also, a lower number or countries have adopted the IAEA Code of Conduct, although in this case a significant increase in adoption can be seen between 2004 and 2006.

Figure A.1. Summary Comparison of Positive Responses for Regulatory Infrastructure (all respondents to 2004 and 2006 questionnaires)

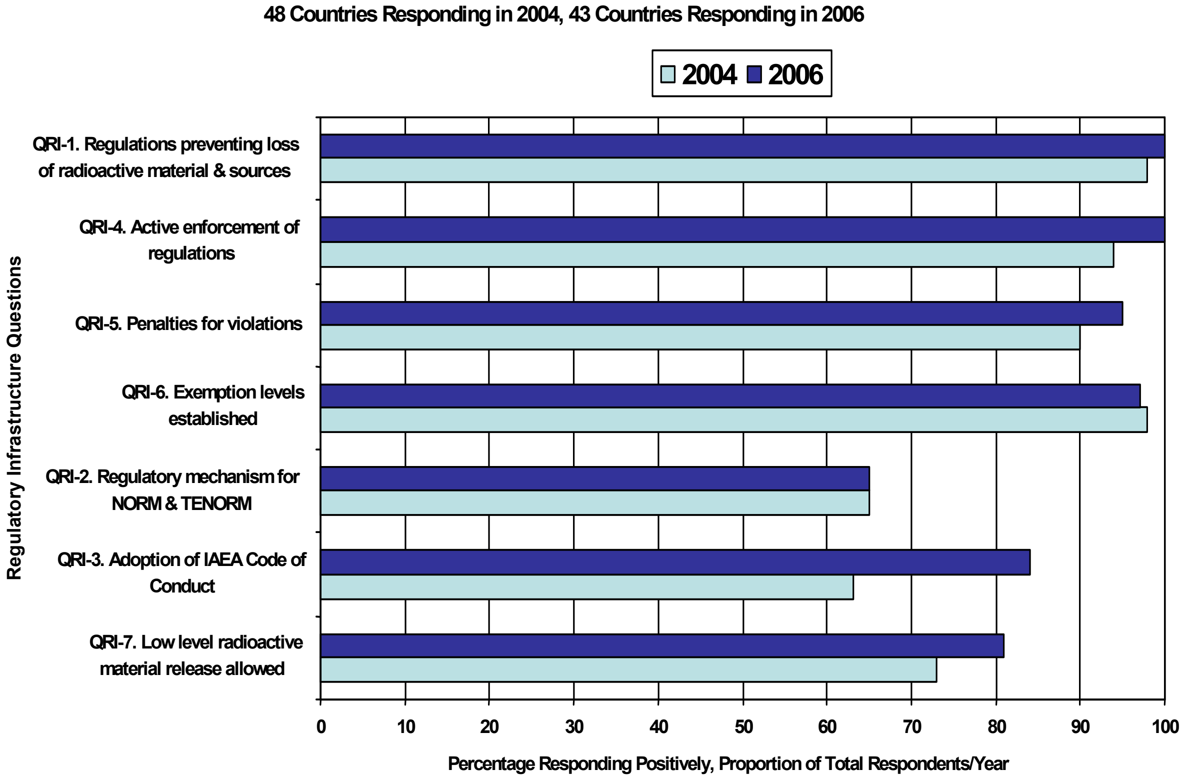
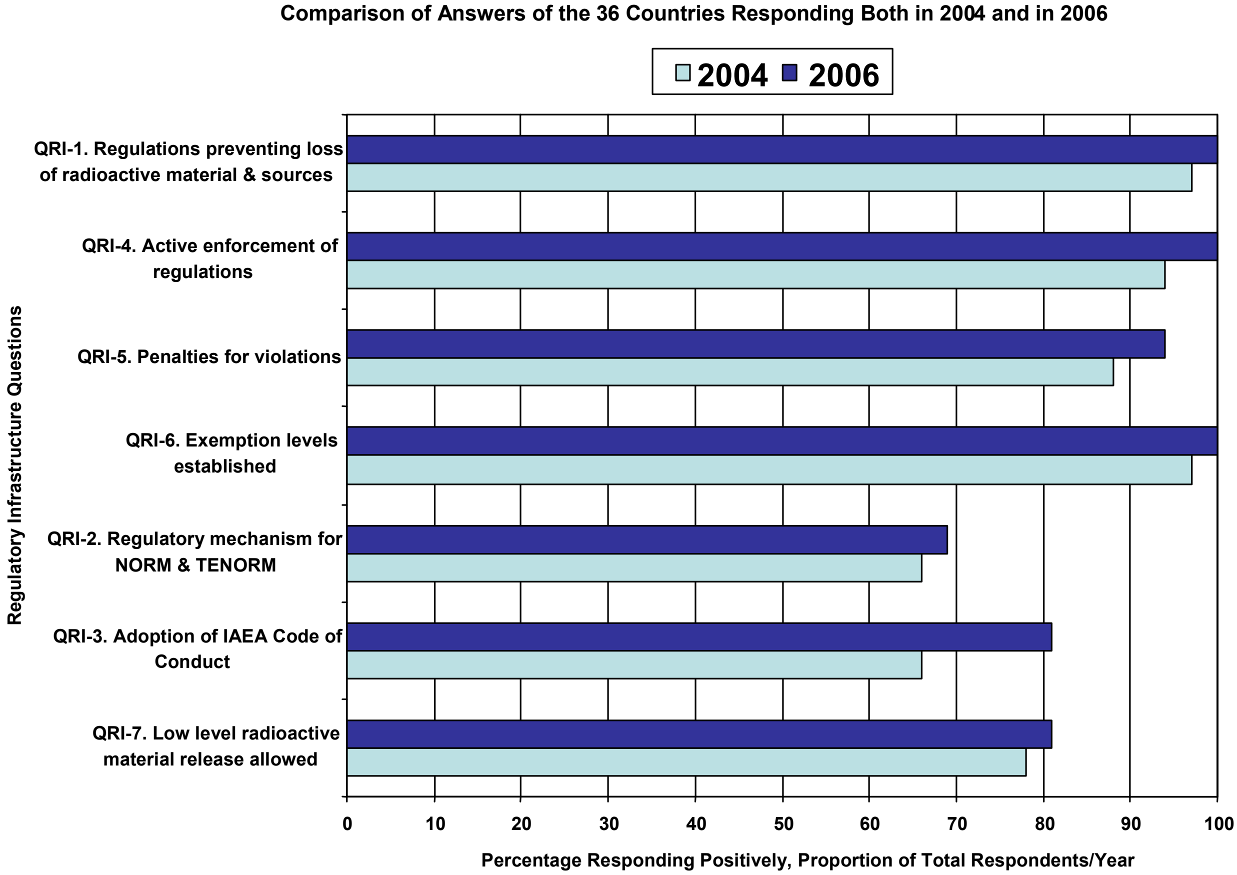


Figure A.2. Summary Comparison of Positive Responses for Regulatory Infrastructure (36 countries that responded to both 2004 and 2006 questionnaires)

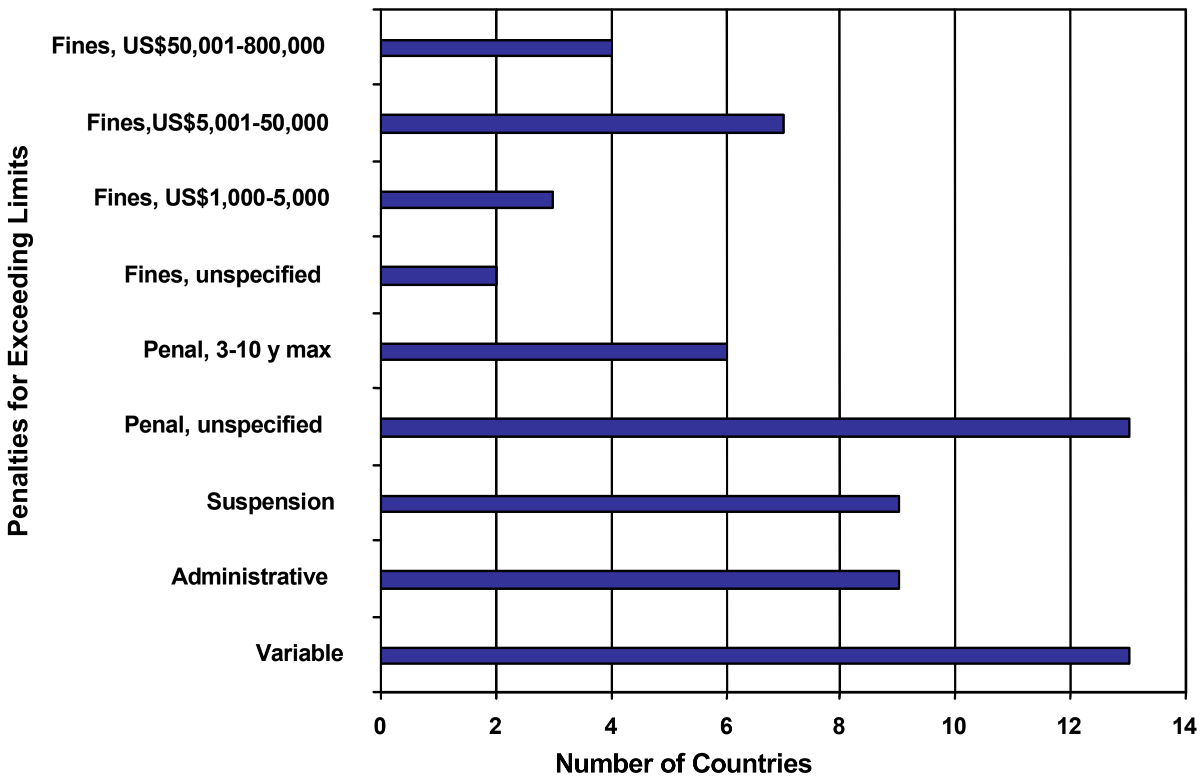


The following section further addresses three of the issues highlighted in figures A.1 and A.2, those of: (a) countries imposing penalties for an operator exceeding the regulatory limits and, for those countries that do impose a penalty, the type of penalty (QRI-5); (b) whether countries have established any levels below which material is exempted from regulatory control and, if so, what are the levels (QRI-6); and (c) whether materials from nuclear facilities, with very low levels of radioactivity, are allowed to be released in accordance with national regulations and, if so, are such releases conditional or unconditional (QRI-7).

(a) Penalties for Exceeding Regulatory Limits [QRI-5]

Figures A.1 and A.2 illustrated that approximately 90 per cent of the responding countries impose penalties of some kind for exceeding regulatory limits. The types of penalties established by these countries, based on their written responses to question QRI-5, are summarized in figure A.3. The figure shows that the penalties include: (a) financial (i.e. monetary fines) ranging from unspecified values and/or small amounts to as high as US$800,000, (b) penal (i.e. imprisonment) ranging from unspecified duration to as much as 10 years, (c) suspension of licences, (d) other unspecified administrative actions, and (e) various combinations of these depending upon the severity of the violation.

Figure A.3. Penalties for Exceeding Regulatory Limits
Analysis of Responses to QRI-5
(using all data provided in the 2004 and 2006 questionnaires)



(b) Established Exemption Levels [QRI-6]

Figures A.1 and A.2 illustrated that almost 100 per cent of the responding countries have established exemption levels. The written responses to QRI-6, dealing with the establishment of these exemption levels, are summarized in figure A.4, which shows that the specification of these exemption levels include: (a) specific quantified limits (e.g. specific activities from 0.3 kBq/kg to 70 kBq/kg, exposures to the public of less than 10 μSv/y and less than 1 man Sv/y, to background levels of exposure rates); (b) exemption of NORM only; (c) specification of compliance with the standards established by the IAEA in its Basic Safety Standards (BSS, SS115), (d) specification of compliance with the EU BSS directive; e) specification of compliance with nationally established laws and regulation; and (f) combinations of these specification levels.

(c) Release of Low Levels of Radioactivity [QRI-7]

Figures A.1 and A.2 illustrated that 70 to 80 per cent of responding countries deal positively with the issue of the release of very low levels of radioactivity from nuclear facilities. Their responses indicate that they handle this issue in various ways, as illustrated in figure A.5, with a majority allowing conditional release or a combination of conditional and unconditional release.

Figure A.4. Established Exemption Levels
Analysis of Responses to QRI-6
(using all data provided in the 2004 and 2006 questionnaires)

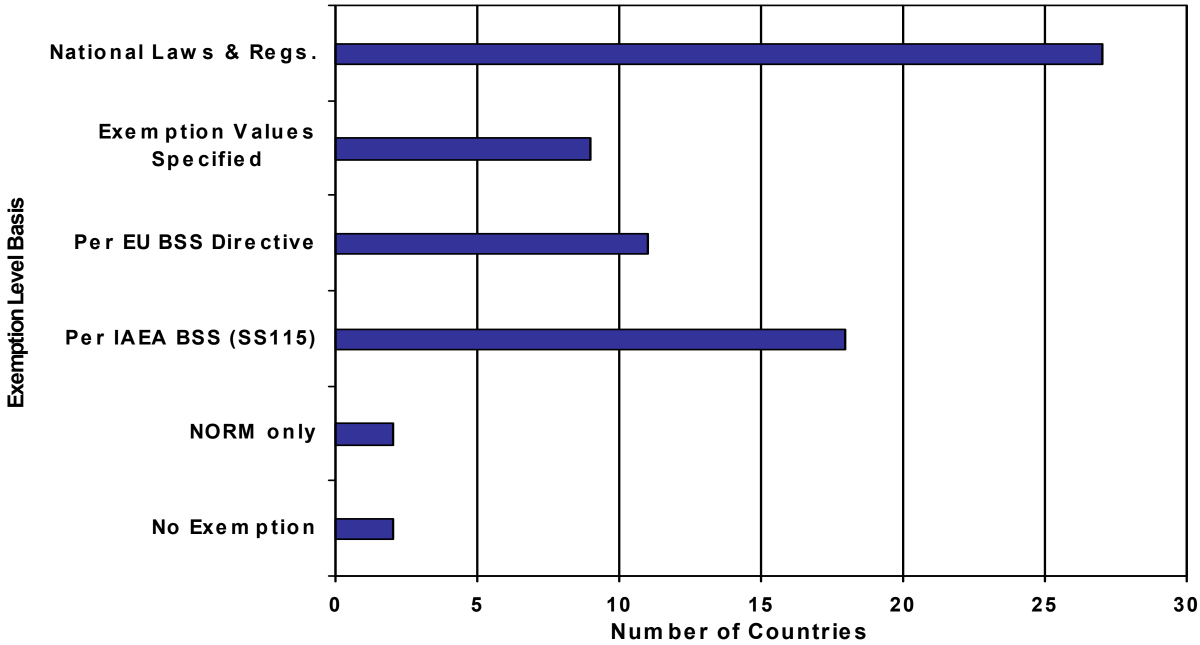
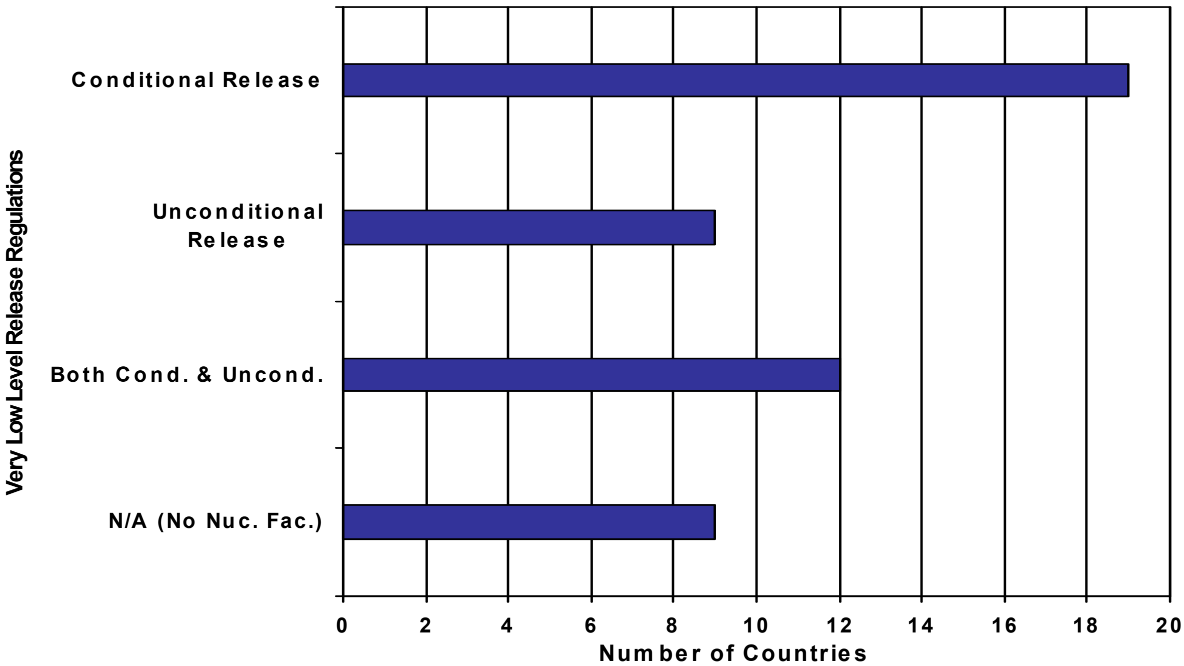


Figure A.5. Release of Material with Very Low Levels of Radioactivity
Analysis of Responses to QRI-7
(using all data provided in the 2004 and 2006 questionnaires)



In considering the responses shown in figure A.5, it was recorded in the proceedings of the 2004 meeting of the Group of Experts that the wording of the last question in Regulatory Infrastructure (QRI-7) may have led to responses, which were not necessarily consistent. The question was worded as follows: "*Are materials from nuclear facilities, with very low levels of radioactivity, released in accordance with a national regulation?*"

Nuclear materials are defined very specifically by the IAEA through its Safeguards and Securities programme such that "Nuclear materials" are limited to those few radionuclides that are capable of sustaining a chain reaction if properly processed (i.e. fissile isotopes of uranium and plutonium, irradiated nuclear fuel and possibly high-level radioactive waste). Thus the term "nuclear facility" was interpreted by a number of countries responding to the questionnaire as being a facility associated with the nuclear fuel cycle (the front-end production of fresh fuel materials, the power and research nuclear reactors that burn the fuel and those facilities that handle discharged fuel and their reprocessed products). As a result, many respondents noted that they did not have nuclear facilities in their country and did not address the question of release of low levels of radioactivity further (the figure shows that nine countries responded in this manner). Because there are many other radionuclides and radioactive sources that can be produced and/or used in non-nuclear facilities in a country (e.g. in medicine, industry and agriculture) that can result in significant contamination of metals if inadvertently processed into them, the response to this question should be viewed with care.

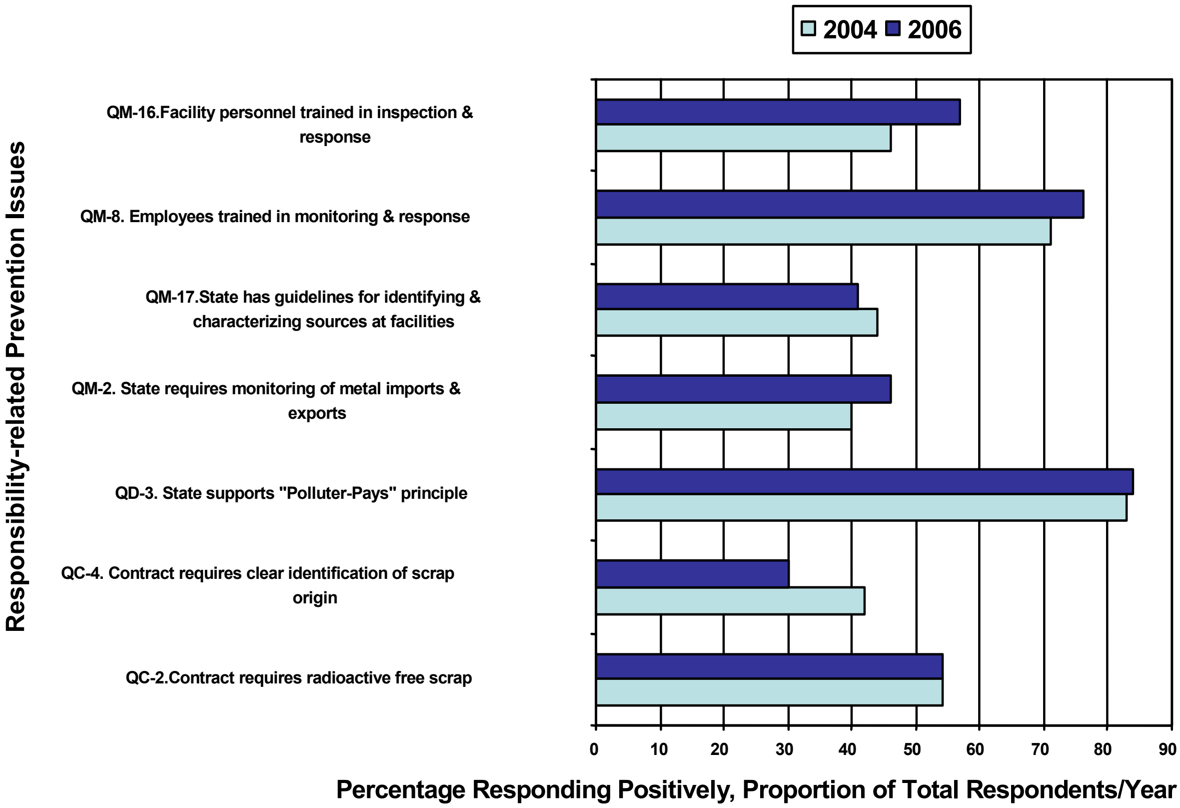
A.1.2 Responsibilities

Prevention of radioactivity in scrap metal also relates to the issues of regulatory, contractual, and training responsibilities - on the part of both the regulators and the industry. The questionnaire focused on these areas with questions on regulatory responsibilities (QM-2 and QM-17), on contract responsibility (QD-3, QC-1, QC-2 and QC-4), and on training responsibility (QM-8 and QM-16). Figure A.6 shows a visual representation of the analysis of the responses to these questions.

Transfer of Ownership of Scrap from Seller to Buyer [QC-1]

Approximately half of the responding countries appear to have requirements in place that impose ownership transfer at the receiving site after the load of scrap material has been screened for contamination and, in some cases approved by the relevant regulatory body. The remaining countries indicated generally that the point of transfer of ownership is a function of the contractual arrangements between seller and buyer, varying from when it departs the seller, to when it crosses the final international border, to when it arrives at the buyer's site. Generally, all countries have a mechanism in place for specifying ownership transfer, but it is far from consistent internationally.

Figure A.6. Summary Comparison of Responses for Prevention Issues Relating to Responsibilities (all respondents to 2004 and 2006 questionnaires)

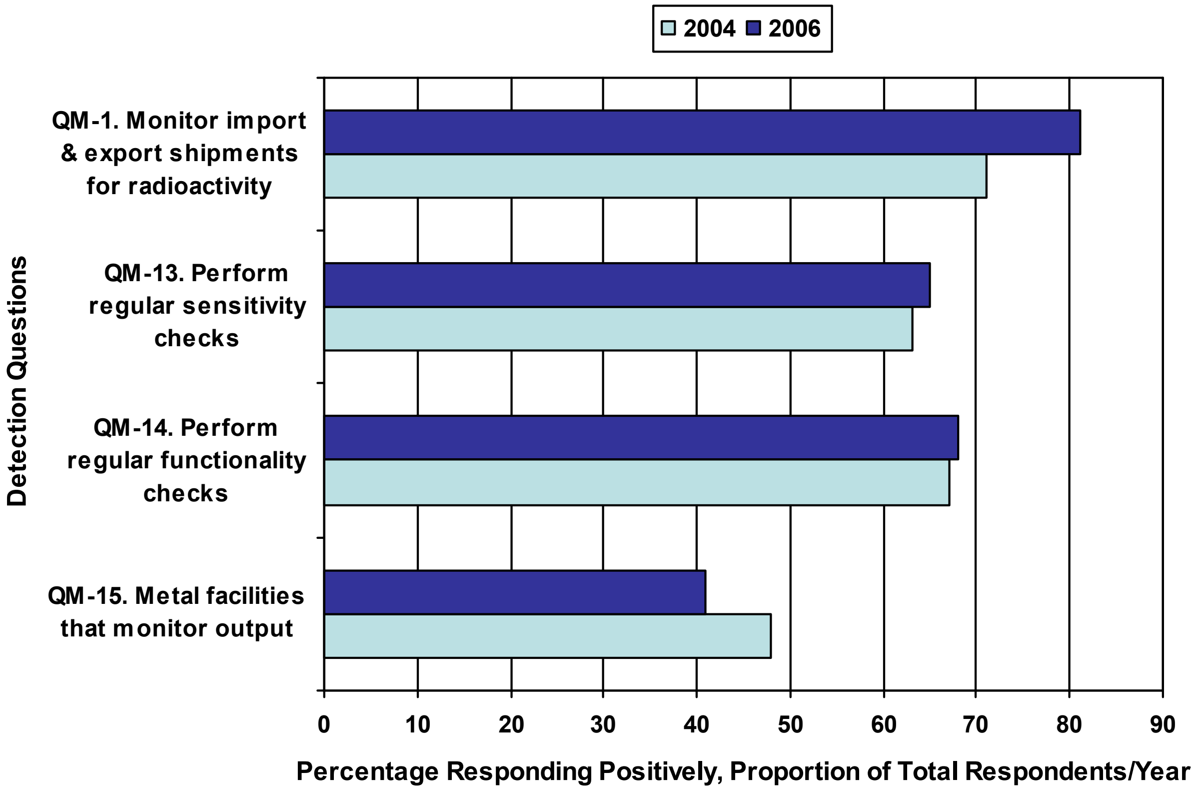


A.2. Detection

"Detection" focuses on those actions applying the requirements discussed in section A.1, provisions in specific international and domestic regulations, and measures arising from any applicable voluntary protocols. The focus of this major field of action is directed toward detecting the presence of radioactive materials or radioactive sources in the metal waste stream as early in the process as possible, and feeding necessary information and data to the response actions.

A number of questions fall into this area of detection, including QM-1, QM-3 through QM-7, and QM-10 through QM-15. Figure A.7 presents a summary of the positive responses to the four questions of the "yes" / "no" type, comparing the results of the responses in 2004 to those in 2006 for all countries responding in each case. The data show that a large number of countries (60 to 80 per cent) are performing monitoring functions, including sensitivity checks. However, (a) many responses show this monitoring is not comprehensive, and (b) only a relatively small percentage is monitoring the outputs on a regular basis from metal processing facilities. These issues are addressed in greater detail in the following topical subsections.

Figure A.7. Summary Comparison of Responses for Issues Relating to Detection (all respondents to 2004 and 2006 questionnaires)



(a) Monitoring of Imported/Exported Scrap [QM-1]

Figure A.7 illustrates that: (a) 71 per cent of the countries responding in 2004 were monitoring imports and exports of scrap metal for radioactivity, and (b) the extent of this monitoring has grown to more than 80 per cent in 2006. However, in the written responses to this question, the comments:

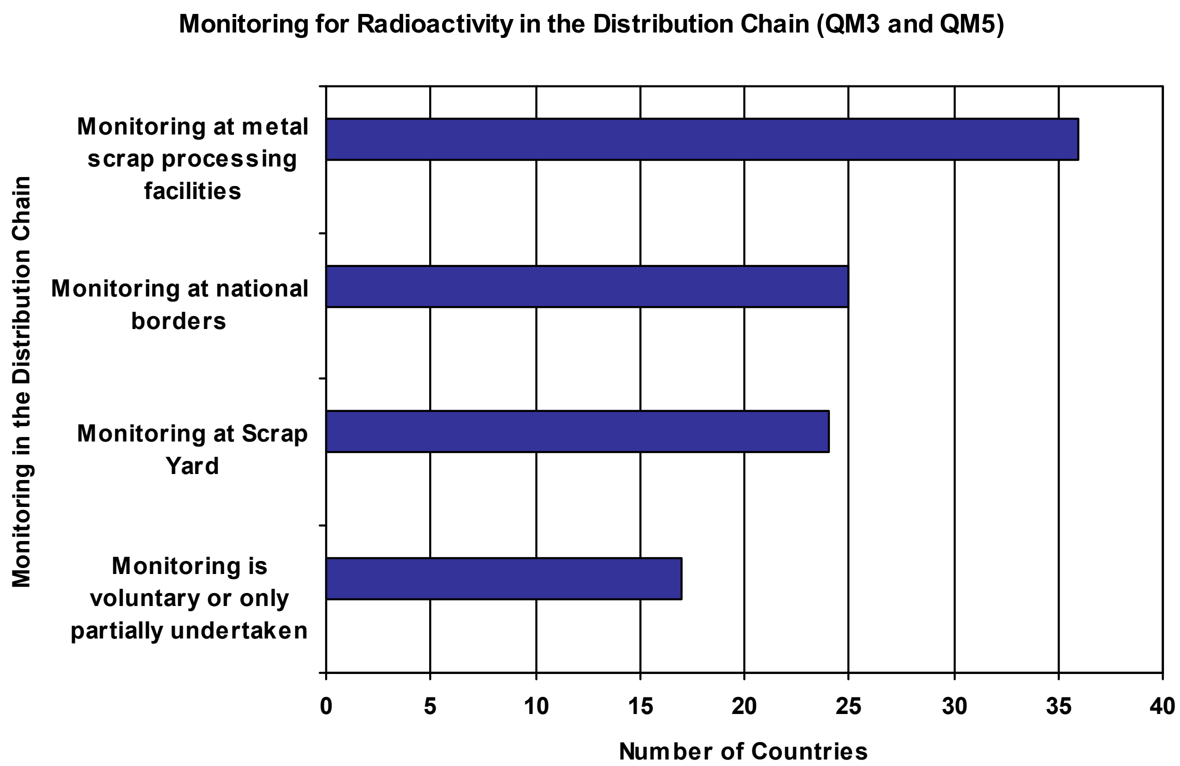
– varied from "*usually*", "*mostly*", and "*partially*"; to "*in process of being developed*", and "*not routinely, only when a vehicle is suspect*";
– indicate that more focus is given by countries to monitoring imports of scrap rather than exports; and
– show that monitoring is occurring at both facilities and at borders.

Thus, it appears that there is no consistent method used worldwide, and that few countries have a fully comprehensive monitoring programme.

(b) Location of Monitoring in Distribution Chain [QM-3 and QM-5]

The written responses to the question "At what point in the distribution chain is the scrap metal monitored" are summarized in figure A.8. These data illustrate that the largest number of responses were for monitoring at the scrap processing facilities, which is downstream in the distribution chain. The next largest response was for monitoring at border crossings, which is again downstream in the distribution chain. Only 24 countries indicated that monitoring occurs at the beginning of the distribution chain, i.e. at the scrap yards. In addition, 17 countries responded that the monitoring is voluntary, undertaken at the initiative of the industry. Finally, one country noted that it had been monitoring scrap metal at its borders until it adhered to the European Union, at which time it terminated this activity. Thus, it appears that (a) greater attention needs to be paid to the location of monitoring, (b) consideration should be given to monitoring at the beginning of the distribution chain while still retaining monitoring further down the chain, and (c) monitoring should be comprehensive and mandatory rather than voluntary.

Figure A.8. Monitoring for Radioactivity in the Distribution Chain:
Analysis of Detection Issue
Responses to QM-3 and QM-5
(all respondents to 2004 and 2006 questionnaires)



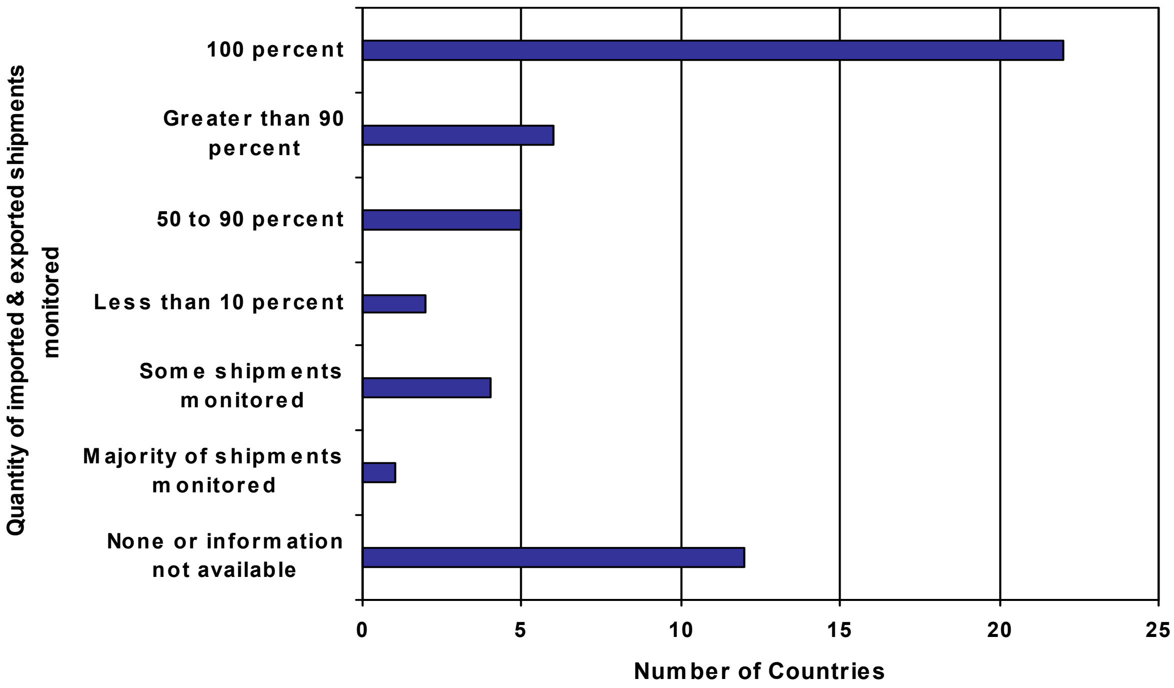
(c) Specification for Detectors [QM-4]

A majority of the respondents (34 countries) noted that their specifications for the detectors were: (a) qualitative in nature, (b) non-standardized and left to the individual monitoring organization or company to define, or (c) not specified in any way. A smaller number of respondents (19 countries) provided quantified specifications, either in terms of the manufacturer and model number of devices used, or in terms of specific capabilities required in terms of sensitivities and types of radiation to be detected.

(d) Quantity of Imported/Exported Material Monitored [QM-6]

Figure A.9 illustrates the responses to the question regarding the percentage of imported and exported materials that are monitored for radiation. These data illustrate that a significant number of countries are working to monitor the import and export shipments of scrap. However, a large number are either monitoring only small portions of such shipments or do not have data available on this aspect of detection.

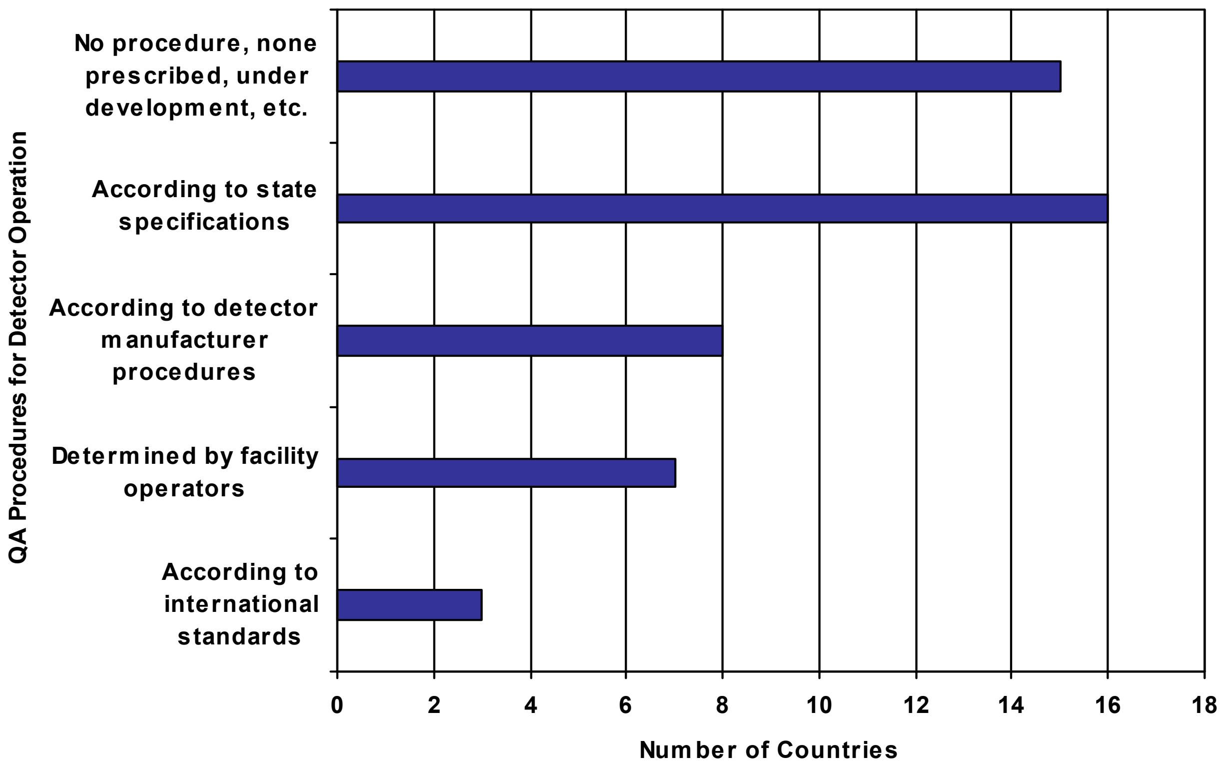
Figure A.9. Quantity of Imported/Exported Material Monitored:
Analysis of Detection Issue
Responses to QM-6
(all respondents to 2004 and 2006 questionnaires)



(e) Quality Assurance in the Operation of Detectors [QM-7]

The responses on quality assurance (QA) procedures for the operation of detectors are summarized in figure A.10. These data illustrate that there is no consistent standard for QA applied to the radiation detectors.

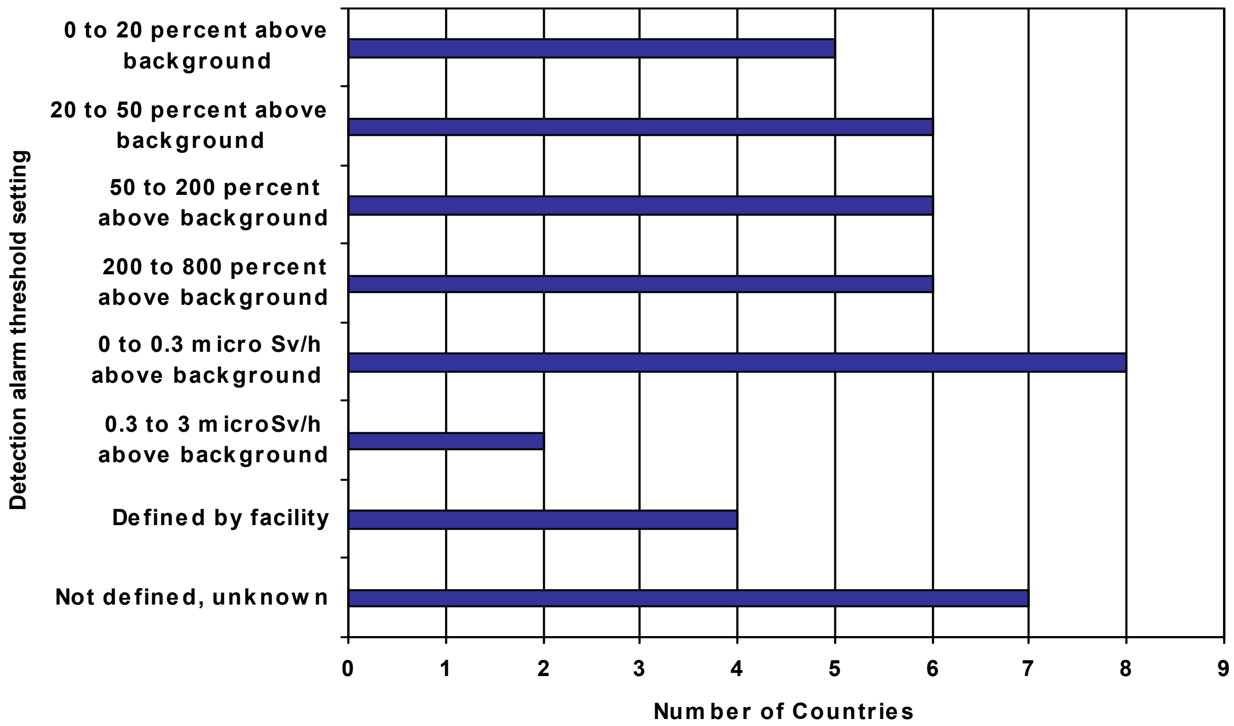
Figure A.10. Quality Assurance in the Operations of Detectors:
Analysis of Detection Issue
Responses to QM-7
(all respondents to 2004 and 2006 questionnaires)



(f) Threshold of Detection Alarm Systems [QM-10]

The level at which a detection system activates an alarm to warn of potential radioactive contamination or presence of a radioactive source in shipments of scrap metal or metals processed from scrap is summarized in figure A.11. The data show that 75 per cent of the respondents have specified thresholds; however they vary over a large range. For example, 34 countries specify thresholds in terms of percentage or radiation level above background, with the lowest values being “above background”, “5 per cent above background”, “20 per cent above background”, “the clearance limit”, and 0 to 0.3 μ Sv/h above background; with the highest values being “800 per cent above background” and “3 μ Sv/h above background”. The selection of thresholds is delegated to the facilities in 9 per cent of responding countries, and 16 per cent have not specified thresholds or they are unknown to those who prepared the response to the questionnaire. Thus, it would appear that detector calibration methods and frequency is an issue.

Figure A.11. Threshold of Detection for Alarm Systems:
Analysis of Detection Issue
Responses to QM-10
(all respondents to 2004 and 2006 questionnaires)



(g) Periodic Calibration of Detection Systems [QM-11, QM-12 and QM-13]

The frequency of calibration for detectors (QM-11) varies significantly from country to country. For 37 countries reporting in this area, it ranged from twice monthly to once every three years, and an additional 9 countries reported that they follow the instructions of the detector supplier. However, in one case it was reported that over a period of 10-years, their detectors had never been calibrated, and for 9 countries either the individual responding did not know or reported that it was not applicable.

The methods used for calibration of detectors (QM-12) was either by qualified radiological services (21 countries) or according to procedures provided by the detector supplier (14 countries). For 12 countries either the individual responding did not know or reported that it was not applicable.

Regular sensitivity checks (QM-13) were reported to be made on detectors by approximately 65 per cent of the reporting countries (see figure A.7). The manner in which these checks were made included (a) using standardized sources and/or according to methods specified by the manufacturer (26 countries); (b) process left to the discretion of the operator (5 countries); and (c) unknown, none or being developed (10 countries). Thus, it would appear that periodic calibration of detectors is an issue.

A.3. Response

"Response" focuses on those actions applying the requirements discussed in section A.1, provisions in specific international and domestic regulations, and measures arising from any applicable voluntary protocols. The focus of this major field of action is directed toward responding to situations when (a) radioactive material or radioactive sources are detected in scrap metal at its source, at border crossings, at other sites while in transit, at arrival, at a metal processing facility or within the facility prior to processing of the scrap; and (b) when radioactivity is detected in processed metal.

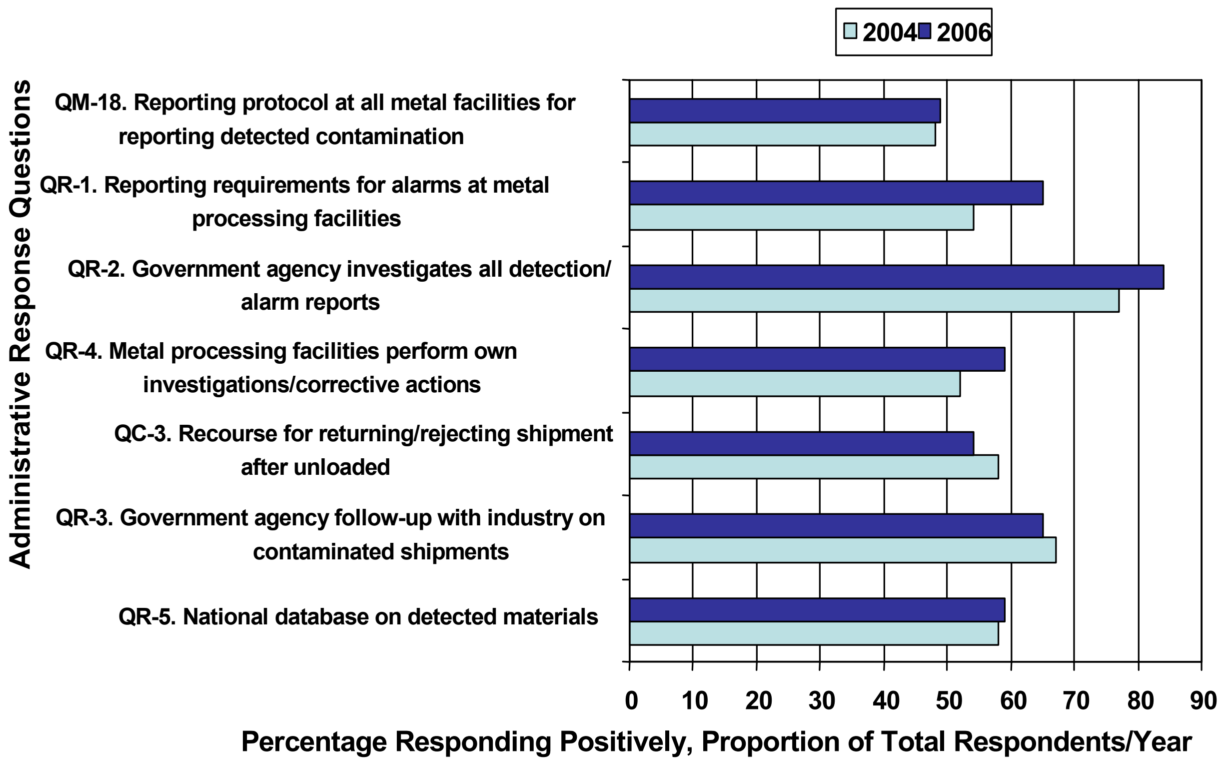
A.3.1. Administrative Procedures and Responsibilities after Detection

A number of questions fall into the area of administrative procedures after detection including protocols, investigations, implementing corrective actions to avoid similar problems in the future, follow-up actions, and establishing a national database on these issues. These questions include QM-9, QM-18, QR-1 through QR-5, and QC-3, and QD-4.

Figure A.12 presents a summary of the positive responses to the seven questions of the "yes"/"no" type, comparing the results of the responses in 2004 to those in 2006 for all countries responding in each case. The data show that a large number of countries require Government investigation of all detection/alarm reports, and there appears to be a slight increase in the number requiring investigation between the 2004 and 2006 responses. However, only 50 to 70 per cent of the responding countries provided positive response in the areas of:

(a) establishing protocols for reporting detected contamination,
(b) having the metal processing facilities perform their own investigations,
(c) applying procedures for returning or rejecting shipments after they are unloaded,
(d) providing Government follow-up on contaminated shipments, and
(e) establishing national databases on detected materials.

Figure A.12. Summary Comparison of Responses for Issues Relating to Administrative Procedures after Detection
(all respondents to 2004 and 2006 questionnaires)

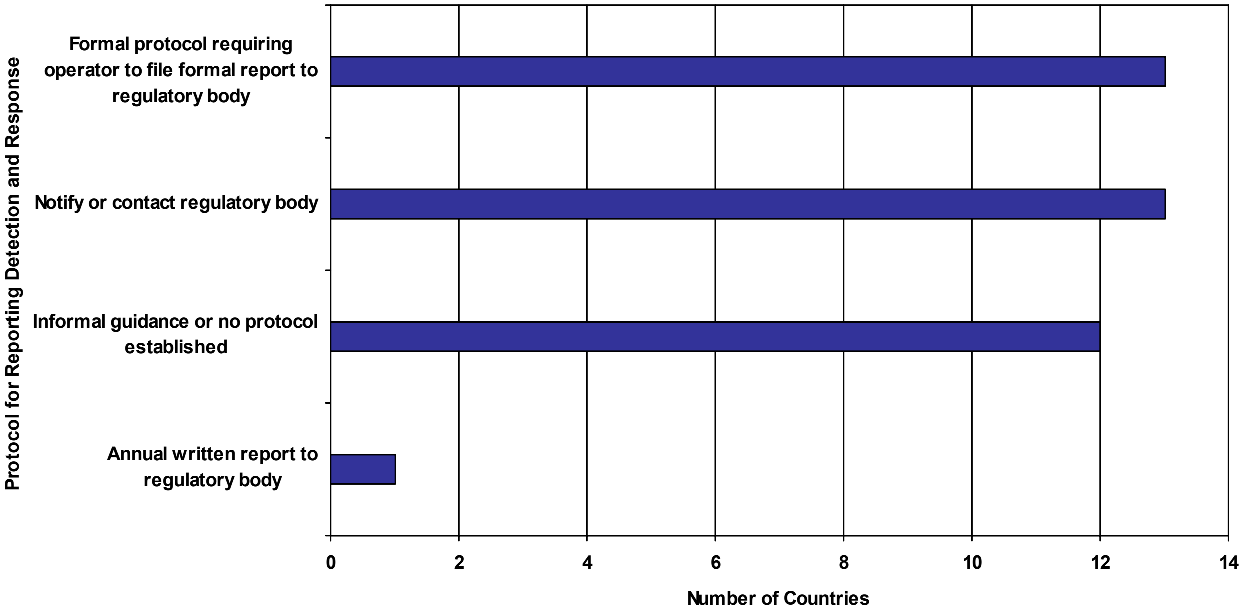


(a) Facility Reporting Protocol for Detection and Action for Radioactivity [QM-18]

Figure A.12 illustrates that only approximately 50 per cent of the responding countries have established protocols for reporting detected contamination. The status of protocols for reporting detections and associated action is summarized in figure A.13. Of those countries, approximately 1/2 have a formal protocol requiring at least some of the following elements: (a) initial reporting of the alarm, (b) cessation of activities, (c) verification of the alarm, (d) remedial actions, and (e) filing a written report to the regulatory body of these events. On the other hand, approximately 1/2 only require notification or contact of the regulatory body.

Figure A.13 also shows that, of those countries without protocols, approximately 1/2 have only informal guidance or no guidance, while the other half indicated “unknown” or “not applicable”.

Figure A.13. Reporting Protocol at Facilities for Detection and Associated Action: Analysis of Protocol Requirement
Responses to QM-18
(all respondents to 2004 and 2006 questionnaires)



(b) Protocol for Response to a Radiation Alarm [QM-9]

Of the responding countries, approximately 80 per cent have a formal protocol defining the process an operator (commercial facility or border crossing Customs' agent) is to take in response to a radiation alarm. These formal protocols generally call for termination of activities, sequestering the load of scrap, verifying the alarm with separate measurements, and notifying Government officials.

(c) Financial and Physical Responsibility for Disposition of Detected Radioactivity [QD-4]

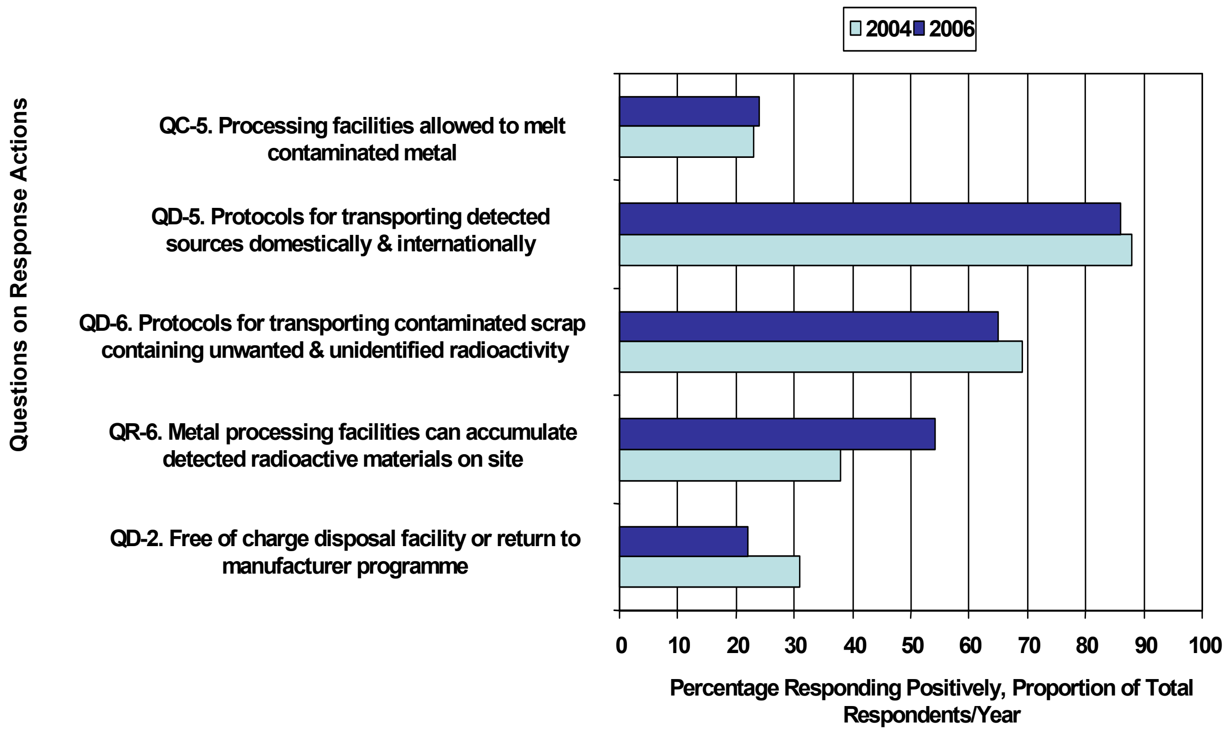
Almost all countries impose financial responsibility for disposition of detected radioactive material on the owner (some countries stated "last owner"). If the discovery of the material is made while in transit, e.g. at a border crossing, then the consignor can usually be readily identified. If the discovery is made at a facility, then many of the countries will impose financial responsibility upon that scrap yard or metal processing facility, and leave it to that facility to recover costs from the original source. In contrast, many of the countries accept the responsibility for the physical disposition of the detected material to ensure timely response and adequate public health and safety. Only three countries noted that the process for assigning financial and physical responsibility was unknown or undefined.

A.3.2. Responsive Actions after Detection

A number of questions fall into the area of responsive actions after detection. These include QC-5, QD-1, QD-2, QD-5, QD-6 and QR-6.

Figure A.14 presents a summary of the positive responses to the seven questions of the "yes"/"no" type, comparing the results of the responses in 2004 to those in 2006 for all countries responding in each case.

Figure A.14. Actions after Detection
Summary Comparison of Responses for Issues Relating to Response
(all respondents to 2004 and 2006 questionnaires)



(a) Disposition of Detected Source [QD-1]

The majority of the responding countries, 84 per cent, reported that their process for dealing with detected sources is documented in regulations for, or guidance to, facilities. This constitutes a combination of:

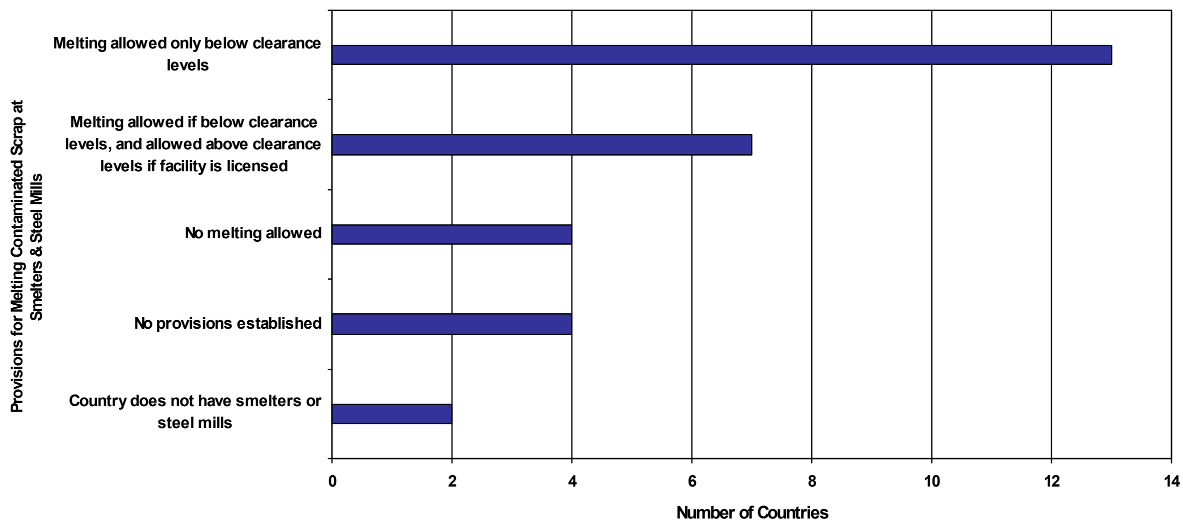
(a) isolating and securing the identified source;
(b) temporarily storing the source until ultimate disposition can be arranged and agreed with the regulatory body;
(c) in some cases and depending upon the activity of the source, returning to the original consignor;
(d) transporting from the facility according to appropriate transport regulations to the original consignor, a licensed waste storage facility, or licensed disposal facility.

Others reported only that the source would be returned to the original consignor, while some indicated they did not have an existing protocol for disposition.

(b) <u>Melting of Radioactively Contaminated Metal Allowed at Steel Mills and Smelters [QC-5]</u>

Figure A.15 illustrates that 13 responding countries allow melting of radioactively contaminated scrap only if it is below clearance levels; while 7 countries allow melting of contaminated scrap if it is above the clearance level, but the melting facilities must be licensed. A limited number of countries reported that they do not allow any melting while another small group of countries have not established provisions for melting. Two countries responded that they do not have smelters or steel mills.

<u>Figure A.15</u>. Melting of Radioactively Contaminated Metal
Allowed at Steel Mills and Smelters
Analysis of Protocol Requirement Responses to QC-5
(all respondents to 2004 and 2006 questionnaires)



(c) <u>Protocols for Transporting Contaminated Scrap with Unwanted and Unidentified Radioactivity [QD-6]</u>

As noted in figure A.14, more than 85 per cent of the responding countries impose the IAEA Transport Regulations on the transport of detected radioactive materials (QD5); whereas, less than 70 per cent had knowledge of a regulatory mechanism for transporting contaminated scrap that contains "unwanted and unidentified" radioactive material (QD6). Most countries responding positively to QD6 indicated an understanding of the provisions of the IAEA Transport Regulations as they are applied at the international and domestic levels, which allows for transport of unidentified material through the provision of "Special Arrangements". Thus, it appears that approximately 30 per cent of the responding countries were not aware of the "Special Arrangement" provision of the international regulations, and/or simply indicated that the method for handling this problem was either unknown or a procedure was under development.

(d) <u>Accumulation of Radioactive Material at Metal Processing Facilities [QR-6]</u>

Figure A.14 illustrates that 40 to 50 per cent of the countries allow metal processing facilities to accumulate detected radioactive material on site. The majority of these allow this accumulation only under special radiation protection controls and/or only when the facility is specifically licensed to do so.

Appendix B

In addition to the inputs obtained from the responding countries on the questionnaires reviewed in detail in Appendix A, some countries provided specific information on their practices which can serve as guides to other countries. These are briefly introduced here.

B.1. BELGIUM – DIRECTIVE, TECHNICAL ANNEX AND HISTORICAL DATA

The "Agence Fédérale de Contrôle Nucléaire" (AFCN) of Belgium issued a technical directive "Directives for the use of a detection portal for radioactive substances in the non-nuclear sector" (9 August 2005). This directive provides instructions to be applied by operators of a detection portal for radioactive substance and, for experts who may need to be called upon to support the application of the detection system. The AFCN has also issued a technical annex to this directive, which is aimed at radioprotection experts, giving indications on the characterization of the radioactive materials, which have been detected. The AFCN notes that these two documents are technical in nature and do not address the issues of responsibility and costs.

The AFCN has some general information on this issue on its webpage[10] (in French) and the directive and the technical annex can also be downloaded from this site (in French and Dutch).

Finally, the AFCN provided data to the UNECE on their recent experience with detections at portals in the waste sector (landfills and incinerators, but excluding radioactive medical wastes), and in the scrap metal recycling industry. The number of detections in Belgium for 2004 and 2005 is shown in Table B-1, and the dose rates at surface contact for these events is shown in Figure B.1, for shipments of scrap in the sector, and Figure B.2, for shipments in the scrap metal recycling sector.

Table B-1. Number of Detections of Radioactive Contaminations in Belgium.

	Waste sector	**Scrap metal recycling sector**	**Total**
2004	37	23	60
2005	34	29	63

[10] The Belgian document is available at the following URL: http://www.fanc.fgov.be/fr/portiques_detection.htm.

Figure B.1. Radiation Levels at Surface Contact for Detections in Belgium in the Waste Sector during 2004 and 2005.

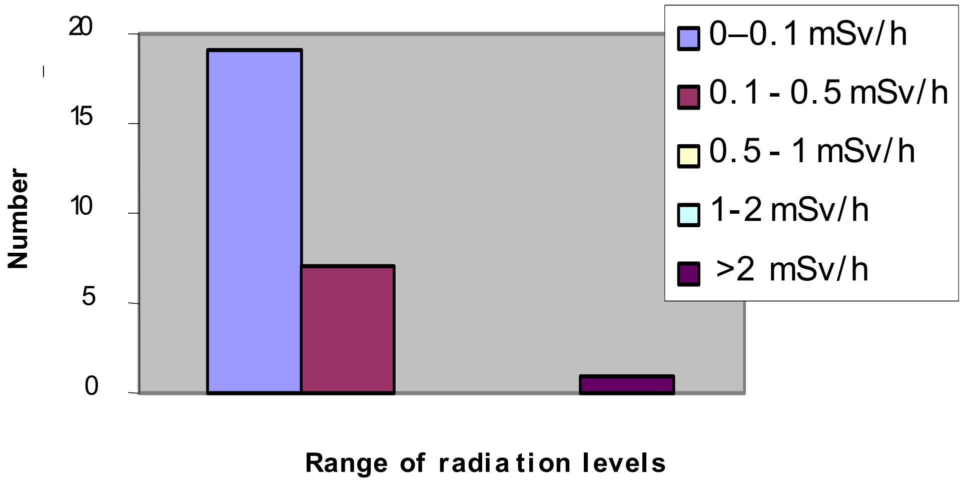
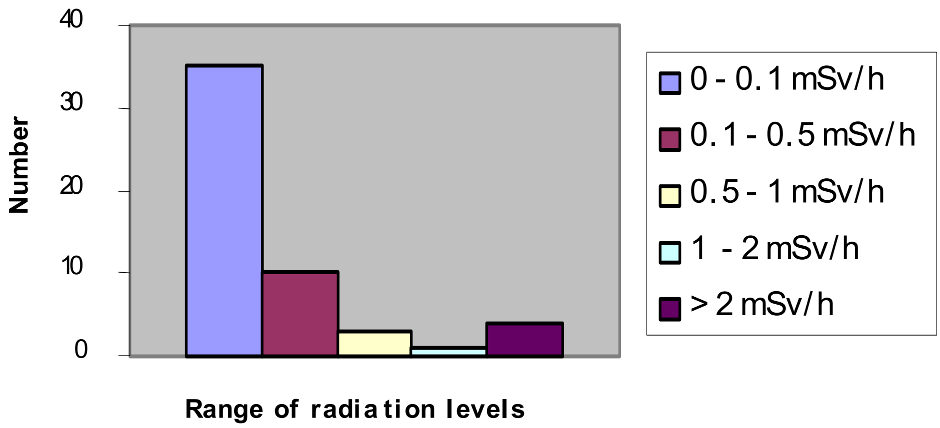


Figure B.2. Radiation Levels at Surface Contact for Detections in Belgium in the Scrap Metal Sector during 2004 and 2005.



Data such as these are very useful to a competent authority in a country in determining the extent of the problem arising from contamination in metal scrap (and in waste materials going to land fills and incinerators).

To place these data in perspective, it is beneficial to consider the radiation level limits specified in the IAEA Transport Regulations. Paragraph 533 of the Transport Regulations establishes the radiation levels at any point on the surface of a package or overpack that are used in establishing the category to be used for that package or overpack as follows:

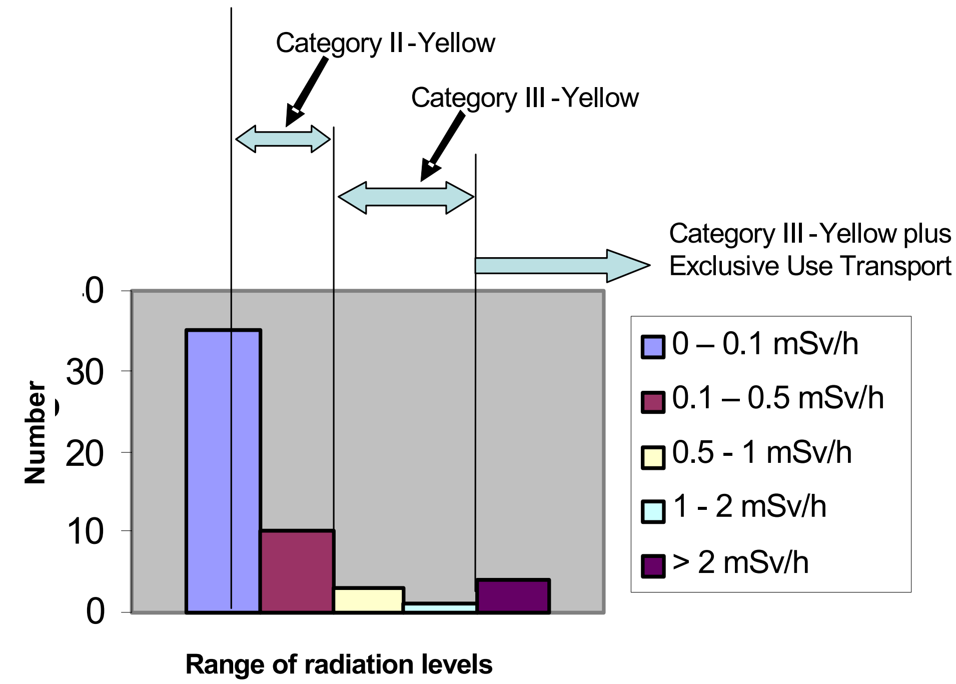
- If the radiation level at the surface is "more than 0.005 mSv/h but not more than 0.5 mSv/h" then the package would be categorized as II-Yellow.
- If the radiation level at the surface is "more than 0.5 mSv/h but not more than 2 mSv/h" then the package would be categorized as III-Yellow (The highest category for radioactive material).
- If the radiation level at the surface is "more than 2 mSv/h but not more than 10 mSv/h" then the package would be categorized as III-Yellow, and the material would have to be transported under exclusive use.

Paragraphs 567 and 573 require that the radiation level at the external surfaces of a transport vehicle (e.g. road trailer or railcar) not exceed 2 mSv/h. These regulatory limits for transport are depicted graphically in figure B.3 for the detections in the scrap metal sector.

If the materials in these detections were all transported in freight containers or closed-sided vehicles from an originating site to the portal where radiation was detected, then the following can be concluded:

(a) The five shipments of contaminated material that had radiation levels exceeding 2 mSv/h would not have been in compliance with the radiation level limit requirement for transport vehicles, or if in packages smaller than the width of the vehicle, should have been categorized as III-Yellow and transported under exclusive use.
(b) One shipment in the waste sector had a surface radiation level between 1 and 2 mSv/h; and three shipments had surface radiation levels between 0.5 mSv/h and 1 mSv/h. These four shipments, if made in a freight container serving the function of a package, should have been categorized as III-Yellow.
(c) The 17 shipments of material with radiation levels between 0.1 mSv/h and 0.5 mSv/h, if made in a freight container serving the function of a package, should have been categorized as II-Yellow.
(d) An indeterminate number of the 55 shipments with radiation levels below 0.1 mSv/h, if made in a freight container serving the function of a package, should also have been categorized as II-Yellow.

Figure B.3. Depiction of the Transport Radiation Level Limits with the Radiation Levels at Surface Contact for Detections in Belgium in the Scrap Metal Sector during 2004 and 2005.



Thus, a significant number of the 81 shipments shown in figures B.1 and B.2, including all of those in items 1 through 3 above, probably were made without being in compliance with the Transport Regulations, incurring the radiation hazards commensurate therewith.

B.2. CANADA – PORTALS DETECTION STUDY

The Canadian Nuclear Safety Commission undertook a study in 2003 of radiation alarms at waste management facilities. The study included a number of internal appendices as follows: (a) a listing and discussion of the features of some of the commercially available vehicle radiation monitors; (b) an incident reporting form for radiation alarms, (c) an estoppel form; which is a tool that may be used to ship hazardous waste when the complete Transport Regulations cannot be met (somewhat equivalent to a special arrangement as defined in paragraph 310 of the IAEA Transport Regulations); (d) an information bulletin; and (e) an estimation of effective dose from radioisotopes in a waste load.

Since this study was completed, Canada has developed and issued an information bulletin on response to alarms from vehicle radiation monitoring systems (INFO-0746-1), and a similar poster for display in facilities (INFO-0746-1).

B.3. CZECH REPUBLIC – PROCEDURE ON RADIOACTIVE MATERIAL SEIZURE

The State Office for Nuclear Safety in the Czech Republic developed in 2002 a "Procedure for radioactive material seizure", which was submitted to the UNECE for consideration at the second meeting of the Group of Experts.

The document is intended to specify the rules for seizures of suspected radioactive materials. It notes that the *"Recommendation is not a legally binding document, however, compliance with the Recommendation will reduce the probability of penalties for persons who own radioactive material (i.e. material, substance or subject) and do not own a licence for management of such radioactive sources. This Recommendation is mainly intended for Customs' officers, fire fighters, policemen, and persons who handle secondary raw materials and municipal waste. However, the principles of this Recommendation can be applied to all other cases of seizures of radionuclide contaminated materials.*"

The procedure discusses at some length, the following: (a) technical equipment at check points; (b) procedures for the suspected presence of radioactivity, radioactive material seizure at border crossings, radioactive material seizure at metal processing facilities, and for all other reported cases and seizures of radioactive material; (c) specifications of safety precautions during transport; and (d) tracking and disposal of discovered radioactive material.

B.4. REPUBLIC OF KOREA – MONITORING AT FACILITIES

Korea provided, in their 2006 response to the questionnaire, an example of the portal monitoring equipment used. It demonstrates that the monitor measures radiation levels on both sides and on top of a conveyance at the portal (see figures B.4 and B.5).

Figure B.4. Schematic diagram of the Korean Portal Monitoring System.

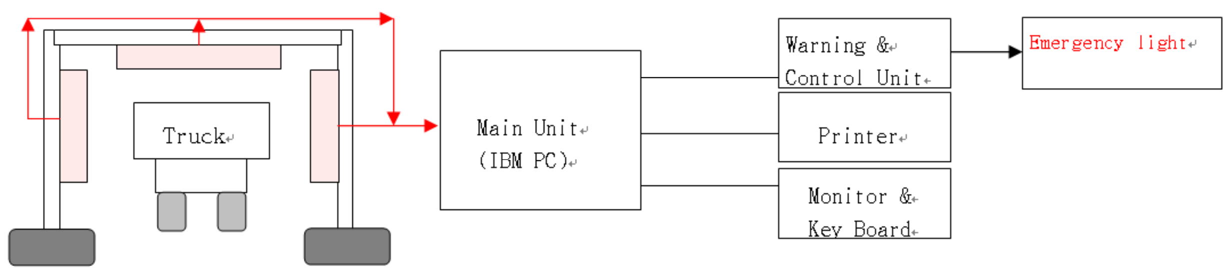


Figure B.5. Photographs of Korean Portal Monitoring System.

B.5. LITHUANIA – ACTIONS FOR THE CONTROL OF RADIOACTIVITY IN SCRAP METAL

Responsible Government agencies in Lithuania have issued various decrees with a view to providing control over radioactivity in scrap metal. These decrees include:

(a) Order of the Minister of Health, Regulations for the Control of High-Activity Sealed Radioactive Sources and Orphan Sources,
(b) Order of the Minister of Economy On the Change of Order of Procurement, Accounting and Storage of the Base Metal Scrap and Waste,
(c) Order of the Director of Radiation Protection Centre on Procedures to Control Radioactive Contamination of Metal Scrap, Waste and Metal Products in Scrap Yards and Reprocessing Plants Waste,
(d) Lithuanian Norm LAND 34-2000 on Clearance Levels of Radionuclides. Conditions for Reuse of Materials and Disposal of Waste, and
(e) Governmental Resolution: Regulations on Handling of Illegal Sources of Ionizing Radiation and Contaminated Facilities.

Actions by Government agencies, such as these, assist greatly in regulating and controlling the inadvertent contamination of scrap metal.

B.6. SOUTH AFRICA – RECOMMENDATIONS FOR MANAGEMENT OF CONTAMINATED SCRAP

South Africa provided, in their 2006 response to the questionnaire, a newly developed set of draft recommendations prepared by a steering committee on methods for management of contaminated scrap. The recommendations were prompted by various problems arising in their country, including:

- most mines were not complying with the requirements of their nuclear authorizations in terms of the control over scrap;
- some scrap dealers encourage scavenging and theft of scrap metal from mines by accepting almost anything that is presented to them for purchase;

– frequent changes in mine ownership and new managements that are not always aware of the requirements of the nuclear authorization;
– people being prepared to resort to scavenging and stealing scrap and to sell these to scrap dealers, since it is their only source of income;
– an undefined quantity of contaminated scrap was already in the public domain by 1993, and still remains in the public domain;
– not all mines and industries generating contaminated scrap have been identified as yet; and
– contaminated scrap are being transported into our country, either to be processed here or to be exported again through the South African harbours, without being monitored at any point of the chain.

The draft recommendations include definition of scope and objectives, specification of current regulatory controls, a process flow diagram, an enumeration of main areas of concern, and recommendations and a plan of action. The plan of action is delineated in two areas: (a) the mining industry, and (b) the scrap industry.

B.7. SWITZERLAND – EXPERIENCE WITH CONTROLLING CONTAMINATED SCRAP METAL SHIPMENTS AT BORDERS

The Schweizerische Unfallversicherungsanstalt (SUVA) of Switzerland submitted a document "Radioactive Materials in Scrap Metal, the Situation in Switzerland" to the UNECE for consideration at the second meeting of the Group of Experts. The document provides information on the steps that have been taken to reduce the number of detections at its border with Italy. A programme was instituted that focused on training, measuring equipment, intervention and waste management. As a result of this added effort, the number of incidents at the borders declined significantly over a short period of time as shown in the table below.

Table B-2. History of Detections at Swiss/Italian Border, Benefits of Enhanced Border Detection Programme.

Year	Number of Detections
From July 1993	12
1994	17
1995	4
To April 1996	4

B.8. TURKEY – INSTRUCTION MANUALS FOR RADIATION DETECTION AND NOTIFICATION OF DETECTION

Turkey provided an Instruction Manual of Radiation Detection System at the Border Gates, and a Nuclear and Radioactive Material Notification Form for use at border crossings when Customs officers discover radioactivity in a shipment crossing their border.

B.9. UNITED KINGDOM – CODE OF PRACTICE ON CLEARANCE AND EXEMPTION PRINCIPLES

Various bodies in the United Kingdom have collaborated in issuing a Code of Practice on "*Clearance and Exemption Principles, Processes and Practices for Use by the Nuclear Industry*". The Executive Summary of this Code states that "*This Code of Practice has been produced to identify and facilitate consistent application of good practice within the nuclear industry regarding the clearance (including sentencing) of articles, substances and wastes which may be clean, or radioactive at levels below the thresholds of regulatory control.*"

B.10. UNITED STATES OF AMERICA – TRAINING PROGRAMME, PILOT STUDY AND WEBSITE

In the United States, it is generally not known if the contaminated scrap metal is coming from domestic or imported sources. The United States Environmental Protection Agency (EPA) is conducting work with a view to identifying the sources and to reducing the number of radioactive sources that find their way into the scrap metal supply.

In partnership with the scrap metal demolition industry, EPA has produced a CD ROM-based training programme entitled "*Identifying Radioactive Sources at the Demolition Site*". This programme is being incorporated into the health and safety programmes of the metal processing industry with the goal of making demolition workers aware of the types and locations of radioactive gauges and devices at industrial facilities, which will hopefully decrease the number of these devices that are put into outgoing scrap metal.

EPA is also conducting a pilot study to determine the feasibility of monitoring imported scrap metal for radiation. Over 2.3 million tonnes of metal have been monitored at two U.S. ports during off-loading operations using grapple mounted radiation detection systems. By monitoring each small, discrete volume of scrap metal as it is taken off the ship, any radioactive material can be identified before it is transported to the metal processing facility.

Finally, EPA prepared a poster on the results of the 2004 Meeting of the Group of Experts[11].

[11] The poster can be obtained, in English, from the following URL: http://www.epa.gov/ORD/scienceforum/2005/pdfs/oeiposter/Kopsick_OEI4.pdf

QUESTIONNAIRE

	Monitoring Radioactive Scrap Metal **Questionnaire**		
	Name: *Ministry (Office /Organization):* *Mailing Address:* *E-mail:* *Phone:* *Fax:*		
	Regulatory Infrastructure:	Yes	No
QRI 1	Does your country/organization have a regulatory mechanism to prevent loss of discrete radioactive sources and/or radioactive materials?	☐	☐
QRI 2	If so, does this regulation include NORM and TENORM? *(NORM = Naturally Occurring Radioactive Material)* *(TENORM = Technologically-Enhanced Naturally Occurring Radioactive Material)*	☐	☐
QRI 3	Has your country/organization adopted the IAEA Code of Conduct for the Safety and Security of Radioactive Sources?	☐	☐
QRI 4	Is there active enforcement of the regulations? What agency is responsible for the enforcement?	☐	☐
QRI 5	Are there penalties for exceeding the regulatory limits? What are the penalties?	☐	☐
QRI 6	Are there any levels below which material is exempted from regulatory control? If so, what are these levels?	☐	☐
QRI 7	Are materials from nuclear facilities, with very low levels of radioactivity, released in accordance with a national regulation? Is the release conditional or unconditional?	☐	☐
	Monitoring		
QM1	Are imported and exported shipments monitored for radioactive materials?	☐	☐
QM2	Is there a regulatory requirement regarding monitoring imported and/or exported scrap metals for radioactivity? If so, please explain.	☐	☐
QM3	At what point in the distribution chain is the scrap metal monitored?		
QM4	What are the specifications of the radiation detectors used?		
QM5	Where are the detectors physically located in relation to the scrap metal?		
QM6	What percentage of imported and exported material is monitored?		
QM7	Explain QA (quality assurance) procedures for the operation of the radiation detectors.		
QM8	Are employees trained in monitoring and response techniques? What topics are covered in the employee training?	☐	☐
QM9	What is the protocol (including organizational structure and coordination) for response to a radiation alarm?		
QM10	What is the detection alarm threshold setting?		
QM11	How often is the detection system calibrated?		

	Monitoring (cont'd)	Yes	No
QM12	How is it calibrated?		
QM13	Are regular sensitivity checks performed? If so, how?	☐	☐
QM14	Are regular functionality checks performed? If so, how?	☐	☐
QM15	Do metal melting facilities (smelters) monitor output? If so, at what location and how?	☐	☐
QM16	Are personnel in metal processing facilities (scrap yards, smelters, etc.) trained in visual inspection and response?	☐	☐
QM17	Are there guidelines for identifying and characterizing sources at metal processing facilities?	☐	☐
QM18	Is there a reporting protocol at all metal processing facilities for detection of radioactive materials and associated action? What is it?		
	Dispositioning		
QD1	How is the detected source dispositioned (removed, eliminated, transported to a waste repository)?		
QD2	Is there a free of charge disposal facility or a return to manufacturer programme?	☐	☐
QD3	Does your Ministry/office/organization support the "Polluter Pays" principle?	☐	☐
QD4	Who is responsible, financially and physically, for disposition of detected radioactive materials?		
QD5	Are there protocols (regulations, procedures, instructions, orders) for transporting detected radioactive materials, both internally and across national borders?	☐	☐
QD6	Are there protocols (regulations, procedures, instructions, orders) for transporting contaminated scrap metal that contain unwanted and unidentified radioactive materials. If so, what is the protocol?	☐	☐
	Contractual		
QC1	At what point does ownership transfer from the seller to the buyer?		
QC2	When scrap metal is purchased, does the contract state it be radioactive-free?	☐	☐
QC3	If radioactive material is found in a shipment after it is unloaded, is there recourse for returning/rejecting the shipment?	☐	☐
QC4	If cleared scrap metal is sold, is the origin of the scrap clearly stated to the buyer?	☐	☐
QC5	Are steel mills and/or smelters allowed to melt radiologically contaminated metal? If so, at what level of radiation and how is it monitored?	☐	☐

	Reporting	Yes	No
QR1	Are there reporting requirements for alarms at metal processing facilities? If so, explain.	□	□
QR2	Does your Ministry (office/organization) investigate all reports on detected radioactive materials/alarms?	□	□
QR3	Does your agency (Ministry/office/organization) follow-up with the receiver/originator of rejected shipments containing radiologically contaminated scrap metal?	□	□
QR4	Are metal processing facilities allowed to perform their own investigations and corrective actions on found radioactive materials? If so, what level of training is required for these site workers?	□	□
QR5	Is there a national database on detected radioactive materials? Who is the information available to?	□	□
QR6	Are metal processing facilities allowed to accumulate detected radioactive materials on-site? If so, what are the restrictions?	□	□
	Experience		
	If you have ongoing scrap metal monitoring programmes, are there any lessons learned to share with other countries? Please describe.		

IV. RECOMMENDATIONS ON MONITORING AND RESPONSE PROCEDURES FOR RADIOACTIVE SCRAP METAL: REPORT OF AN INTERNATIONAL GROUP OF EXPERTS CONVENED UNDER THE AUSPICES OF THE UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE (UNECE)

EXECUTIVE SUMMARY

Radioactive substances can become associated with scrap metal in various ways and if not discovered they can be incorporated into steel and non-ferrous metals through the melting process. This can cause health hazards to workers and to the public as well as environmental concerns and it can also have serious commercial implications. Numerous incidents have occurred in recent years involving the discovery of radioactive substances in scrap metal and, in some cases, in metal from the melting process. These incidents have proved to be very costly in relation to the recovery and clean-up operations required but also in terms of the potential loss of confidence of the industry in scrap metal as a resource. This has led the scrap metal industry to seek ways of managing the problem.

Shipments of scrap metal are monitored in most countries but at different points in the distribution chain and to different extents and efficiencies. As yet, only limited efforts towards unifying and harmonizing monitoring strategies and methods in the context of scrap metal have been made at the international level. For these reasons, the United Nations Economic Commission for Europe (UNECE) was requested to provide a consistent and harmonized approach for the prevention and detection of radioactive scrap metal and for appropriate response procedures. Radioactive scrap metal is defined here as radioactively contaminated scrap metal, activated scrap metal and scrap metal with radioactive source(s) or substances contained within it. It may include both radioactive substances that are subject to regulatory control and radioactive substances that are outside regulatory control. The work of the UNECE is complementary to that of other international organizations, in particular the International Atomic Energy Agency (IAEA) and the European Union (EU), in relation to their efforts to prevent the uncontrolled release of sealed radioactive sources and other radioactive material from regulatory control.

The present document, prepared by a group of Governmental and industry experts, provides recommendations and examples of good practice for prevention, detection and response in relation to radioactively contaminated scrap metal, activated scrap metal and scrap metal with radioactive source(s) or substances contained within it (referred to in this document as ‘radioactive scrap metal’). It identifies the roles and responsibilities of all concerned parties in Government and industry in helping to establish an effective collaborative and unified approach at the national level.

Governments and industry alike are encouraged to use the recommendations and examples of good practice contained in this document to develop strategies to effectively monitor scrap metal, metal products and associated waste and to respond to any discovery of radioactive material. This, in turn, should lead to better international harmonization of approaches and methods and, thereby, to more effective prevention, detection and response at the national level.

INTRODUCTION

Recycled scrap metal is increasingly used in metal production. In 2004, the worldwide consumption of scrap metal was of the order of 440 million tonnes out of which around 184 million tonnes were traded internationally [1]. In the case of steel, the proportion of steel products now made from scrap is more than one half. The rise in the importance of scrap metal as a resource has been paralleled by an increase in the frequency that radioactively contaminated scrap metal, activated scrap metal and scrap metal with radioactive source(s) or substances contained within it (hereafter referred to as 'radioactive scrap metal') is detected in scrap metal shipments. Scrap yards, steel works and non-ferrous metal smelters and refiners are increasingly detecting radioactive substances in incoming scrap metal as the result of losses, accidents or inadvertent disposal of radioactive material. In the United States of America alone, over 5,000 incidents were recorded in 2004 that involved various types of radioactive scrap metal. Of these, about 53% involved the detection of naturally occurring radioactive material (NORM), 7% were due to radium, and less than 5% were due to artificially produced radionuclides (for the other reported incidents, such information is not available) [2]. Some of this radioactive scrap metal has gone undetected and has been accidentally melted down or processed and thus entered the metal stream. Although much of the available data originate from developed countries the problem is also apparent in developing countries.

The detection of, and the response to, radioactive scrap metal is complicated by the fact that radioactive substances are ubiquitous in nature and, specifically, that metal ores contain radioactive elements. When low levels of radionuclides are detected in scrap metal it is sometimes difficult to determine whether the radionuclides are naturally occurring or have been added through human activities. Over the years, there have been national and international efforts aimed at defining levels of natural and artificial radionuclides in materials that are acceptable from a radiological health perspective, that is, levels so low as to have an insignificant health impact. The terms exclusion, exemption and clearance have been introduced in this context [3].

While the potential environmental and health risks of the incidents involving radioactive scrap metal are usually not very high due to the relatively low radiation levels involved, the economic and financial consequences of such incidents for the metal processing industry are always very serious. The detection of radioactive materials in processed metal almost always results in the closure of the involved facilities and usually requires expensive clean-up action. In addition, such incidents can lead to a loss of trust in the recycled metal industry and the associated products since consumers do not wish to have unnecessary radiation emanating from their purchases.

The frequency at which radioactive scrap metal is detected may be expected to continue to rise with the ever-increasing use of scrap to produce processed materials, the wider application of radiation monitoring procedures and the ever-increasing effectiveness of radiation detection equipment. Current efforts to control high-activity sealed radioactive sources are unlikely to change this trend in the near future since recovered and recycled scrap can be 40 years or more old.

Radioactive substances can also appear in other types of (non-metal) scrap but it is because of the scale of the metal recycle industry, the difficulties in detection caused by the radiation shielding of metal and the possibility of the radioactive substances being incorporated into the final recycled product that the radioactive scrap metal issue has become so important.

Considerable work has been undertaken in many countries and by international bodies, such as the International Atomic Energy Agency (IAEA) and the European Union (EU), on the control of radioactive sources and their safe transport [4, 5, 6]. In addition to efforts on regulatory control, the metal recycling and producing industries have organised themselves to reduce the probability that radioactive material which has escaped regulatory control is introduced into the recycling process. They have introduced measures aimed at detecting radioactive scrap metal at the earliest possible stage in the recycling chain, but its detection is not an easy task. Even with the most sensitive and sophisticated equipment, radioactive scrap metal may be undetected and be introduced into the recycling process. As noted earlier, radioactive scrap metal is an issue in both developed and developing countries, but the developing countries are generally less well equipped and have a lesser capacity for dealing with the problem.

To date, there has been little published work at the international level aimed specifically at countering the problem of radioactive scrap metal although guidance is currently being developed by the IAEA and the EU. At the national level, the ‘Protocol for Collaboration on the Radiation Monitoring of Metal Materials’ adopted in 1999 in Spain by concerned industrial organizations and by the relevant parts of Government is an important model for action in this area [7]. The Protocol provides for a unified national scheme of collaboration between concerned industry and Government based on monitoring measures to prevent the inclusion of radioactive substances in the scrap recycling process and the management of the consequences of such events if they were to occur.

In 2001, the United Nations Economic Commission for Europe (UNECE), the European Commission (EC) and the International Atomic Energy Agency (IAEA) prepared a ‘Report on the Improvement of the Management of Radiation Protection in the Recycling of Metal Scrap’ [8] that recommended measures to avoid the introduction of radionuclides into the metal recycling stream.

In continuation of this work, the UNECE, with the support of the Government of the United States of America, prepared and circulated a questionnaire to ascertain the current state of the radiation monitoring of scrap metal worldwide. Following the evaluation of the information received, an international Group of Experts met in April 2004 under the auspices of the UNECE to discuss policies and experiences in the monitoring and interception of radioactive scrap metal and to explore ways and means to facilitate and secure the international trade and transport of scrap metal.

The proceedings of the Group of Experts meeting together with extensive documentation on national experiences are contained in a report published by the UNECE on ‘Monitoring, Interception and Managing Radioactively Contaminated Scrap Metal’[9]. The Group of Experts identified ten issues as a common basis for possible future work and recommended that a permanent international dialogue should be maintained on these issues among Governments and private industries. In particular, the following concrete outputs were envisaged:

(a) Establishment of a voluntary international “Protocol” or “Recommendations” providing for a consistent and internationally harmonized approach to monitoring and response procedures;
(b) Establishment and maintenance of an Internet-based information exchange system open to all concerned parties;
(c) Compilation of training and capacity-building programmes.

The present document (hereafter referred to as “Recommendations”) was developed in fulfilment of the first of these proposed initiatives. It was agreed upon after the second meeting of the Group of Experts on the Monitoring of Radioactive Scrap Metal held in June 2006 under the auspices of the UNECE.

The document provides a framework of recommendations and examples of good practice based, to the extent possible, on existing national, regional and international instruments and standards and on national experience. The document is intended to support States in developing their own national systems of monitoring and response while encouraging further cooperation, coordination and harmonization at the international level. It is also intended to facilitate international trade in, and the use of, scrap metal without compromising safety.

It is recognised that there are significant ongoing national and international programmes aimed at controlling high activity radioactive sealed sources and orphan sources including programmes for their detection at borders [4, 5]. The recommendations in this document go beyond these programmes and focus on detection and response in relation to radioactively contaminated scrap metal, activated scrap metal and scrap metal with radioactive sources or substances contained within it. The recommendations cover both radioactive substances that are subject to regulatory control and radioactive substances that are outside such control and should be seen as complementary to existing programmes.

A. GENERAL PROVISIONS

1. Definitions *(from IAEA Safety Glossary [10] unless otherwise stated)*

(a) **Clearance level:** A value, established by a regulatory body, and expressed in terms of activity concentration and/or activity, at or below which a source of radiation may be released from regulatory control.

(b) **Naturally Occurring Radioactive Material (NORM):** Material containing naturally occurring radionuclides. *(Defined for the purposes of this document).*

(c) **Orphan source:** A radioactive source which is not under regulatory control, either because it has never been under regulatory control, or because it has been abandoned, lost, misplaced, stolen or otherwise transferred without proper authorization [4].

(d) **Polluter Pays Principle:** The principle that the polluter *(i.e., owner of the source or radioactive material)* should bear the cost of pollution *(i.e., recovery, radioactive waste management and clean-up)*, with due regard to the public interest and without distorting international trade and investment [11].

(e) **Sealed radioactive source:** Radioactive material that is (i) permanently sealed in a capsule, or (ii) closely bonded and in a solid form whose structure is such as to prevent, under normal conditions of use, any dispersion of the radioactive material into the environment. *(Defined for the purposes of this document).*

(f) **Radiation dose:** A measure of the energy deposited by radiation in a target.

(g) **Radiation monitoring:** The measurement of dose or contamination for reasons related to the assessment or control of exposure to radiation or radioactive substances, and the interpretation of the results.

(h) **Radiation protection:** The protection of people from the effects of exposure to ionizing radiation, and the means for achieving this.

(i) **Radiation protection experts:** Persons who have been approved by national authorities as certified experts having had appropriate training and experience in operational radiation protection. *(Defined for the purposes of this document).*

(j) **Radioactive contamination:** Radioactive substances on surfaces, or within solids, liquids or gases (including the human body), where their presence is unintended or undesirable.

(k) **Radioactive material:** Material designated in national law or by a regulatory body as being subject to regulatory control because of its radioactivity.

(l) **Radioactive scrap metal:** This may comprise radioactively contaminated scrap metal, activated scrap metal and scrap metal with radioactive source(s) or substances contained within it. It may include both radioactive substances that are subject to regulatory control and radioactive substances that are outside regulatory control. *(Defined for the purposes of this document).*

(m) **Radioactive substance:** A substance which exhibits radioactivity.

(n) **Radioactive waste management:** All administrative and operational activities involved in the handling, pre-treatment, treatment, conditioning, transport, storage and disposal of radioactive waste.

(o) **Radioactivity:** The phenomenon whereby atoms undergo spontaneous random disintegration, usually accompanied by the emission of radiation.

(p) **Regulatory body:** An authority or a system of authorities designated by the Government of a State as having legal authority for conducting the regulatory process, including issuing authorizations, and thereby regulating nuclear, radiation, radioactive waste and transport safety.

(q) **Response level**: A radiation level above which outside radiation protection experts should be involved. *(Defined for the purposes of this document).*

Note: In this document the term 'radioactive material' as defined above, is used to denote material that is radioactive by regulatory definition. The term 'radioactive substance' is used to describe material that is radioactive in the physical sense and so it may be within regulatory control or outside of regulatory control. Similarly, the term 'radioactive scrap metal', as defined above, may include radioactive substances that are within regulatory control and radioactive substances that are outside regulatory control.

2. Objectives

This document is intended to support States in developing their own national systems of monitoring and response related to radioactive scrap metal and to encourage further cooperation, coordination and harmonization at the international level, thereby creating global confidence in the reliability, effectiveness and quality of monitoring and response.

The recommendations in this document are intended to assist Governments, industry and all concerned parties to counter the problem of radioactively contaminated scrap metal, activated scrap metal and scrap metal with radioactive source(s) or substances contained within it (termed 'radioactive scrap metal' in this document) by seeking to prevent its occurrence, by effectively monitoring metal shipments and facilities, and by intercepting and managing any radioactive scrap metal that is detected.

This document establishes a framework of recommendations and examples of good practice for this purpose based, to the extent possible, on existing national, regional and international documents and on national experience. It sets out the responsibilities of all concerned parties and the actions required of them to fulfil the objectives.

3. Scope

The recommendations in this document cover all metals used and traded nationally and internationally as part of the metal recycling industry.

The Recommendations are addressed to all parties concerned with the metal recycling industry, including demolition companies, scrap collectors, sellers of scrap metal, owners of scrap yards, owners of scrap metal processing facilities, buyers and traders in scrap metals, temporary storage companies, owners of metal works, the transporters of scrap metal, the departments of Government responsible for the control of incoming and outgoing shipments of scrap metal, e.g. Customs or border authorities, and the Governmental bodies responsible for safety, health and the environment in the context of radioactive material usage and transport.

The Recommendations address the prevention of the occurrence of radioactive scrap metal which may or may not have been under regulatory control, its detection and the prevention of associated radiological consequences through response actions, including the subsequent management of the material and of any radioactive waste produced.

The Recommendations are aimed mainly at facilitating national and international commerce in scrap metal and improving radiation protection; they are not concerned with national/State security aspects of radioactive sources, although the recommendations on monitoring for radioactive scrap metal may complement programmes aimed at detecting highly active sources and orphan sources.

The Recommendations are aimed at achieving at least a minimum standard of performance in prevention, detection and response in countries; they are not intended to supersede existing monitoring arrangements which may go beyond this minimum standard.

The Recommendations are not intended to place legal commitments on countries but, instead, to provide recommendations and examples of good practice which have been agreed upon by Governmental and industry experts in the field for application on a voluntary basis.

The application of the Recommendations in a country will depend on national administrative and commercial circumstances as well as on prevailing national legislation.

The Recommendations are intended to help prevent the introduction of discrete radiation sources and of improperly released activated and radioactively contaminated material into the recycling stream. This will help to achieve the protection of workers and the public and to minimise the detriment to commerce. The three main steps for achieving these aims are: **prevention, detection and response**. The Recommendations address each of these steps.

4. Guidance and international legal instruments

As yet, there are no international instruments that directly address the problem of radioactive scrap metal, however, the UNECE has considered the problem in two reports [8, 9]. The reports explore the nature and scale of the problem and the ways and means to manage the problem through national and international action. In addition, the problem has been addressed by the European Union and is the subject of a Council Resolution [12].

(a) National actions

There are various national initiatives aimed at countering the problems associated with radioactive scrap metal but few are well documented. Two such initiatives are described below.

In Spain, the ‘Protocol for Collaboration on the Radiation Monitoring of Metal Materials’ has been adopted by the concerned industrial organizations and by the relevant parts of Government [7]. The Protocol provides for a unified national scheme of collaboration between concerned industry and Government based on monitoring measures to prevent the inclusion of radioactive substances in the scrap recycling process and the management of the consequences of such events if they were to occur. The Protocol establishes a register held at the Ministry of Industry and Energy to which companies can subscribe - thereby accepting the rights and obligations arising from registration.

In the United States of America, the National Council on Radiation Protection and Measurements (NCRP) has reviewed the problem of potentially radioactive scrap metal in a national context and discussed the commercial and health implications as well as the practical solutions [13].

(b) Actions by industry

Some industry specifications exist for the quality of scrap metal [14, 15, 16] but these are all purely voluntary. As mentioned previously, in Spain the different operators work together under the

Spanish Protocol [7] to minimize the risks to the metal industry and to the wider society from radioactive scrap metal. In other countries where there is no voluntary agreement or legislation in place, the largest scrap yards and metal works have installed and operate radiation detection equipment. Some importers in the United States for instance, have installed grapple-mounted detectors to intercept any radioactive materials from bulk cargoes. These installations are all voluntary and there is currently no federal- or state-required testing in the United States. In some countries there are legislative requirements that the larger scrap yards and metal works install and operate detection equipment. However, in general, the initial investment in the equipment and the ongoing costs of operation are borne in full by the industry.

In the United States, the Institute of Scrap Recycling Industries (ISRI) has an active Radioactive Materials Task Force and is currently revising the "Recommended Practice and Procedure concerning radioactivity in the scrap recycling process". The Conference of Radiation Control Programme Directors, Inc. (CRCPD) has two task forces that deal with "Resource and Recovery of materials contaminated with radioactive materials", and "Orphaned Radiation Sources". The CRCPD is a non-profit organization consisting of radiation programme directors from all 50 states, and is attended by affiliate members from numerous federal agencies and industry. In this organization, federal and state agencies work together with industry to solve the difficult issues with radioactive scrap metal.

It is also practice to sell and buy scrap metal according to standards drawn up by international or national standards bodies. Where standards do not exist, industry scrap specifications will usually have been agreed between the industry trade associations representing sellers and buyers, and scrap metal is sold and bought on the basis of these documents. Some of these documents have clauses that require the seller to give some assurance that the scrap metal has been checked for radioactive contamination. For instance, in the German "General Terms of Metal Trading" [16] issued by the German Metal Traders Federation it is stated that "radioactively contaminated material is excluded from any delivery, even when this has not been specifically agreed between the parties and when the quality meets the contractual specifications in all other areas". The European Scrap Specifications developed jointly by Eurofer and EFR [14] require that all scrap consignments are completely free of any radioactivity above ambient levels. However, it should be noted that care is needed concerning which specific clauses are acceptable to insurance companies.

(c) International legal instruments and standards

The Basel Convention is the principal international legal instrument governing the control of the transboundary movement of hazardous waste and it places requirements and obligations on Contracting Parties wishing to move hazardous waste between countries [17]. It is concerned that "States should take necessary measures to ensure that the management of hazardous wastes and other wastes including their transboundary movement and disposal is consistent with the protection of human health and the environment whatever the place of disposal".

Radioactive waste is excluded from the scope of the Basel Convention because it is part of another international convention, the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (the Joint Convention) [6], but the general principles of the Basel Convention are supported in the Joint Convention. These conventions are concerned, inter alia, with regularizing planned trade in hazardous material across borders. They declare the illicit movement of such material to be a criminal act but they do not address the inadvertent transfer of material - which is the main mechanism causing the appearance of radioactive material in scrap metal.

The problem of orphan sources is addressed in several international and regional documents. A voluntary Code of Conduct on the Safety and Security of Radioactive Sources [4] and guidance on its application for the import and export of radioactive sources [18] exist to encourage States to exercise control over radioactive sources. To date, eighty IAEA member States have advised that they are supporting the Code. A Directive of the Council of the European Union (EU) on the control of high activity sealed radioactive sources and orphan sources addresses essentially the same problem [5]. The control of disused radioactive sealed sources is the subject of Article 28 of the Joint Convention [6]. In addition to its efforts to control high activity sealed radioactive sources, the IAEA has for many years assisted its Member States in the collection, safe storage and disposal of all types of disused radioactive sources. These efforts are mainly concerned with attempting to prevent the uncontrolled release of radioactive material from the system of control established for radioactive material. However, for the present, the problem of uncontrolled release of radioactive material exists. It continues to be necessary, therefore, to monitor shipments crossing borders and also within countries. This need is recognized in the context of orphan sources both in the Code of Conduct [4] and in the EU Directive [5]. Documents relating specifically to the recovery and control of orphan radioactive sources in the metal recycling industry are currently under development at the IAEA.

In relation to the controlled release of material containing very low levels of radioactive material, an international Safety Standard has recently been published by the IAEA which establishes a set of levels of radionuclides, including radionuclides from NORM, for use in the practical application of the concepts of exclusion, exemption and clearance [19]. Clearance levels have also been defined in the European Commission's document Radiation Protection 122 [20]. Schemes for the clearance of such materials are applied in many countries using similar approaches to that described in the international documents. Details of a scheme used in the United Kingdom, which has been agreed by all parts of the nuclear industry have recently been published [21]. However, it should be noted that even the detection of very low levels of radiation (above normal background) emanating from a shipment may indicate a significant, but shielded, source of radiation. Therefore all detected radiation above background levels in shipments should be subject to further investigation.

5. Origins of radioactive scrap metal

Radioactive scrap metal can occur in a number of different ways. Some of the main origins are listed below:

(a) **Demolition or decommissioning of industrial facilities processing raw materials containing naturally occurring radionuclides**. These industries include phosphate ore processing and oil and gas recovery and processing. The pipes and metal vessels from such facilities are sometimes lined with significant deposits of naturally occurring radionuclides and they may, on occasions, be mistakenly collected as scrap metal.

(b) **Decommissioning of nuclear installations (such as nuclear power plants and other nuclear fuel cycle facilities) and other facilities.** This can produce significant amounts of various metals. A fraction of this material is radioactively activated or contaminated and is normally decontaminated or disposed of as radioactive waste but, on occasions, it may be mistakenly released for recycling. Material from decommissioning or demolition containing artificial or naturally occurring radionuclides at levels below the regulatory clearance level may be released with the approval of regulatory authorities for possible recycling.

(c) **Loss of sources.** Sealed radioactive sources are sometimes lost or mislaid. They may be collected as scrap metal, often with the sealed sources still housed within their protective containers. Industrial radiography sources are used for testing welds on pipework and may be lost in the field. The loss of radioactive sources used in medicine sometimes occurs through poor accounting.

(d) **Demolition of facilities in which radioactive sources have been used**. Radioactive sources are used for many purposes in medicine (e.g., radiotherapy, diagnostic applications), research (e.g., for experimental irradiation of materials or biological specimens) and industry (e.g., level gauging, product irradiators). If such sources are not removed from facilities prior to demolition then there is a risk that they may become part of the scrap metal taken from the premises.

(e) **Incorporation of old radioactive devices into scrap.** Items such as timepieces and compasses covered with radioluminous paint, lightning rods, thoriated lenses, etc. may be collected as scrap. They may have never been subject to regulatory control.

The events most likely to give rise to radioactive scrap metal are inadvertent industrial mishaps, carelessness in the management of radiation sources and other radioactive material, errors in source accounting etc.; they are less likely to be concerned with the illicit trafficking of high activity radioactive sources.

6. Recommendations on responsibilities and coordination

(a) Responsibilities

(i) National responsibilities

There are a number of stages in the scrap metal processing chain and at each stage it is possible to identify persons with specific responsibilities in relation to preventing or monitoring for the presence of radioactive scrap metal. They include the owner of radioactive sources, the seller of scrap metal, and the buyer of scrap metal.

The owner of radioactive sources or material could be the owner of a nuclear power plant, industrial premises, a research institution or a hospital in which radioactive sources or material are used or produced. The owner of the radioactive sources or material is the person formally authorized in national legislation to use and take care of the radioactive sources or material. The seller of the scrap metal could be the owner of the premises being demolished, the company carrying out the demolition, a trading company in scrap metal, etc. The buyer of the scrap metal could be the owner of a scrap yard, a processing facility or a melting works or a scrap metal trading company. In addition, there are persons between the seller and the buyer with responsibilities in relation to the shipment of scrap metal, such as Customs or border officials and shipment carriers.

Specific Recommendations - National Responsibilities

1. **The owner of radioactive sources or material** has obligations under national legislation to keep radioactive sources and material safe and secure while they are in use and for arranging their safe storage, transport or disposal after their period of use. In the event of a radioactive source or material being lost or removed from control, the source or material owner should remain responsible.

2. **The seller of the scrap metal** (who is usually the consignor for the shipment) is usually responsible to the buyer of the scrap metal, by contractual obligation or by national regulations, to provide a product free of added radionuclides. If the seller is so contractually or legally bound, the seller should arrange for radiation monitoring to be performed on the scrap metal at the point of origin and to provide a certificate indicating the results of that monitoring. An example of a certificate of shipment monitoring is attached as Annex I. The seller should provide appropriate training of involved staff.

3. **The carrier (or carriers) of the scrap metal** could be held responsible for the material being carried, for example, in circumstances where the owner of the shipment is not known. In this and similar situations, the carrier should either monitor the shipment for radiation, or request a certificate from the seller (i.e. the consignor) of the scrap metal that the load has been appropriately monitored (see Annex I).

4. **National Customs or border authorities** should be concerned to prevent the import or export of unauthorized and potentially hazardous material and should therefore provide for the radiation monitoring of incoming and outgoing shipments of metal scrap at key border points. They should also provide appropriate training of involved staff.

5. **The buyer of the scrap metal** (e.g. the owner of the scrap yard, the processing facility or the melting works) should be sure that the material received is free of added radioactive substance. It is therefore in the buyer's interest to require a certificate indicating that the shipment has been monitored by the seller and, in addition, to arrange for monitoring of the scrap metal as it enters and leaves the premises of the scrap yard, processing facility or melting plant. The buyer should provide appropriate training of involved staff.

6. **The national regulatory body** is responsible under national legislation and regulations for the licensing and regulation of radioactive sources and radioactive material and of facilities for their radioactive waste management.
   The regulatory body also has responsibilities related to ensuring the safety of workers, the public and the environment in the event of radioactive sources or other radioactive material becoming lost or misplaced (for example, in scrap metal). In some countries, these responsibilities may be shared between different national authorities, for example, Government departments dealing with safety, health, and the environment.

   The relevant national regulatory body or bodies should therefore promulgate appropriate regulations and provide guidance and advice on:
   - procedures to ensure safety in the event of the discovery of radioactive scrap metal, and
   - the safe storage, transport and disposal of radioactive scrap metal.

7. **The seller, the buyer and the national Customs or border authorities** should institute agreements with **national organizations with expertise in radiation monitoring and radiation protection** (or these arrangements may be established by the State):
   - on the provision of advice and training on the detection of radionuclides in scrap metal or metal product and on response procedures; and
   - on the provision of assistance in the event of incidents involving radioactive material in scrap metal, processed metal or product waste producing radiation levels requiring expert response as described in Section B.3.

   The seller, the buyer and the national Customs or border authorities should also be aware of the identity of the relevant national regulatory body (or bodies) so that the regulatory body can be quickly informed in the event of such an incident.

8. **The national competent authority responsible for the safety of the transport of radioactive material** should:
   - provide advice on the requirements for the safe transport of recovered radioactive sources, radioactive material, radioactively contaminated scrap metal or product and of any resulting radioactive waste;
   - issue special authorizations, as needed, for the safe transport of the recovered material or radioactively contaminated scrap metal or product and of any radioactive waste; and
   - facilitate the return of radioactive scrap metal and of any radioactive waste across national boundaries, where this is appropriate.

9. **The national organization responsible for radioactive waste management** should, when required, provide arrangements for the safe processing and storage or disposal of the radioactive material resulting from any incident involving radioactive scrap metal, metal product or production waste.

It is noted that while responsibilities can be attributed at different levels, as indicated above, there will be circumstances in which the allocation of responsibilities is not clearly established. This is most evident when the owner of the radioactive source or material or the seller cannot be discovered or located. In the event of the detection of radioactive scrap metal, contaminated metal product or production waste, this can cause severe difficulties in financing the necessary radioactive waste management or clean-up operations. This is discussed further in Section (c).

(ii) International responsibilities

As discussed in Section 4, international and regional instruments such as the Joint Convention and the EU Directive [6, 5] place legal obligations on States to control and safely manage radioactive sources and disused radioactive sources but to date there are no international instruments related directly to the management of the inadvertent transfer of radioactive substances in scrap metal.

(b) Coordination

A distinction may be made between situations involving radioactive scrap metal due to events within the country and due to trade with other countries. In general, the responsibilities and financial liabilities are easier to allocate when the source owner, the seller and the buyer of the scrap metal are all within the same country. When imported material is discovered to be radioactive scrap metal, determining the source owner and/or scrap metal seller can be a problem. In addition, the involvement of more than one national legal and regulatory system can complicate the issue. Finally, the allocation of responsibilities and the recovery of the costs of radioactive waste management and clean-up are likely to be more difficult.

(i) National coordination

National laws and regulations apply with respect to the loss of control of radioactive sources and the national regulatory body is empowered to take action in relation to the owner of the radioactive sources.

Specific Recommendation - National Coordination

Government ministries, Governmental authorities (safety and Customs or border authorities), agencies competent in radiation protection, transport and waste management and the industry (the metal scrap recycling industry and metal works) should cooperate in resolving problems associated with radioactive scrap metal and products. They should aim to establish a unified national approach with positive incentives and relief measures for all concerned. The example of Spain in this context provides a good model [7]. Annex II shows an example of the possible contents of a unified national collaborative scheme.

(ii) International coordination

By coordinated action, the Governments and industries of States can together contribute to improving the effectiveness of the detection of radioactive scrap metal and of measures in response to its discovery.

Specific Recommendations - International Coordination

1. **States** should:
   - promote cooperation between Customs or border authorities in relation to monitoring at borders, for example, by two neighbouring States sharing monitoring facilities, thereby reducing monitoring needs;
   - promote cooperation between involved States' regulatory bodies in the management of incidents involving radioactive scrap metal.

2. **The metal recycling industry** should promote cooperation between the industries in different States in providing advance warning of potential problems with scrap metal shipments.

3. **States and the metal recycling industry** should encourage industries and Customs or border authorities in neighbouring States to work towards the harmonization of methods and procedures used for detection, thereby increasing confidence that shipments have been effectively monitored for the presence of radiation.

(c) Costs and financing

To the extent possible, the costs due to loss of revenues because of delays, unavailability of facilities, clean-up operations and radioactive waste management should be allocated on the basis of the ‘polluter pays’ principle [11]. Application of this principle implies that the original owner of the radioactive material found in the scrap metal is responsible for the recovery, transport, storage and waste management costs and for the costs associated with any clean-up operations required.

The ‘polluter pays’ principle should be incorporated into the contract between the seller and the buyer of scrap metal such that the costs associated with the management and disposal of any radioactive material found in a scrap metal shipment and any clean-up costs are covered by the seller if the original owner of the radioactive material cannot be found.

The ownership of any detected radioactive material should be clearly established, for example, by reference to the INCOTERMS (an international set of trade terms adopted by most countries defining exactly the responsibilities and liabilities of both the buyer and seller while the merchandise is in transit) in the contract between the seller and the buyer of the scrap metal. In particular, the time and location of any transfers of ownership should be clearly specified.

In cases where it is not possible to determine the original owner of the radioactive material or the seller of the scrap metal, the financial responsibility normally falls on the owner of the premises where the radioactive scrap metal or contaminated processed metal is discovered. Since this could place undue financial burdens on individual owners of premises, it is desirable for there to be arrangements established in the State to provide assistance in the radioactive waste management and disposal and for any clean-up operations needed in relation to radioactive material originating from unidentifiable suppliers. This can be achieved in various ways including a specific insurance policy, a special national fund, possibly established in national legislation or a collaborative approach between Government and industry. In the context of orphan sources, it is noted that Article 10 of the EU Directive [5] requires that Member States establish “a system of financial security ... or any other equivalent means to cover intervention costs relating to the recovery of orphan sources”. Annex III gives some examples of national provisions that have been made to provide assistance in the management of the potential consequences associated with the discovery of radioactive scrap metal when the original owner cannot be found.

Specific Recommendations - Costs and financing

1. **The buyer of scrap metal** should ensure that a ‘polluter pays’ clause is contained in all contracts for the purchase of scrap metal.

2. **Government and industry** should establish arrangements to assist owners of premises at which radioactive scrap metal or contaminated processed metal has been discovered originating from unidentifiable suppliers, in the recovery operations, the management and disposal of any radioactive waste and any necessary clean-up operations.

B. FIELDS OF ACTION

1. Recommendations on prevention

(a) Prevention of occurrence

In order to prevent the occurrence of events leading to radiation hazards to workers, the public and the environment, States should make arrangements for the safety of facilities and sources of ionizing radiation. Effective safety arrangements prevent the loss of control over sealed radioactive sources and radioactive material and reduce the likelihood of the appearance of radioactive material in scrap metal shipments.

An important first step in achieving this objective is to establish an appropriate legal and Governmental infrastructure for the safety of facilities and sources of ionizing radiation. This should include national arrangements for radiation protection, the safe management of radioactive waste and the safe transport of radioactive material. To assist States in creating such an infrastructure, the IAEA has published safety standards which cover the establishment of a legal framework and regulations, the establishment of a regulatory body and other actions to achieve effective control of facilities and activities involving radioactive sources and radioactive material [22, 23, 24].

In recognition of the particular problems associated with sealed radioactive sources and to ensure that sources within States' territories are safely managed and securely protected during their useful lives and at the end of their useful lives, an international Code of Conduct has been established [4]. It encourages States to institute means for ensuring that sealed radioactive sources are managed safely and securely. The EU Directive of 2003 places similar obligations on EU Member States [5].

Specific Recommendations - Prevention of occurrence

States should:

– have in place an effective national legislative and regulatory system of control over sealed radioactive sources and radioactive material. This should include a regulatory body to enforce the regulations established within this system;
– have appropriate facilities, arrangements and services for radiation protection available to persons who are authorized to manage radioactive sources;
– ensure that adequate arrangements are in place for the training of staff from the regulatory body, law enforcement agencies and emergency service organizations;
– establish a national register of radioactive sources (for details see reference [4]);
– ensure that source owners carry out regular checks to confirm that their inventory of radioactive sources is intact;
– promote awareness of the safety and security hazards associated with orphan sources;
– emphasize to sealed radioactive source designers, manufacturers, suppliers and users and those managing disused sources their responsibilities for the safety and security of the sources;
– ensure that the possession, remanufacturing or disposal of disused sealed radioactive sources takes place in a safe manner;
– provide arrangements for the safe management and disposal of radioactive waste.

(b) Preparedness

Recognizing that the above arrangements are not always completely effective because of human error, neglect, and lack of proper training, etc. and that there is always a finite risk that radioactive scrap metal will be discovered, States should assess their own national situations. They should assess the likelihood that such problems could occur within their territories and their state of preparedness for such events. In this context, it is noted that the likelihood will vary considerably depending, inter alia, on the location of the country under consideration and the nature and extent of its metal industries. The likelihood assessment should include consideration of the following:

(a) the magnitude of the scrap metal recycling industry in the country, i.e. the number of scrap metal suppliers, collection facilities and metal processing facilities;
(b) the frequency of incoming scrap metal shipments from foreign countries and the sources of the scrap metal; and
(c) the history of the occurrence of national events involving the detection of radioactive scrap metal.

Plans to counteract the possible presence of radioactive scrap metal should be in place. They should include the provision of radiation detection capabilities at key locations in the State (Section B. 2.), expertise to evaluate and respond to radiation alarms (Section B.3.), and the training of relevant personnel (Section C.1.).

The nature and extent of the plans and arrangements in a State should be proportional to the risk of the occurrence of radiation events involving scrap metal. They may, therefore, range from small scale monitoring in States with little or no scrap metal processing industries, e.g., monitoring checks at scrap metal suppliers‘ premises and at borders, to wide ranging monitoring in countries with large scale metal recycling industries, e.g. scrap metal collection yards, metal processing facilities and metal works and at borders. The level and extent of monitoring arrangements, of national expertise in radiation detection and event evaluation and of training programmes should be determined on the basis of the findings of the likelihood assessment.

Specific Recommendations – Preparedness

States should:

- assess the likelihood of the occurrence of events involving the presence of radioactive scrap metal within the State;
- review and, if necessary, improve national arrangements to counteract the possible presence of radioactive scrap metal. The extent of the arrangements should be proportional to the likelihood of event occurrence and the associated hazard; and
- as appropriate, and based on the likelihood assessment, require Customs or border organizations to install radiation monitors for the surveillance of scrap metal shipments at key border points and encourage owners of major scrap metal yards, processing facilities and melting plants to install equipment to monitor incoming shipments and outgoing metal products and waste.

2. Recommendations on detection

(a) General aspects

The monitoring of scrap metal should be performed at key points during its movement from its origin to the processing or melting facility, that is:

(a) at the main points of origin of the scrap metal;
(b) at main borders and points of entry of the State or region; and
(c) at the entrances and exits to major scrap yards, processing facilities and melting plants (including the monitoring of metal products and production waste, e.g., slag and waste gases).

Monitoring, in this context, may take the form of 'administrative monitoring', to determine the likelihood that scrap metal shipments contain radioactive scrap metal; 'visual monitoring', to check for the presence of typical radiation warning signs and source housings; and 'radiation monitoring', to check radiation levels in the vicinity of the shipment.

It will be necessary to make judgements on the extent and location of the monitoring required in a State. A first priority should be given to providing monitoring at the scrap yards of the major sellers and at the major locations of other sources of scrap metal, e.g: at demolition sites where the presence of radioactive material is suspected. Next, monitoring should be provided at the border crossings through which scrap metal shipments pass with some regularity and at the larger of the scrap metal processing facilities and at melting plants. The judgements should be informed by knowledge of the previous history relating to the occurrence of radioactive scrap metal in shipments.

It is noted that, in some regions, the barriers at border crossings between States no longer exist, for example, in some parts of the European Union, and this means that there is monitoring only at the outer borders of the region. This may imply that greater reliance has to be placed on monitoring at the scrap metal recycling facilities within each State of the region.

Arrangements are already in place in many States to provide for monitoring [8, 9]. However, the monitoring and response schemes in use vary in their extent and nature from country to country and from facility to facility. As stated earlier, an important objective of these Recommendations is to assist countries in harmonizing monitoring and response arrangements in States and between States so that there is improved confidence in the reliability of the neighbouring States' arrangements. Neighbouring States should therefore exchange information about their national arrangements and, if necessary, seek to improve them using this document as a basis. The information exchanged should include, inter alia, the locations of border monitoring stations, the types and sensitivities of the systems employed, the monitoring procedures adopted including alarm levels, and response arrangements.

Specific Recommendations - Detection (General)

States should:

- ensure that monitoring is carried out at each of the key points of the scrap metal movement within the State. The monitoring should take the form of:
  - administrative monitoring, to determine the likelihood that scrap metal shipments contain radioactive scrap metal,
  - visual monitoring, to check for the presence of typical radiation warning signs and source housings, and
  - radiation monitoring, to check radiation levels in the vicinity of the shipment;

- exchange information on monitoring and response arrangement with neighbouring States as a means of improving international harmonization.

(b) Administrative monitoring

Knowledge of the origin of the scrap metal, of the scrap metal supplier and the history of previous transactions can provide a first indication of whether there is a significant potential for radioactive scrap metal to be present in consignments. Incoming shipments to scrap yards, processing facilities and melting plants should, therefore, be reviewed in relation to these factors.

Specific Recommendations - Administrative Monitoring

Persons responsible for the reception and monitoring of the shipments should be alerted if the shipment:

- arrives without evidence of radiation monitoring having been performed before shipment or during shipment;
- is from a supplier with a previous history involving the supply of radioactive scrap metal; and
- is from a supplier not previously known to the recipient company or the regulatory authorities.

(c) Visual monitoring

Scrap metal should be visually monitored during its handling at scrap yards, processing facilities, melting plants and at borders. Persons handling scrap should be trained to recognize the different types of radiation sources, source housings and radioactivity warning signs. Guidance on the different types of radiation sources and source housings is contained in an international catalogue produced by the IAEA [24].

<u>Specific Recommendation - Visual Monitoring</u>

Scrap yard, processing facility, melting plant and border personnel should be properly trained to visually recognize radioactivity warning signs and the different types of radiation sources and source housings.

(d) Radiation monitoring

Where there is an identified risk or doubt concerning the possible presence of radioactive material in scrap metal shipments by road, rail, inland waterway and sea, the shipments should be checked for radiation using fixed (for example, portal, conveyor, or grapple monitors) or portable monitors. <u>Annex IV</u> provides more detail on the radiation monitoring of scrap metal shipments.

As noted earlier, even the detection of very low levels of radiation (above normal background) from a shipment may indicate a significant, but shielded, source of radiation. Therefore all detected radiation above background levels in shipments should be subject to further investigation.

For convenience in application, guidance on monitoring is given separately in the following paragraphs for owners of companies from which scrap metal shipments originate, Customs or border authorities, and owners of scrap yards, processing facilities and melting plants.

(i) Radiation monitoring at the point of origin

Scrap metal shipments should be monitored for radiation at the main points of origin prior to their transportation.

In the event that certification is not provided for a shipment, **the assigned carrier** should request such a certificate from the owner of the shipment or arrange for the monitoring of the shipment to be performed, as described below.

<u>Specific Recommendations - Radiation monitoring at the point of origin</u>

Owners of companies from which scrap metal shipments originate should:

- ensure shipments are checked by administrative and visual means (Sections B.2.(b) and B.2.(c)) for the possible presence of radioactive scrap metal;
- perform monitoring of shipments for radiation at the exit of the premises where scrap is collected;
- provide a certificate to accompany the scrap metal shipment as evidence that the shipment has been checked for the presence of radiation (see <u>Annex I</u>)
- ensure the effectiveness of the radiation monitors by appropriate quality assurance procedures to verify their ability to detect changes in radiation intensity;
- arrange for periodic calibration and testing of the detectors (at least annually) to ensure optimum performance;
- provide appropriate training in radiation monitoring and initial response procedures for the involved personnel;
- establish a response plan for action in the event of radioactive scrap metal being discovered (Section B.3.);
- make formal arrangements with a national organization with expertise in radiation monitoring and radiation protection:
  - to provide training of personnel in radiation detection and response procedures, and
  - to provide assistance in the event of a radiation incident involving the detection of radioactive scrap metal.

(ii) Radiation monitoring at borders

At key border points, arrangements should be made for the monitoring of scrap metal shipments; this includes seaports and land crossings. In this context, States may consider introducing appropriate administrative instructions and/or legislation requiring that incoming or outgoing scrap metal is monitored for radiation at borders or, in the case of the EU or other similar regions, at the borders of the region.

It is noted that radiation monitoring at borders is also carried out for the purpose of detecting the illicit trafficking of sources and for the detection of orphan sources [4, 5, 25] and that the monitoring of scrap metal shipments may be seen as a complementary activity.

Specific Recommendations- Radiation monitoring at borders

Customs or border authorities should:

- ensure that shipments of metal scrap are checked by administrative and visual means (Sections B.2.(b) and B.2.(c));
- perform radiation monitoring at each major road and rail border crossing on shipments of scrap metal;
- ensure the effectiveness of the radiation monitors by appropriate quality assurance procedures to verify the ability to detect changes in radiation intensity;
- arrange for periodic calibration and testing of the detectors (at least annually) to ensure optimum performance;
- provide appropriate training in radiation monitoring and initial response procedures for Customs' officers likely to be involved in the monitoring of scrap metal shipments;
- establish a response plan for action in the event of radioactive material being discovered (Section B.3.); and
- make a formal arrangement with a national organization with expertise in radiation monitoring and radiation protection:
  - to provide training of personnel on radiation detection and response procedures, and
  - to provide assistance in the event of radiation incidents involving the detection of radioactive scrap metal.

(iii) Radiation monitoring at scrap yards, processing facilities and melting plants

Scrap metal should be monitored for radiation at the entrances and exits of all major scrap yards, processing facilities and melting plants and at any facility where there is a significant potential for radioactive scrap metal to be present in incoming shipments. Depending on the size of the facility this may be achieved by means of fixed portal monitors and/or hand-held monitors. In addition, in-plant monitoring of conveyors or within scrap grapples or dust collection systems may be used to supplement the other forms of monitoring.

Specific Recommendations - Radiation monitoring at scrap yards, processing facilities and melting plants

1. **Owners of major scrap yards, processing facilities and melting plants** should:
   - ensure incoming and outgoing shipments are checked by administrative and visual means (Sections B.2.(b) and B.2.(c));
   - provide radiation monitors at the entrance/exit to the premises and, as appropriate, on conveyors and grapples. All entrances and exits should be monitored;
   - ensure the effectiveness of the radiation monitors by appropriate quality assurance procedures to verify the ability to detect changes in radiation intensity;
   - arrange for periodic calibration and testing of the detectors (at least annually) to ensure optimum performance;
   - provide appropriate training in radiation monitoring and initial response procedures for personnel likely to be involved in the monitoring of scrap metal shipments;
   - establish a response plan for action in the event of radioactive material being discovered (Section B.3.);
   - make a formal arrangement with a national organization with expertise in radiation monitoring and radiation protection to provide:
     - training of personnel on radiation detection and response procedures, and
     - assistance in the event of a radiation incident involving the detection of radioactive scrap metal; and
   - require that contracts for the supply of scrap metal include the condition that any costs associated with radioactive material discovered in shipments will be accepted by the seller unless the original owner of the radioactive source or material can be found.

2. **Owners of melting plants** should provide arrangements for the radiation monitoring of production waste systems, including monitoring of slag and dust collectors.

3. Recommendations on response

A response plan should exist at all locations where scrap metal, metal product or production waste is being monitored so that, in the event of sources or source housings being observed or elevated levels of radiation being detected in the scrap metal, in the processed metal, or the production waste, actions are clear and known in advance by operators and responsible organizations. Those involved should be appropriately trained in the implementation of the response plan.

(a) Response to an alarm

If radiation is detected such that a radiation alarm in a monitor is triggered:

(a) The result should be checked and, if, after checking, the result is verified, the shipment should be immobilized, or in the case of metal processing, the process should be stopped. Access of personnel to the material should be limited to staff members of the facility trained in radiation monitoring and radiation protection.

(b) The staff members of the facility trained in radiation monitoring and radiation protection should carry out a preliminary investigation of the situation. If they find that the radiation level is less than a specified "Response Level" and if no radioactive contamination is detected, they should continue to investigate the situation. They should locate and isolate the radioactive substance so that it will not interfere with the operation of the radiation detection system.

(c) If, at the time of the preliminary investigation, the observed radiation levels exceed the "Response Level" or if radioactive contamination is detected in the vicinity, the external radiation protection experts (referred to in Section A.6.(a)(i)) should be promptly contacted. Similarly, they should be contacted if, during the preliminary investigation, any movement and rearrangement of the scrap metal produces radiation levels in excess of the "Response Level". The "Response Level" above which outside radiation protection experts should be involved should be set by the national regulatory body (Annex IV provides some examples of response levels set for this purpose).

The external radiation protection experts should:

(i) inspect the scrap metal shipment or the affected processed metal or production waste in detail until the part or parts containing the radioactive substance have been identified, taking due care to ensure that all persons involved are adequately protected from radiation during the inspection operation (that is, their exposures are kept as low as reasonably achievable with the restriction that doses to individuals are less than the dose constraints set by the national regulatory body [3]);
(ii) determine the radionuclides (and their approximate activities) contained in the unprocessed metal scrap in the shipment, the processed material, the melt or the production waste;
(iii) isolate the radioactive source or substance and place it in a safe location;
(iv) check to determine if any radioactive substances have been dispersed in the local area (by measurements to detect any surface contamination) and assess the likelihood of any other area being affected prior to the arrival of the shipment at the facility;
(v) draw up a report describing the actions taken, the results of the investigation and the steps taken to recover from the incident (an example reporting form is contained in Annex V).

(d) The regulatory body should be promptly notified of the event by the facility owner or manager or by the senior Customs or border official, if it is judged to be radiologically significant by the radiation protection experts according to State requirements or guidelines. The regulatory body should be provided with a copy of the report of the radiation protection experts.

(e) The recovered radioactive source or substance should be stored in a safe and secure location until arrangements have been made to safely dispose of it. In the event that the discovered radioactive substance is a sealed source, it is important to consult the national regulatory authority urgently on the best course of action for its management.

Specific Recommendations - Response to an alarm

1. **Members of staff of the facility trained in radiation monitoring and radiation protection,** should, when a radiation alarm in a monitor is triggered and the result has been checked and verified, carry out a preliminary investigation of the situation. If they find that the radiation level is **less than a specified "Response Level"** and if no radioactive contamination is detected, they should continue to investigate the situation. They should locate and isolate the radioactive substance so that it will not interfere with the operation of the radiation detection system.

2. **Owners or managers of the companies from which scrap metal shipments originate, Customs or border officials, owners or managers of scrap metal yards, processing facilities or melting plants** should, on being alerted by responsible staff of a verified radiation alarm with radiation levels **in excess of the "Response Level"** or of radioactive contamination being detected:
   - contact the external radiation protection experts to provide assistance in safely locating and removing the radioactive source or substance from the scrap metal, the melt or the production waste and/or determining the presence and extent of any radioactive contamination;
   - notify the regulatory body promptly (by telephone) if the event is judged by the radiation protection experts to be radiologically significant, and, subsequently, provide the regulatory body with the report of the radiation protection experts; and,
   - ensure that the recovered radioactive material is placed in a safe and secure location pending its disposal.

3. **The relevant national regulatory body** should:
   - provide guidance and advice on procedures to ensure safety in the event of radioactive material being discovered in scrap metal, metal product or waste; and,
   - authorize arrangements for the safe storage and disposal of radioactive sources and material, scrap metal, metal product or waste contaminated with radioactive material.

4. **The national competent authority for the safe transport of radioactive material** should:
   - provide advice on the requirements for the safe transportation of radioactive material, scrap metal, metal product or waste contaminated with radioactive material; and
   - issue special authorizations, as needed, for the safe transport of the recovered material, scrap metal, metal product or waste contaminated with radioactive material.
   - where possible, and in collaboration with competent authorities in neighbouring States, facilitate the return of radioactive scrap metal across national boundaries.

(b) Management of detected radioactive material

Several options exist for the management of radioactive sources or material found in the scrap metal. It may be:

(a) returned to the last owner of the material, if this is possible, using arrangements approved by the regulatory body and the national competent authority for the safe transport of radioactive material (however, as stated in the Joint Convention and the Code of Conduct [6, 4], disused radioactive sources should not be exported to States not having the administrative capability, resources and regulatory structure needed to ensure that the source will be managed safely). In the event that radioactive sources or material are to be returned to another State, the national regulatory body should inform its counterpart regulatory body;

(b) treated as radioactive waste and transferred to a suitable waste repository or waste storage facility.

It will generally not be acceptable to leave radioactive sources or material at the facility or border crossing where they were detected unless the facility has been licensed by the appropriate regulatory body for storage of such material, as it may ultimately cause a hazard to persons and/or contaminate the local environment and, in addition, may interfere with the operation of the radiation detection system at the facility. Temporary storage may be allowed by the regulatory body if the proposed storage arrangements provide adequate radiation protection and security of the stored radioactive sources or material.

In the event of radioactive material having become dispersed at the facility where it was detected, the affected areas should be decontaminated and cleaned and the resulting material should be disposed of as radioactive waste. Such actions may require that metal processing operations be halted until the decontamination, cleanup and disposal activities are adequately completed, and radiation protection of personnel is ensured. Assistance in decontamination, cleanup and disposal should be available from the national organizations responsible for radiation protection and radioactive waste management.

In the event that radionuclides have been transferred into metal products and these products have been distributed from the manufacturing facility prior to detection of the contamination, it will be necessary to take actions to safely recover these manufactured products, transport them and appropriately store and/or dispose of them.

In all cases, when the recovered material is moved for return to its previous owner, to storage or for disposal at locations away from the site of its discovery, it must be transported as radioactive material in compliance with transport regulations for radioactive material. These exist both at the national level and at the international level. However, national and international transport regulations [26,27,28,29,30] are generally consistent with the internationally agreed transport regulations recommended by the IAEA [23] and the United Nations [31].

Specific Recommendations - Management of detected radioactive material

1. **The owner of the scrap metal yard, processing facility or melting plant or the Customs or border authority** should**:**
   - if possible, request the last owner of the shipment containing radioactive scrap metal to take it back, provided that this action is approved by the relevant national authorities and that the last owner is competent to safely manage the radioactive material on its return;
   - if this is not possible, contact the national organization responsible for radioactive waste management and request assistance in disposing of the radioactive material;
   - if there is radioactive contamination present on surfaces, request the assistance of the radiation protection experts and/or the national organization responsible for radioactive waste management to decontaminate the affected areas and to dispose of any radioactive waste produced in the decontamination operation;
   - ensure that any movement of radioactive material is done with the approval of the national competent authority for the safe transport of radioactive material.

2. **States** should**:**
   - have arrangements in place for the safe storage or disposal of radioactive material and waste;
   - have an authorized national body to manage such radioactive material and waste;
   - ensure regulations are in place, and are managed by a competent authority, to cover the safe transport of radioactive scrap metal or waste resulting from the disposition of radioactive scrap metal; and
   - to the extent possible, facilitate the return of radioactive scrap metal across borders.

(c) Reporting

(i) National reporting

As indicated in Section B.3.(b), in the first instance, a report should be made by the owner of the facility at which the detection of radioactive material occurred (seller, Customs authority, buyer) or by the carrier to the national regulator - (i) promptly, by telephone or email, and (ii) later, in writing using a reporting format similar to that shown in Annex V.

Specific Recommendation– National reporting

Managers of scrap metal yards, processing facilities and melting plants, Customs or border officials, and carriers should promptly notify the responsible national authorities in the event of a radiation incident involving radioactive material in scrap metal, metal product or production waste.

(ii) International reporting

If the incident could have transboundary implications, as for example, in the case of the dispersal of radioactive material to atmosphere from a melting facility or the discovery of a widely exported batch of scrap or processed metal, the incident should be reported to the IAEA as soon as possible so that potentially affected States can be warned and can take protective action. Such an event, which may have potential radiological significance to another State, should be reported by the designated national authority (usually the national regulatory body) to the IAEA Incident and Emergency Centre (IEC). This is a legal requirement for States that are Contracting Parties to the Convention on Early Notification of a Nuclear Accident [32] but is recommended as an appropriate course of action for all States in these circumstances. For States of the European Union there is a similar reporting requirement within the European Union.

Specific Recommendation– International reporting

States should immediately report to the IAEA as well as to the potentially affected State or States any incident involving the dispersal of scrap metal containing radioactive material that may have transboundary implications.

C. ADDITIONAL PROVISIONS

1. Training

<u>Specific Recommendations – Training</u>

1. **Owners of companies from which scrap metal shipments originate, Customs or border authorities, owners of scrap metal yards, processing facilities and melting plants, and owners of scrap metal shipment companies** should provide appropriate training for the management and workers at border points or facilities where scrap metal, metal product or production waste containing radioactive substances may be found or processed, and for the staff of carriers involved in the shipment of scrap metals. Staff should be:
   - informed of the possibility that they may be confronted with scrap metal containing radioactive substances;
   - informed of the basic facts about ionizing radiation and its effects;
   - advised and trained in the visual detection of sealed radiation sources and their containers;
   - trained in the use of fixed and portable radiation detection equipment, as appropriate; and
   - trained in the action to be taken in the event of the detection or suspected detection of a radiation source or radioactive substance.

2. The training in radiation protection, monitoring and response should be provided by recognized **radiation protection experts.**

2. Information exchange

Reports and analyses of incidents involving radioactive scrap metal are valuable to the national and international scrap metal community as a means of learning from the experiences of others.

(a) National level

The national authorities (regulatory body, Customs or border authority) should make available to the scrap metal industry, through the national registry of companies (if it exists), professional bodies, associations, unions, etc. information on incidents that have occurred involving radioactive scrap metal.

(b) International level

An international internet-based information exchange system of radiation incidents affecting the scrap metal industry should be established for the benefit of the worldwide metal recycling community. It should include analysis of incidents and a summary of the lessons learned.

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ANNEXES TO THE RECOMMENDATIONS ON MONITORING AND RESPONSE PROCEDURES FOR RADIOACTIVE SCRAP METAL

Annex I

EXAMPLE CERTIFICATE OF SHIPMENT MONITORING

(to be part of the supplier's consignment documents)

It is desirable for the supplier of scrap metal to provide evidence, in the form of a certificate of shipment monitoring, for the benefit of the buyer that shipments of scrap metal have been monitored for radiation. This will often be a requirement within the contract between supplier and buyer. The monitoring should be done before the shipments leave the premises of the supplier and should be carried out by a reliable, qualified and independent organization/company. The qualified monitoring organization should provide the supplier with a certificate for each shipment that is monitored. An example certificate is shown below.

MONITORING STATION	
Location of monitoring station	
Name of organization/company and person conducting the monitoring	
Address	
Telephone	
Fax	
E-mail	
DETAILS OF LOAD	
Country of origin	
Origin of load - supplier of merchandise (*address, contact person and telephone)*	
Destination of load (*contact details of recipient)*	
Identification of load (*reference to transit documents being carried with the load)*	
Means of transport (*identify truck, ship, container, etc.)*	
Details of carrier (*contact details*)	
MEASUREMENTS	
Details of the monitoring equipment used	
Average values measured at 1 metre from the surface of the load (μSv/h)	
Maximum dose rate value in contact with the outer surface of the container, truck or wagon, in μSv/h (*identify position*)	
Background radiation value in the area, in μSv/h	
CERTIFICATION STATEMENT (*by person responsible for monitoring*) Certifying that the above values are a true record of the measurements made at the date of monitoring stated below.	
Official stamp of monitoring organization/company	
Date of monitoring of shipment	

N.B. No certification document should be provided for a load showing radiation levels significantly in excess of natural radiation background in the local area.

Annex II

EXAMPLE CONTENT OF A UNIFIED NATIONAL COLLABORATIVE SCHEME

A unified national collaborative scheme would provide benefits to all parties involved. The concerned industrial companies would benefit through a reduction of the likelihood that their products would be affected by radioactive material and also through the knowledge that, in the event of an incident, they could obtain help on response procedures and waste management through the national scheme. The national authorities would benefit from the scheme through the reduced likelihood of events leading to public radiation exposure and possible environmental damage and the evidence that they are fulfilling their mandates effectively.

The features of such a unified national collaborative scheme could be:

1. **National registry**
   A registry which individual companies would sign and thereby commit themselves to the national scheme. The registry would provide a means for determining the scale and scope of the monitoring network required. It would provide a clear overview of all the companies involved and, therefore, of the national situation.

2. **Harmonized detection measures**
   Agreed and harmonized measures and procedures for detecting radioactive materials at key stages and points in the metal recycling process. These would include regular checks by expert organizations on the effectiveness and efficiency of radiation detection equipment.

3. **Checks at key border points**
   Provision of arrangements by Governmental organizations (Customs or border authorities) at key border points to check imported and exported material for the presence of radiation.

4. **Assistance in response**
   Assistance by national expert organizations in responding to incidents involving the discovery of radioactive material.

5. **Assistance in management**
   Assistance by national expert organizations in the handling, management and disposal of any radioactive material discovered and the management of incidents involving the spread of radioactive contamination.

6. **Assistance in training**
   Assistance by national expert organizations in the training of involved staff.

7. **National support arrangements**
   Where it is not possible to determine the original owner of the radioactive material or the seller of the scrap metal, the financial responsibility would normally fall on the owner of the premises where the radioactive material is discovered. Since this could place undue burdens on individual owners of premises, it is desirable for there to be arrangements established in the country to assist in providing for the radioactive waste management and disposal and for any clean-up operations needed in relation to radioactive material originating from unidentifiable suppliers.

This example is based on the Spanish Protocol for Collaboration on the Radiation Monitoring of Metallic Materials [7] which provides a good example of a unified national approach to countering the problem of radioactive material appearing in scrap metal. It is an incentive scheme that involves all of the main concerned Governmental and industrial organizations.

Annex III

EXAMPLE NATIONAL ARRANGEMENTS TO SUPPORT RESPONSE TO THE DISCOVERY OF RADIOACTIVE SCRAP METAL

INTRODUCTION

Various types of national arrangements exist to manage and pay for events associated with the discovery of radioactive material in scrap metal shipments or in processed metal or process waste. They vary from schemes in which the Government takes whole or partial responsibility for the management and associated costs to schemes which rely on insurances taken out by the private companies. In almost all cases, the polluter pays principle is applied whenever it is possible.

Some examples are briefly described below. They are all of the former type, i.e. based essentially on the polluter pays principle backed by partial Governmental support.

BULGARIA

In Bulgaria, a system of nuclear control exists which extends to the scrap metal recycling industry.

For scrap metal, the first line of defense is the scrap metal delivery contact, i.e. the declaration provided by the suppliers (scrap metal owners) stating that according to their own measurements (performed with hand-held devices) the scrap is free of dangerous waste. The second line of defence consists of measurements performed by the big smelting companies by means of two pillars containing plastic-scintillation detectors.

If radioactive scrap metal is discovered, the scrap metal owner (national or foreign), is obliged to cover all expenses associated with the recovery and disposal of the material and any clean-up costs.

In the case of detection of radioactive scrap metal at the borders, the scrap is returned to the country of origin and the Nuclear Regulatory Agency (NRA) notifies the competent foreign authorities.

However, in the case of the discovery of an orphan source, including an orphan source in scrap metal, if it is not possible to find the owner of the source, the NRA assigns a legal person or responsible organization to deal with it and prescribes the conditions for the implementation of the assigned activities. In this case, the orphan source is declared as radioactive waste and becomes State property and all expenditures are covered by the specially created state Radioactive Waste Fund.

All radioactive materials are sent for storage at the radioactive waste repository operated by the State radioactive waste organization and the information is recorded by the NRA.

CROATIA

In Croatia, the appointed Government agency for radiation protection manages the situations in which radioactive material is discovered in shipments. On discovery of radioactive substances in a shipment from abroad, the shipment is sealed and returned to the border.

If the detected radioactive substance is from within the country, the radiation protection agency provides a safe and secure store for the radioactive substance or source. It then seeks to discover the owner of the radioactive source or material within the country. If the owner cannot be found it takes over the costs of management of the radioactive source or substance.

SPAIN

Within the terms of the Spanish Protocol for Collaboration on the Radiation Monitoring of Metallic Materials [7], the subscribing companies obtain advice, assistance and training from Governmental expert organizations related to the monitoring of scrap metal shipments or processed metal and appropriate response actions. In the event of radioactive substances being discovered in shipments or in processed metal, a well-defined scheme exists for the management of the radioactive substances involving all concerned Governmental agencies.

The costs of the management activities are to be borne by the subscribing companies unless they can be recovered from the “supplier or dispatcher”. These costs are much higher for companies not subscribing to the Protocol. An exception is where the radioactive source or substance originates within the territory of Spain, in which case the costs are borne by the national organization responsible for radioactive waste management (ENRESA). The national regulatory body can claim back any costs of work it has performed from the subscribing company.

A Royal Decree 229/2006 on the control of sealed radioactive sources with high activity and orphan sources came into force in 2006. This is the national adaptation of European Union Directive 2003/122/EURATOM of 22 December 2003 on the control of sealed radioactive sources with high activity and orphan sources. Through this decree, which complements the Protocol, the necessary financial guarantees are established to remove orphan sources and to cover the costs of whatever incident such sources may cause (although the polluter pays principle is invoked wherever possible).

Annex IV

EXAMPLES OF
MONITORING PROCEDURES USED FOR SCRAP METAL SHIPMENTS

In this annex, examples are provided of the procedures specified by the regulatory authorities of two countries (Belgium and Switzerland) for the radiation monitoring of scrap metal shipments. In addition, some guidance is extracted from an IAEA document on the procedures for monitoring shipments at borders. It should be noted that the IAEA document was developed mainly in the context of detecting orphan sources or the illicit trafficking of high activity radioactive sources at borders.

I. BELGIUM

Summary of the Belgian directive on the use of a portal monitor of radioactivity in the non nuclear sector

Each portal monitor must be registered with the Federal Agency for Nuclear Control. The portal monitor must be tested at least once a month. Maintenance and calibration must be carried out at least once a year. The threshold of the portal monitor must not exceed 5σ (where σ is the standard deviation of the background count rate). The speed of the vehicle passing through the portal monitor must be limited (typically to 10 km/h). The staff of the facility responsible for the operation of the detection equipment must have had proper training.

In case of the detection of radiation in excess of the threshold levels (portal monitor alarm level), the shipment may not be returned to the supplier except in the following cases:

- the supplier's facility is also equipped with a registered portal monitor
- the supplier is located abroad
- the supplier is an hospital with a nuclear authorization (for medical waste)

Even in these three cases, return is not allowed if the dose rate at the surface of the shipment is higher than 5 μSv/h. If the portal monitor threshold levels are exceeded (alarm level), the operator must measure the contact radiation dose rate at the surface of the shipment,

- If the radiation dose rate is greater than 5 μSv/h, the operator must call a radiation protection expert to handle the situation. *(This level is termed the Response Level in the main part of this document)*
- If the radiation dose rate is less than 5 μSv/h the operator may handle the situation alone.

A distinction is made between a homogeneous distribution of radioactivity over all the shipment (often characteristic of bulk NORM waste) and a localized distribution (characteristic of a source).

Homogeneous distribution: the shipment may be accepted if:

- the dose rate is less than a specified action level (approximately 3 times the background level)
- the origin of the anomaly is known (e.g. due to refractory bricks).

If one of these two conditions is not fulfilled, the shipment has to be put aside and a radiation protection expert must characterize the shipment (i.e. identify the radionuclides and measure their activities).

Localized distribution: The shipment is put aside on the site of the operator. Properly trained members of staff of the facility should then locate and isolate the radioactive source. They must wear appropriate protective clothing (gloves, overshoes, etc…)

During this operation, the trained staff members must continuously measure the radiation dose rate. If the dose rate (at the position of the person investigating) reaches a level higher than 20 μSv/h, the staff must stop the operation and a radiation protection expert must be called. Once the source has been isolated, it may be kept on the site of the operator in a drum placed in a closed room. The radiation dose rate on the external face of this room may not exceed 1 μSv/h. The Federal Agency for Nuclear Control must be notified of any source detected. The sources discovered must be characterized by a radiation protection expert (identification of the radionuclides and measurement of their activities). Activity thresholds levels are defined for these sources. Below these levels no regulatory control is required.

II. SWITZERLAND

<u>Minimum performance requirements for monitoring instruments used in Switzerland for detecting radioactive material in scrap metal</u>

Basic requirements for measuring instruments

The instruments have to meet the following requirements:

- They have to give a consistent result within at most 30 seconds for each measuring point.
- If a measurement is repeated, the result should correspond within ± 5 % to the result of the preceding measurement. In order to achieve this objective the instrument has to be able to average over at least 1000 counts.
- The instrument should be able to detect gamma radiation with an energy between 60 keV and 1.33 MeV.
- The instrument should resist environmental conditions such as air humidity (up to 100 %), rain, and temperatures between -15°C to +40 °C. The display should be readable in the dark and in bright sunshine. The instrument has to be resistant to damage due to sharp objects.

In general, measurements are performed with hand-held instruments.

Procedure in practice

Before the measuring campaign starts a function control of the instrument has to be carried out.

The level of background has to be determined without the presence of the load (railway carriage, container, truck). The measured value is registered in the certificate and serves as reference value for the subsequent measurements of the load. Generally dose rates in the order of 0.1μSv/h are detected.

For each load a sufficient number of measurements are necessary. This means that measurements are performed at a distance of 20 cm of the side walls in sectors of 1 metre. Usually the measuring point is at a height of 1.8 metres above ground. If the content of the load is lower or variable, the height of the measuring point has to be adapted. In some cases (material from shredder, aluminium scrap) additional measurements are performed on the load. The maximum value of the measurements is noted in the certificate for each load.

During the measurements on the load, the dose rate is usually lower than the reference value due to shielding effects. If the value of the measurement at one point exceeds +5 % of the level of the reference value, the load cannot be released. The source has to be localized, removed and stored in a safe place on the premises. The regulatory authority has to be informed.

Response Level

If during the measurement the dose rate exceeds 20 μSv/h at a distance of 50 cm from the surface or object, the monitoring procedure has to be stopped and the area concerned has to be cordoned off. The removal of the source must be performed by an emergency expert team under the control of the regulatory authority.

III. INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

(adapted from 'Detection of Radioactive Material at Borders', IAEA-TECDOC-1312, (2002))

A. Types of monitoring instrument

Instruments for detecting radioactive material at borders can be divided into three categories.

Pocket-type instruments are small, lightweight instruments used to detect the presence of radioactive material and to inform the user about radiation levels.

Hand-held instruments usually have greater sensitivity and can be used to detect, locate or (for some types of instrument) identify radioactive material. Such instruments may also be useful for making more accurate dose rate measurements in order to determine radiation safety requirements.

Fixed, installed, automatic instruments are designed to be used at checkpoints. Such instruments can provide high sensitivity monitoring of a continuous flow of vehicles whilst minimizing interference with the flow of traffic.

The specifications for pocket-type and hand-held instruments are set out in reference [4.1]. In the following, attention is focused on fixed, installed, automatic instruments.

B. Fixed, installed automatic instruments

1. Application

Modern, fixed, installed radiation monitors are designed to automatically detect the presence of radioactive material being transported in vehicles (i.e. road vehicles or railroad cars or railway wagons). The monitoring systems do this by measuring the radiation level taken while a vehicle occupies the detection area, and comparing this level to the background radiation level that is measured and updated while the detection area is unoccupied. Continuous measurement of the background radiation level and adjustment of the alarm threshold enables a constant, statistical false alarm rate to be maintained. It follows that suitable occupancy sensors are needed, so that the instrument knows when to monitor the vehicles as they pass through and when to monitor background radiation levels.

2. Installation and operation, calibration and testing

Fixed, installed radiation monitors are often known as portal monitors and typically consist of an array of detectors in one or two vertical pillars with associated electronics. Because instrument sensitivity is strongly dependent upon distance, it is important to get the vehicle as close as practically possible to the detector array. Therefore, highest effectiveness is achieved if the monitors are installed such that the vehicles are forced to pass close by, or between monitors. Careful consideration should, therefore, be given to selecting the optimum location to install fixed radiation portal monitors so they can be most effective.

The effectiveness of a fixed, installed instrument is also strongly dependent on its ability to measure the radiation intensity over the search area of interest. Therefore, when installing the monitor, it is important that the detector is positioned so that it has an unobstructed view of the search area. However, the instrument must also be protected from mechanical damage. Alarm indications should be clearly visible to the persons manning the inspection point. Training in the appropriate response procedures is required for the persons responding to the alarms. Portal monitors need to be tested periodically to ensure optimum performance. Automatic portal monitors should be checked daily with small radioactive sources to verify they can detect radiation intensity increases.

The use of fixed, installed radiation monitors to detect radiation sources in vehicles is complicated by the inherent shielding of the vehicle structure and its components. While standard truck-bed monitors can be effective in detecting abnormal radiation levels in shipments of metals for recycling, they are much less effective in detecting radioactive material when that material is purposefully concealed.

As discussed earlier, the sensitivity of detectors is dependent upon the closeness of the detector and source as well as the slowness with which they pass each other. For large trucks, two pillars are required and the maximum recommended distance between pillars is 6 metres, dependent on the maximum width of the road vehicle to be scanned. It is important that barriers, which do not obstruct the view of the monitor, are installed to protect the monitor from being damaged by vehicles.

Since the sensitivity of the monitor is also strongly dependent on monitoring time, the instrument needs to be placed where the speed of the vehicle is controlled. Instruments vary in their capabilities, but it is recommended that the speed of the vehicle does not exceed 8 km/h and that the vehicle is not allowed to stop while passing through the monitor. It is recommended that the occupancy sensor is positioned so that it is only triggered when the monitoring system is occupied and not by other traffic in the vicinity.

3. Minimum performance recommendations

The instrument performance characteristics given here should be regarded as guidance only. The conditions given are not operational settings, but criteria against which performance tests can be made.

(a) Sensitivity to gamma radiation

It is recommended that at a mean indication of 0.2 μSv/h, an alarm should be triggered when the dose rate is increased by 0.1 μSv/h for a period of 1 second. The probability of detecting this alarm condition should be 99.9%, i.e. no more than 10 failures in 10,000 exposures. This requirement should be fulfilled in a continuous radiation field, with the incident gamma radiation ranging from 60 keV to 1.33 MeV (tested with ^{241}Am, ^{137}Cs and ^{60}Co).

(b) Search region

The volume in which efficiency of detection is maintained will vary according to the instrument. The following is a description of the geometrical region in which the performance characteristics for the given alarm levels should be applicable.
Truck monitor (two pillars):

(i) Vertical: 0.7 to 4 m;
(ii) Horizontal, parallel to the direction of movement: up to 3 m (6 m between the two pillars);
(iii) Speed up to 8 km/h.

(c) False alarm rate

The false alarm rate during operation should be less than 1 per day for background dose rates of up to 0.2 μSv/h. If a high occupancy rate of say, 10,000 occupancies per day were expected, this would mean ensuring not more than 1 false alarm in 10,000, for which the recommended testing requirement is not more than 4 false alarms in 40,000 occupancies.

(d) Operational availability

Installed equipment should be available at least 99% of the time, i.e. less than 4 days out of service per year.

(e) Environmental conditions

The system should be weather proofed and designed for outdoor operation. A desirable working temperature range would be –15°C to +45°C. However, this will be dependent on conditions at the installed location and lower temperatures down to –35°C may be necessary.

C. Investigation levels and instrument alarm settings

The nominal investigation level is defined here as that radiation level which is selected as the trigger for further investigation. This needs to be distinguished from the instrument alarm threshold. The instrument alarm threshold must be set considerably below the nominal investigation level chosen in order to allow for statistical variations. To achieve a 99.9% detection probability, assuming the idealized case of Gaussian distribution, the instrument threshold has to be set at least at 3σ (3 standard deviations) below the desired level.

1. Determination of an instrument alarm threshold

The selection of a particular investigation level means that the alarm threshold of a monitoring instrument has to be set appropriately. The alarm threshold can be expressed in terms of multiples of background, or as a multiple of the standard deviation of the background count rate. Since the relationship between background dose rate and its standard deviation depends on the detection sensitivity of the instrument and the actual value of the background, a generally applicable investigation level cannot be derived. Similarly, because of unknown factors such as the amount of shielding and the energy of the radiation, it is not possible to set an investigation level in order to detect a certain quantity of radioactivity. Therefore, it becomes reasonable to set the level at a value that is as sensitive as possible without causing too many false alarms.

On this basis, recommendations for an optimum investigation level can be derived from results obtained from the large scale pilot study on border monitoring systems conducted by the Austrian Research Centres and the IAEA [4.2].

A compromise must be reached in establishing a practical alarm threshold so that radioactive material being inadvertently moved can be detected yet provide an acceptably low nuisance alarm rate. For a false alarm rate of 1 in 10,000 the instrument alarm threshold must be set at least 4σ higher than average background for systems under Gaussian assumptions. Results from the ITRAP field tests [4.2] for truck monitoring indicate that an investigation level of at least 1.2 times natural background (at a normal background level of approximately 0.070μSv/h), is needed to meet the performance characteristics for the false alarm rate given earlier.

Specialist personnel involved in the selection and installation of this type of equipment are advised to consider these issues in the local context, and thereby satisfy themselves that appropriate instrument alarm settings have been made to achieve an investigation level that is practical under local conditions. Inevitably, once a unit has been in operation for a while some adjustments to the alarm settings will need to be made based on operational experience.

As discussed earlier, once an alarm has been signified the next tasks are to:
- verify that the alarm is caused by an actual increase in the radiation level;
- localize the source of the radiation, if present;
- identify the radioactive material and evaluate the situation.

D. Verification of alarms

1. Types of alarm

(a) False alarms

The normal, statistical fluctuations of the background radiation intensities can cause false alarms. They can also be caused by nearby radio-frequency interference, but this should not be a problem with modern, well-designed instruments.

(b) Real alarms

The other category of alarms, real alarms are defined here as being ones that: (a) are caused by an actual increase in the radiation intensity; and (b) result from the inadvertent movement of radioactive material. Making the latter determination normally involves further evaluation of the situation.

2. Alarm verification by monitoring

Verifying an initial alarm usually involves repeating the measurement under the same conditions and/or using another instrument. A similar response is a good indication that there is a real increase in radiation levels.

(a) Monitoring of vehicles

When the passage of a vehicle through a fixed installed radiation monitor triggers an alarm (as verified by repeated measurements), it will normally be necessary to remove the vehicle from the monitor for further investigation.

E. Radiological conditions and response levels

In general, the level of response needed for a real alarm will be dependent upon the radiological conditions found. Most situations encountered will involve little or no hazard and can be handled by non-radiation safety specialists. It is recommended that the response be upgraded to involve radiation protection experts if any of the following situations are found:

- radiation level greater than 0.1 mSv/h at a distance of 1 m from a surface or object;
- uncontrolled contamination indicated by loose, spilled or leaking radioactive material.

The value of 0.1 mSv/h at 1 m has been selected in view of the fact that this is the limit for legal transport of radioactive material as detailed in the IAEA ‘Regulations for the Safe Transport of Radioactive Material’, IAEA Safety Requirements No ST-1 [4.3].

References

[4.1] International Atomic Energy Agency, Detection of Radioactive Material at Borders, IAEA-TECDOC-1312, (2002).

[4.2] Austrian Research Centres Seibersdorf, Illicit Trafficking Radiation Detection Assessment Programme (ITRAP), Final Report, OEFZS-G-0002, Seibersdorf (2002).

[4.3] International Atomic Energy Agency, Regulations for the Safe Transport of Radioactive Material (2005 Edition), Safety Standards Series No. TS-R-1, IAEA, Vienna, (2005).

Annex V

EXAMPLE FORM FOR
REPORTING DETECTED RADIOACTIVE MATERIAL IN SCRAP METAL

(adapted from Spanish Protocol for Collaboration on the Radiation Monitoring of Metallic Materials [7])

In the event of radiation levels being detected in shipments of scrap metal, in processed metal or product waste in excess of the threshold levels of the detection equipment, it is necessary to investigate and report the results of the investigation. The following is a typical form used for the purpose of reporting such investigations. The form, or national versions of it, will be required for notifying and reporting the event to the national regulatory body.

DETECTION OF RADIOACTIVE MATERIAL IN METAL SCRAP AT THE ENTRANCE TO THE INSTALLATION (*)

Date of detection:	
IDENTIFICATION OF INSTALLATION OR DETECTION LOCATION	
Detection location	
Address	
Contact person	
Telephone	
Fax	
E-mail	
DETAILS OF LOAD	
Country of origin	
Supplier of merchandise *(address, contact person and telephone)*	
Identification of load *(reference to transit documents being carried with the load)*	
Means of transport (*identify truck, ship, container, etc.*)	
PRELIMINARY INVESTIGATION DATA	
Average values measured by instrumentation *(wherever possible, attach monitoring record obtained from the equipment)*	
Environmental background radiation value in the area (in µSv/h)	
Area in which there is an increase in radiation levels over background levels	
Maximum measured dose rate in contact with the outer surface of the container, truck or wagon (in µSv/h) *(identify position)*	
Maximum dose rate measured in driver's cab (in µSv/h)	

(*) Initially the notification should be made with the information available. Any further information should be submitted as soon as it becomes available.

ACTIONS PERFORMED FOLLOWING DETECTION *(Circle the appropriate reply)*		
Unloading and segregation from the rest of the load	YES	NO
Identification of material	YES	NO
Plastic coated	YES	NO
Shielded	YES	NO
Others (*please indicate*)		
IDENTIFICATION OF SEGREGATED MATERIAL		
Description of material *(contaminated parts, radioactive sources with or without shielding, radioactive lightning rods, ...)*		
Photographic information attached	YES	NO
Dimensions and weight		
Physical status *(intact, deteriorated, oxidized, corroded, ...)*		
Nature *(lead, steel, ceramic, brass, aluminium, ferroalloy, copper, ...)*		
Encapsulated source	YES	NO
Housed inside the shielding container	YES	NO
Labels, signs, plates, marks		
RADIOLOGICAL CHARACTERIZATION		
Measure of dose rate in contact	μSv/h	
Measure of dose rate at 1 metre	μSv/h	
Material contaminated superficially with β-γ emitters	Bq/cm^2	
Material contaminated superficially with α emitters	Bq/cm^2	
Radionuclide(s)		
Activity or concentration of activity	Bq,	Bq/g

DETECTION IN FINAL PRODUCTS AND PRODUCTION WASTE (*)

Date of detection:		
IDENTIFICATION INSTALLATION OR DETECTION LOCATION		
Detection location		
Address		
Contact person		
Telephone		
Fax		
E-mail		
IDENTIFICATION OF PROCESS AFFECTED BY THE RADIATION EVENT		
Affected product *(processed scrap, ingots, smoke dust, slag)*		
Description of event *(Briefly describe the event including time and location of detection, the instrumentation used and the radiological values obtained)*		
Parts of installation affected *(Identify the parts of the installation and/or vehicles with radiation levels in excess of the background levels for the area and take samples of all resulting products for subsequent analysis)*		
Shutdown of process phases affected *(If so, indicate date and time)*	YES	NO
Exit of materials from the installation *(If so, identify means of transport used and destination)*	YES	NO
Notification of Expert Radiation Protection Organization *(If so, indicate name, date and time of contact and initiation of activities)*	YES	NO

(*) The notification should be made initially with the information available at that moment. Any further information should be submitted as soon as it becomes available.

V. COUNTRY-BASED PILOT PROJECTS TO DEVELOP NATIONAL ACTION PLANS TO EFFECTIVELY MANAGE RADIOACTIVE SCRAP METAL (UNITAR)

UNITAR's Programmes in Chemicals, Waste and Environmental Governance provide legal, institutional and technical support to Governments and stakeholders in developing and transition countries around the world to develop sustainable capacity for managing dangerous chemicals and wastes.

UNITAR has significant experience in and has conducted capacity building programmes to assist national strategy development processes for a range of international activities, including:

- national action plan development for Stockholm Convention, the Rotterdam Convention, the Globally Harmonised System of Classification and Labelling of Chemicals (GHS)
- design of PRTRs (pollutant release and transfer registers), and
- national pilot projects in support of Strategic Approach to International Chemicals Management (SAICM) implementation.

In addition, more than 100 countries have completed a National Chemicals Management Profile, which documents the existing infrastructure and gaps for national chemicals management and is an entry point to identifying relevant institutions and facilities. Some 30 countries have initiated a National Programme for the Sound Management of Chemicals.[12] The UNITAR approach to capacity building supports a country-driven programmatic and integrated approach to chemicals management, as endorsed at the International Conference on Chemicals Management (ICCM) in Dubai, February 2006.

Proposal for Capacity Building to Manage Radioactive Scrap Metal at the National Level

Countries require national capacity to determine their national approach to, and effectively monitor and manage radioactive scrap metal, however in many cases that capacity may be lacking. To support national activities to prevent, detect and react to issues related to radioactive scrap metal and implement the Recommendations, UNITAR would be interested to explore development of a capacity building programme to develop national action plans to improve management of radioactive scrap metal in 2-3 pilot countries.

The development of national action plans would require a coordinated and systematic ("step-by-step") approach at the national level and could, for example, include the following elements:

- *Development of Baseline Report and Situation Analysis*. A national infrastructure assessment provides baseline information about and identifies the magnitude and nature of potential problems related to national management of radioactive scrap metal. Additionally, it provides an analysis of relevant legal, technical and administrative infrastructure with the objective of revealing existing capacities and capabilities, as well as gaps or areas that require strengthening to address the identified problems.

- *Development of National Strategic Action Plans.* A National Action Plan represents a comprehensive strategy which outlines a precise goal and objectives; planned activities; indicators of success; suggested implementation mechanisms; and financial and human resource needs required to strengthen effective scrap metal management and implement the Recommendations at the national level.

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[12] More information about all UNITAR activities related to chemicals, waste and environmental governance can be found on the website: <http://www.unitar.org/cwg/>.

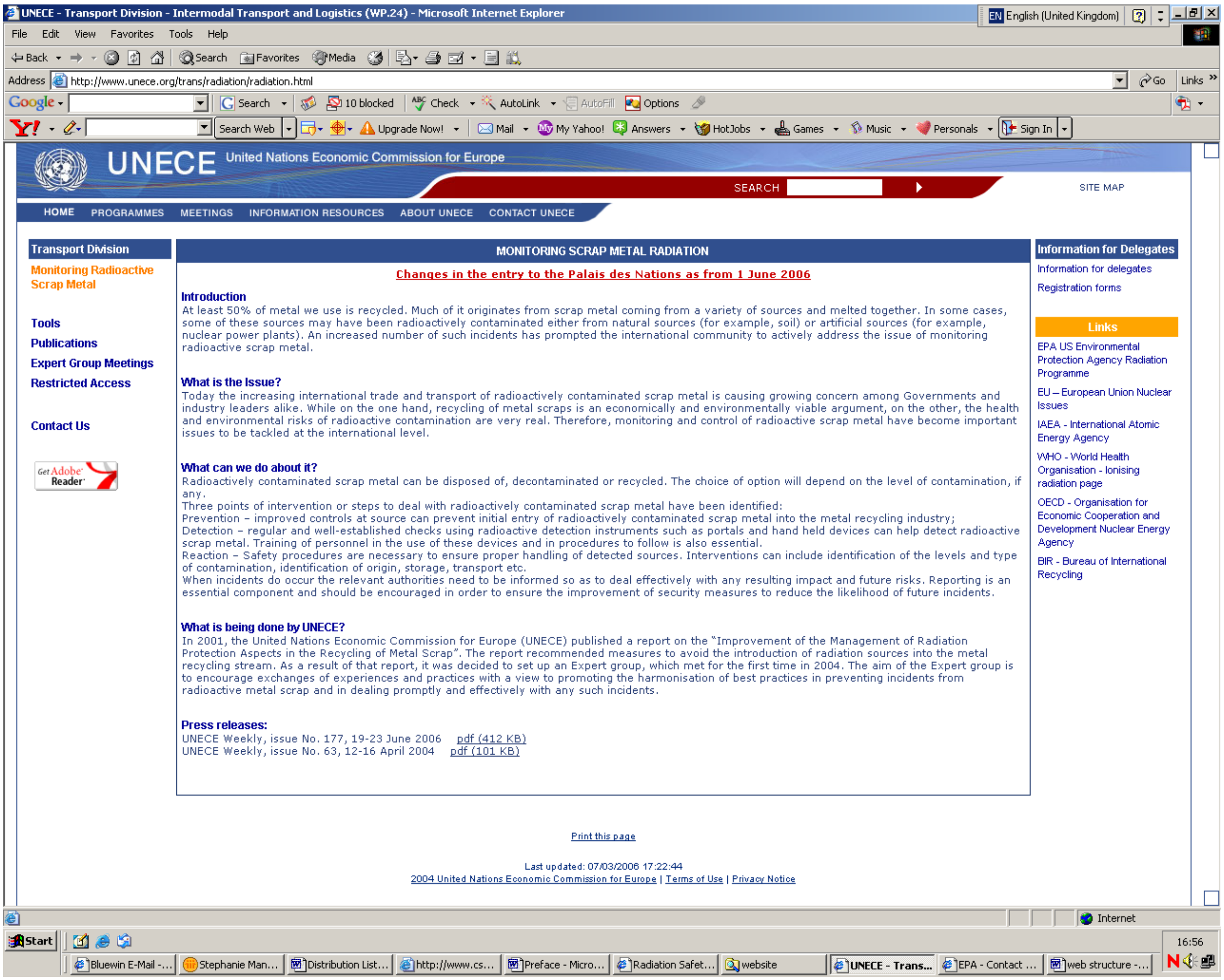
- *Implementation Activities*. Based on the proposals in the national action plan, implementation of specific activities to concretely build capacity to strengthen and effectively manage issues related to radioactive scrap metal, such as strengthening of Customs authorities, revision to relevant regulations/legislation, etc.

Development of national capacity in this area also has, in our view, strong potential to be strengthened by the development of public-private partnerships to execute certain activities. UNITAR would be interested to explore this possibility with other interested parties. Experience gained in the pilot countries could also be shared, for example, via regional workshops. These national pilot projects would be a complementary activity to the more technical training that is also under consideration. UNITAR would be pleased to explore further with members of the Group of Experts, and subject to securing the required financial resources, the development of such a pilot programme.

VI. OVERVIEW OF THE UNECE WEBSITE ON MONITORING RADIOACTIVE SCRAP METAL (www.unece.org/trans/radiation/radiation.html)

Aim: The website is intended to be an easy-to-use resource for practitioners dealing with radioactive scrap metal. It provides numerous cross-links to existing information in other institutions.

Audience: The metal, and recycling industries; Customs; legislators and regulatory agencies; the transport sector and any other practitioner confronted with the risk of radioactive scrap metal.



What It Offers:

Page 1: Monitoring radioactive scrap metal

Introduces the main issues concerning radioactive scrap metal and what UNECE is doing about it.

Page 2: Tools

- International regulatory tools – international regulations from bodies like the IAEA, the EC or the OECD
- National best practices and lessons – a selection of documents provided by national contact points on their best practices in the field
- Technical tools – a selection of useful tools from different agencies
- Training & capacity building – a selection of international training options in relevant fields

Page 3: Publications

This section contains some of the recent UNECE publications in the field.

Page 4: Expert Group meetings

- 1st meeting
- 2nd meeting

Two expert group meetings have been held to date. This section contains official documents from these meetings.

Page 5: Restricted Access

This section contains all other internal documents that have been provided by the experts participating in the Expert Group meetings. It also contains the country questionnaire responses from 2004 and 2006. To obtain access to this page, contact: radiation@unece.org.

Page 6: Contact information

Links:

A few links to other relevant agencies and organizations are provided on the website.

ANNEX

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