

SAFETY GUIDES

*ON IMPLEMENTATION OF THE
LEGAL REQUIREMENTS*

SAFETY GUIDE

Prevention, Detection and Response to Radiation Emergency in Case of Discovering of Radioactive Material in Metal Scrap

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SAFETY GUIDE
ON PREVENTION, DETECTION AND RESPONSE TO RADIATION EMERGENCY
WITH RADIOACTIVE MATERIAL IN METAL SCRAP

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1. GENERAL PROVISIONS

INTRODUCTION

1.1. In this document, the term “**radioactive scrap**” means metal scrap (i.e. waste metals intended for recycling and reuse after melting), in which the radioactive sources or substances are found, as well as radioactively contaminated metals (surface or volume contaminated with radioactive substances) and activated metal details.

1.2. Different ways exist for radioactive substances to be found in metal scrap and if they are not detected in time, in the process of melting they may be incorporated into ferrous or non-ferrous metals and various articles manufactured from them. This may lead to hazardous consequences for the health of the workers and the population and radioactive contamination of the environment, as well as to negative economic, trade and social consequences.

1.3. A negative trend is seen world-wide for increase of incidents with **radioactive scrap** (i.e. finding of radioactive substances in metal scrap) at various places like: scrap yards, metallurgical enterprises for production of steel and non-ferrous metals, oil and gas production and processing enterprises, border check points during import/export of scrap, scrap loading and unloading stations, etc. According to the data of the International Atomic Energy Agency (IAEA) for a ten-year period, until 1998, in the world there have occurred 300 cases when radioactive sources have been melted in metallurgical enterprises during the process of reprocessing of metal scrap (average 30 incidents per year).

1.4. During 2004, only in the USA, more than 5000 incidents were registered associated with **radioactive scrap**. About 2500 of these incidents were related with finding materials with increased content of natural radioactive substances, while in about 250 cases man-made radioactive sources were found in metal scrap (orphan, abandoned, lost or stolen).

1.5. In the period, following 1983, in USA were registered 30 cases of melting radioactive sources in metallurgical enterprises (20 cases in steel plants and 10 cases in non ferrous plants). During the same period in other 18 States are also registered 30 cases of melting of **radioactive scrap**. In 1994 such an incident occurred in Bulgaria – in the Pernik steel plant a radioactive source ^{60}Co was melted, which led to contamination of steel consignment exported to the USA. Other type of incidents are also possible, where as a result of melting **radioactive scrap**, on the market may appear products contaminated with radioactive substances.

1.6. In Bulgaria for the period 1998-2006 were registered a total of 125 incidents with **radioactive scrap**, i.e. on the average 14 cases for this 9 year period. In 120 of the cases components with increased content of natural radionuclides were found, while in 5 cases orphan radioactive sources were found (Cs-137 and Co-60). In all of these cases no radioactive consequences were established for the Bulgarian population and the environment, but nevertheless such type of incidents should not be allowed to occur, which requires implementing preventive and response measures on a national scale.

1.7. The accumulated experience for liquidation of incidents with **radioactive scrap** shows that in all cases severe economic consequences arise for the metallurgical enterprises and companies working or trading with scrap. The economic losses of metallurgical plants in USA as a consequence of melting of radioactive sources are evaluated, on the average of 10 million USD



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for each incident. The sustained damages from the incident in Spain in 1998 (melting of scrap containing radioactive source Cs-137) are evaluated to be about 26 million USD.

1.8. At present reprocessing of metal scrap (recycling of metals) has wider application in the metallurgical industry throughout the world, in this way saving energy and natural resources and diminishing the harmful effects to the environment. For 2004 the worldwide consumption of metal scrap is estimated to be 440 million tons, of which 184 million tons were traded internationally. On the world scale more than 50% of the production in the ferrous industry (steel and cast iron) is produced from metal scrap. The tendency for the growth of the volume of the metal scrap used, as an utilizable waste for production of steel, cast iron and non-ferrous metals will be preserved in the future.

1.9. According to the forecast of the United Nations Economic Commission for Europe (UNECE) it is expected that the number of incidents with **radioactive scrap** will increase despite of the efforts, on the world scale, to avert such incidents.

1.10. The reasons and conditions for radioactive sources and materials to be found in the metal scrap may be generalized as follows:

- violation or careless implementation of the requirements for safe use and storage of radioactive sources, not proper accounting and control of these sources, as well as human error;
- the presence of unknown or non registered radioactive sources, used for activities which remain out of regulatory control. (The practice shows, that in a number of countries, where in the past, there was weak or nonexistent regulatory control, the number of radioactive sources is not known exactly. Due to the enormous number of radioactive sources used in the world it is always possible some of them, for example: smoke detectors or lightning prevention rods with built in radioactive sources, to remain outside of the regulatory control, even in countries with well developed infrastructure.);
- the presence of radioactive sources, for which no necessary control and physical protection is ensured by their owners or the sources being abandoned (orphan sources);
- the occurred emergency events in the enterprises, which led to the loss of control over the radioactive sources or to uncontrolled radioactive contamination;
- the existence of illicit trading and trafficking of radioactive sources and materials;
- loss or theft of radioactive sources and materials.

1.11. The possible ways of radioactive sources and materials to be found in a metal scrap may be classified as follows:

- dismantling or decommissioning of industrial facilities for processing of materials with increased content of naturally occurring radionuclides (NORM);
- dismantling of facilities and equipment from the nuclear industry (NPP's and facilities from the nuclear fuel cycle) and from other industry branches using radioactive sources and materials;
- finding (dumping) of lost or stolen radioactive sources in the scrap;
- dismantling of equipment with built in radioactive sources and their subsequent finding in the scrap;
- delivery as a metal scrap of devices, products and objects containing radioactive substances or radioactive sources, which were left outside the range of regulatory control or contain naturally occurring radionuclides with increased concentration.



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1.12. The increase of the number of cases connected with **radioactive scrap** and the appearance on the market of radioactively contaminated products, produced after reprocessing of such scrap, is a worldwide problem. The potential hazard from occurrence of incidents with radioactive scrap is significantly higher when:

- there is no sufficient regulatory control of radioactive sources and materials used or stored at the facilities;
- there is no preventive control of the collected and treated scrap for timely finding of radioactive materials.
- Annex № 1 presents the summary of the “**radioactive scrap**” problem and gives some facts and data, which characterizes to a great detail this, in essence, a world problem.

1.13. The present document “GUIDE on prevention, detection and response to radiation emergency with radioactive material in metal scrap” is developed based on the requirements of the Regulation on Emergency Planning and Preparedness to Nuclear and Radiation Emergencies [1], the Regulation of the conditions and procedure for notification of the Nuclear Regulatory Agency about Events in Nuclear Facilities and Sites with Sources of Ionizing Radiation [2], the Regulation on Basic Norms of Radiation Protection [3], the Disaster Protection Act [4], the Act on the Ministry of Interior [5] and the Health Act [6].

The document takes into consideration the “Recommendations on Monitoring and Response Procedures for Radioactive Scrap Metal” [7]. The “Report on the Improvement of the Management of Radiation Protection Aspects in the Recycling of Metal Scrap” [8] and the “Handbook for Response to Suspect Radioactive Materials” [9] are also taken into account. The IAEA experience concerning monitoring and prevention of incidents with radioactive scrap as well as the response to such incidents are used as well.

OBJECTIVES AND SCOPE

1.14. The present document “GUIDE on prevention, detection and response to radiation emergency with radioactive material in metal scrap” is intended for officials working in:

- companies and organisations which collect, transport, store and trade with metal scrap;
- companies and organisations which carry out preventive radiation monitoring of metal scrap during import, export, transport and other activities with scrap;
- metallurgical facilities for ferrous and non ferrous metals, scrap depots and loading and unloading scrap stations, facilities for scrap shredding;
- some departments and organisations, which are connected with the control of the import, export, trade, collecting and reprocessing of scrap (Customs Agency, National Services “Border Police”, Ministry of Economics and Energy, Bulgarian Recycling Association and other);
- state organisations, with responsibilities for ensuring of radiation protection and prevention of radiation incidents as well as response during incidents and emergencies (NRA, GDNSCP, MH, MI, SANS – State Agency “National security”).

1.15. The aim of the Guide is to clarify the responsibilities and the functions of the respective legal and official persons and to determine the measures and actions for prevention of incidents with radioactive scrap, as well as the emergency procedures for actions in case of incidents.

1.16. The instructions, contained in this guide, include the minimum of measures and actions for ensuring radiation protection during work with metal scrap and for liquidation of incidents with radioactive scrap. The instructions are differentiated in the following way:

- instructions for prevention of incidents with radioactive scrap (see Section 3);



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- instructions for detection of radioactive sources and materials in metal scrap (see Section 4);
- instructions for response upon appearance of an incident with radioactive scrap (see Section 5);
- additional instructions (see Section 6).

1.17. The Guide is the base on which the facilities for collection, reprocessing and recycling (melting) of scrap, the consignors, suppliers and consignees (buyers) of scrap should organise and carry out their activities in such a way as to exclude the possibility for accidental falling of radioactive substances in the metal scrap and to respond adequately to possible incidents with radioactive scrap.



2. DISTRIBUTION OF RESPONSIBILITIES AND ROLE AND FUNCTIONS OF THE COMPETENT STATE AUTHORITIES, LICENSEES AND MANAGERS IN CHARGE OF FACILITIES WORKING WITH METAL SCRAP

2.1. The owner/holder of radioactive sources or materials (the licensee), in accordance with the Act on the Safe Use of Nuclear Energy (ASUNE), ensures the safety of radioactive sources and materials during their use, keeps records and exercises control and undertakes measures for their safe storage, transport and delivery for deposition after the termination of their use.

2.2. The vendor/supplier/consignor of the metal scrap (usually each of them at the same time can be consignors of the scrap) is responsible to the scrap buyer, according to provisions of the contract signed between them, and the related legal regulations for supplying of metal. The vendor organises the performance of radiation monitoring of the metal scrap at the site of its origin and submits to the buyer a protocol (certificate) with the results of the measurements proving that the offered scrap is not radioactive. The example template of such a protocol (certificate) is given in Annex No.2 (see Form No.1). The vendor of the metal scrap organises suitable training of its personnel for application of the present Guide. The successful completion of the training course should be documented with a protocol (certificate), signed by the vendor.

2.3. The carrier of the metal scrap is responsible for the transported consignment, including the cases when the owner of the load (scrap) is unknown. In such case (unknown owner of the load) the carrier undertakes measures for performing the radiation monitoring of the load or requires from the seller (consignor) of the metal scrap documents ascertaining the scrap origin and a protocol (certificate) for the results of the radiation measurements (see the template Form No.1).

2.4. The buyer of the metal scrap (the owner of a scrap storage facility, scrap reprocessing or melting facility, scrap trading company) should be convinced that the scrap received by him does not contain radioactive substances. For this purpose the buyer requires from the vendor submission of a protocol (certificate) verifying that the consignment does not contain radioactive substances.

2.5. The buyer of the metal scrap undertakes measures for carrying out radiation monitoring of the metal scrap upon its delivery to the predetermined place (facility for recycling or melting of scrap, scrap warehouse or other site).

2.6. The buyer of the metal scrap organises a suitable training course of its personnel for application of this Guide. The successful completion of the course should be documented with a protocol (certificate) signed by the buyer.

2.7. Customs and Border Control are obliged not to admit forbidden or potentially dangerous materials during import or export and to undertake measures for performing radiation monitoring of passing loads, including metal scrap, through the Border Check Points of the country. The Managers of the Border Check Points (BCP), with the assistance from the Nuclear Regulatory Agency (NRA), organise training and preparation of the respective Custom and Border officials for effective use of the available devices for radiation monitoring.



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2.8. During import/export in case of detection of radioactive substances in metal scrap or in final product the Border Check Points, the Custom and Border Control authorities act in accordance with the procedure for emergency response approved by the Ministry of Interior, the Border Police, the Civil Protection and the Ministry of Health.

2.9. NRA, in accordance with ASUNE and secondary legislation, is responsible for licensing and control of activities connected with the use of radioactive sources and materials and management of radioactive waste in the country. The Chairman of NRA determines the conditions and the entity to which radioactive sources or materials, detected in metal scrap, with unknown owner should be consigned.

2.10. NRA, Civil Protection, Ministry of Interior, Ministry of Health and State Agency of National Security in accordance with the acting legislation are responsible for ensuring radiation protection and response during incidents with radioactive scrap in the country. The interaction and response upon incidents with radioactive scrap is carried out along the approved procedures.

2.11. NRA, jointly with the Ministry of Health, Ministry of Interior and State Agency of National Security carries out preventive, regular and follow up control for the implementation of the conditions of the issued licenses and permits, for observation of the requirements and the rules for radiation and physical protection at the facilities, as well as for the implementation of the prescriptions and recommendations given by the control bodies. Upon establishment of violations NRA applies compulsory administrative measures or imposes sanctions in accordance with the ASUNE. If it is necessary the NRA inspectors issue compulsory prescriptions for ensuring radiation protection in the controlled facilities.

2.12. NRA carries out analysis and safety evaluations for the use and storage of radioactive sources and materials in the country and maintains a National Register of Sources of Ionising Radiation. Upon demand NRA supplies information for the controlled radioactive sources and materials to all interested state institutions and organisations following the established in the country order.

2.13. NRA, Civil Protection, Ministry of Interior, Ministry of Health, State Agency for National Security and State Enterprise “Radioactive Waste” develop and issue documents, give recommendations, render technical and expert assistance and carry out control of:

- activities and procedures for prevention of incidents with radioactive scrap, for ensuring radiation protection and for response in case of incidents;
- activities, procedures for safe storage, transport and delivery for deposition of radioactive scrap, as well as for limitation and liquidation of the consequences to the population and the environment from radioactive incident.

2.14. The vendor and the buyer of the metal scrap shall develop procedures for emergency response in case of detection of radioactive substances in metal scrap and coordinate them with NRA and Civil Protection.

2.15. Each vendor and buyer of the metal scrap should know the addresses, telephones and faxes of NRA and Civil Protection and inform them immediately in case of detection of radioactive sources or materials in scrap.



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2.16. The vendors and buyers of the metal scrap sign written agreement with institutions, organisations or companies, which have radiation protection experts and suitable devices for radiological measurements. These agreements ensure competent outside assistance for:

- training and preparedness of the staff working with scrap, carrying out measurements for detection of radioactive materials in scrap and in the final product after reprocessing, and at the working places of a given facility, perform consultations and expertises;
- liquidation of incidents in case of detection of radioactive sources or materials in metal scrap, in the final product after scrap reprocessing, in generated waste during the recycling process;
- performing individual dose control of the personnel, execution preventive radiation monitoring at a given facility, in which the scrap is collected or treated or articles manufactured.

2.17. NRA as a competent State Body for transport of radioactive materials:

- gives instructions and determines the conditions and procedures for safe transport of, the retrieved from the metal scrap radioactive sources or materials, of radioactively contaminated consignments of scrap or the generated radioactive waste as a result of liquidation of an incident;
- in cases, if necessary, issues a written permit for transport of the found radioactive sources or materials, of radioactively contaminated consignments of scrap or the generated radioactive waste as a result of liquidation of an incident;
- coordinates the return beyond national borders of radioactive sources or materials found in scrap and generated radioactive waste as a result of liquidation of an incident with scrap, originated from another country.

2.18. State Enterprise “Radioactive waste”, as State enterprise responsible for management of radioactive waste in the country, develops procedures to ensure safety during recycling, storage and deposition of radioactive sources and materials generated as a result of incidents with radioactive scrap, including radioactively contaminated final products or industrial waste from activities with radioactive scrap. The procedures take into consideration the remaining free volume in the facilities for temporary storage in the State Enterprise “Radioactive waste” at Novi Han.

2.19. NRA, Civil Protection, State Agency National Security and Ministry of Interior evaluate and take a decision for each case when it is not possible to establish neither the vendor nor the owner of the radioactive scrap or when the information for their location is unavailable and they can not be found. The financial expenditures for the liquidation of the consequences in such cases are undertaken by the State and are due to be reimbursed according to the legal procedures by the responsible for the incident person, when such is established.

2.20. Upon finding radioactive sources or materials in metal scrap the response procedure and coordination of NRA, Civil Protection, Ministry of Health and State Enterprise “RAW” is applied. The mentioned State authorities interact with the respective facilities, companies or organisations connected with the incident and, if necessary, render to them expert and technical assistance for the liquidation of the incident and its consequences.

2.21. The general requirements and the procedure of interaction of competent State bodies in case of radiation emergencies, including those with radioactive scrap, are given in detail in the Regulation on Emergency Planning and Emergency Preparedness in Case of Nuclear and Radiation Accident and in the National Emergency plan. (Here “emergency” means such an



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incident/event, which cause or may cause overexposure of the personnel or the population above the established limits and/or to contamination of the environment above the permitted limits.).

2.22. In case of an emergency (incident) with radioactive scrap, which concerns other countries, NRA notifies and undertakes interaction and coordination with the respective foreign regulatory bodies and with the IAEA. If necessary the NRA may request international assistance.

2.23. When, the found in the metal scrap orphan sources and materials, can not be delivered at once for storage to a licensed storage place, specified by NRA, the Civil Protection undertakes measures for their delivery to an isolated location, coordinated with NRA (this can be the site of the incident or other temporary location, specified by the Civil Protection and NRA depending on the existing situation).

2.24. If necessary the Ministry of Interior carry out investigation and in this case the found radioactive sources and materials in metal scrap are placed for temporary storage in special premises for evidence radioactive materials after coordination with NRA.

2.25. The owners of the radioactive sources undertake the financial expenditures for liquidation of the incidents with radioactive scrap or materials found in metal scrap (the “polluter pays” principle is applied). The expenses are evaluated based on expenditures for removal of the source (material) from the scrap, for its transport and storage, as well as expenditures for decontamination, treatment of radioactive waste and other activities for liquidation of the incident.

2.26. The buyers of the metal scrap should include in the buying and delivery contracts, with the respective vendors, special clauses and conditions taking into account the principle “polluter pays”.

2.27. In cases when the original owner of a given radioactive source (material), found in the delivered consignment of scrap can not be established and found, the expenditures for liquidation of the incident are undertaken by the vendor of the metal scrap. Such a clause should be included by the buyer in the contract with the scrap vendor.

2.28. In cases when it is impossible to establish and find neither the original owner of the radioactive source (material) found in scrap nor the vendor of this scrap, the expenditures for liquidation are undertaken by the owner of the facility (the site), where the incident has occurred.

2.29. In accordance with ASUNE the persons who perform activities with radioactive sources and materials (the licensees and permit holders) are obliged to:

- ensure measures and activities for safe storage of radioactive sources and materials until delivery to SERAW;
- maintain a system of accounting and control of radioactive sources and materials;
- ensure physical protection of radioactive sources and materials in coordination with Ministry of Interior and State Agency National Security;
- ensure sufficient financial, human and technical resources for safe realisation of the permitted activity, including for its termination;
- observe the requirements, norms and rules of the radiation protection and for accounting, control and physical protection of the radioactive sources and materials during carrying out of the permitted activity;



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- undertake measures for prevention of incidents and emergencies with radioactive sources and materials;
- allow for working only persons who have the necessary qualification and certified for such activities;
- submit annually to the NRA the results of accounting of radioactive sources and materials;
- inform immediately the Ministry of Interior, State Agency National Security and NRA for a shortage or theft of radioactive sources or materials.

2.30. According to the ASUNE each person who losses or finds radioactive sources or materials is obliged immediately to notify the NRA, Civil Protection, State Agency National Security or the specialised units of the Ministry of Interior.

2.31. According to the Regulation for Emergency Planning and Emergency Preparedness in Case of Nuclear and Radiation Accident the border check points and facilities for storage and treatment of RAW and scrap sites are classified as sites from threat category V.

2.32. The managers of such sites develop action plans (emergency procedures) for response in case of incident with radioactive sources or materials. These action plans (emergency procedures) should be coordinated with NRA and Civil Protection.



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3. PREVENTION OF INCIDENTS WITH RADIOACTIVE SCRAP

3.1. The scope and the range of preventive measures for avoiding of incidents with radioactive scrap are determined by the managers of the facilities working with scrap based on the assessment of the probability of occurrence of such incidents, taking into account the following factors:

- the quantities of the incoming scrap at the facility, its origin and frequency of the deliveries from the country and abroad;
- the number, character and the consequences of the previous incidents with radioactive scrap in the respective facility;
- the perspectives and scales of further development of activities involving scrap at the site;
- the qualification level and the number of the personnel at the facility.

3.2. During the assessment and determination of the necessary preventive measures the managers of the facilities may call for consultations and to require assistance from NRA, Civil Protection and other competent authorities and organisations.

3.3. Based on assessment along the p. 3.1 the facility managers (owners of companies for collection or reprocessing of metal scrap, the vendors, buyers and carriers of metal scrap) develop plan – programs for implementation of the envisioned measures and activities for prevention of incidents with radioactive scrap. These plan – programs shall include as a minimum:

- ensuring suitable measurement devices for control of the radiation purity of the metal scrap and alarm threshold individual dose meters for some persons of the personnel at the facility;
- conducting training and preparation of the personnel for finding radioactive sources and materials in scrap and for response to incidents with radioactive scrap;
- developing of an organisation and maintaining preparedness for response upon incidents with radioactive scrap;
- carrying out radiation control of the incoming, stored and processed scrap and the articles produced from it, as well as the working places at the respective facilities (the scope and the frequency of the control is determined by the specifics of the site and scale of activities with metal scrap.).

3.4. The managers of the facilities submit to NRA and the Civil Protection the developed plan-programs for coordination.

3.5. NRA and Civil Protection, jointly with other relevant authorities and organisations periodically perform the risk assessment of incidents with radioactive scrap and the preparedness for response upon such incidents. The assessment is performed on the probability of arising of incidents with radioactive scrap, the number of critical facilities, the scope and the range of the necessary prevention measures on a national scale. During the assessment the following factors should be taken into account:

- the quantities of metal scrap which are collected and reprocessed in the country and the quantities imported into the country and exported abroad;
- the origin of the metal scrap from sites and companies in the country and from foreign companies as well as the frequency of scrap deliveries from the country and abroad;
- the number of suppliers, warehouses, companies and enterprises working with scrap, the number of licensed vendors of scrap in the country;



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- the number, the character and the consequences of previous incidents with radioactive scrap in the country;
- the perspectives and the scale of development of the scrap reprocessing field in the country;
- The qualification level and the number of personnel at the sites working with scrap.

3.6. Based on the performed assessment, along p. 3.1, the scope and the range of the preventive measures for avoiding incidents with radioactive scrap are determined. They are related to:

- preventive control of the collected and reprocessed scrap;
- timely detection of radioactive sources and materials found in scrap;
- maintaining of a system for response (organizational infrastructure, human and material resources) for possible incidents with radioactive scrap and for evaluation and liquidation of their consequences;
- carrying out of training courses, preparation and instructions of the personnel at facilities working with scrap and at the border check points for avoiding incidents with radioactive scrap;
- ensuring devices for radiation control at facilities working with scrap and at the border check points.

3.7. NRA and Civil Protection control the fulfilment of the planed measures for prevention of incidents with radioactive scrap in the country.

3.8. The managers of the facilities such as scrap storage sites, metallurgical companies, foundries, loading and unloading sites for scrap should ensure, as a minimum, hand held devices for radiation control and alarm threshold individual dose meters for some persons of the personnel at the facility.

3.9. The managers of metallurgical plants, large scrap storage facilities (warehouses) and of the major loading and unloading sites in the country should ensure suitable devices for incoming/outgoing radiation control of the metal scrap (portal monitors) which automatically would alarm for presence of radioactive substances in the scrap.

3.10. The managers of facilities working with scrap organise the performance of preventive radiation control of the metal scrap and the finished products in the following ways:

- through purchasing of suitable devices for radiological measurements and individual dose control;
- through using of an outside organisation or company which will perform the radiation control of the metal scrap and the finished products at the respective facility;
- through leasing of devices for radiological measurements and individual dose control which is owned by other organisation or company.

NOTE: *The devices for radiological measurements and for individual dose control must conform to the respective requirements given in the Act on Measurements. The hired external organisation or company must have the necessary documents proving its competence and the right to perform such activity.*



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3.11. NRA and Civil Protection control the applied measures for prevention of incidents with radioactive scrap and render expert assistance to the managers of the facilities working with scrap.

NRA assists the Boarder Police in equipping the border check points with suitable devices for radiation control at import/export of metal scrap and other materials.

3.12. The managers of the facilities working with scrap (scrap warehouses, metallurgical plants, foundries, the loading/unloading sites for scrap, companies trading or transporting scrap) ensure suitable training to the respective persons of their personnel (managers, staff, workers). The personnel in such facilities should:

- be informed in advance about the possibility, during discharging of its duties, to find in the metal scrap radioactive sources or materials hazardous to him and to other persons;
- to be informed and to have a general knowledge of the sources of ionising radiation and the potential hazards they present, for methods and means of radiation protection;
- to be instructed and prepared for visual recognition of radioactive sources, their containers and packages which may accidentally appear in the scrap;
- to be instructed and prepared for the use of the equipment present at the site for radiation control and radiation protection;
- to be instructed and prepared for response upon finding of radioactive sources and materials in the scrap.

3.13. The initial and the subsequent periodic training of the personnel should be conducted by persons, who have undergone specialised training on radiation protection and have a qualification certificate for work with sources of ionising radiation.

3.14. For the training courses of their personnel the managers of the facilities working with scrap may call for assistance NRA, Ministry of Health and Civil Protection.

3.15. The managers of facilities working with scrap keep a special register in which they record all initial and periodic instructions of the personnel (each person signs for passing the training course on the topic, indicated in p. 3.6 and the date it was conducted).

3.16. NRA distributes to the interested authorities, organisations, associations and companies information for incidents with radioactive scrap that occurred and the conclusions from them, including reports, documents and other materials dealing with the preventive activities and control measures as well as radiation protection upon working with metal scrap.



4. FINDING RADIOACTIVE SOURCES AND MATERIALS IN METAL SCRAP

4.1. The managers of the facilities working with scrap organise the implementation of control for timely finding of radioactive sources and materials in metal scrap. Control of the metal scrap is carried out:

- at the main outgoing places from where the metal scrap originates;
- at the main loading and unloading facilities, where the metal scrap is delivered for transport by road, river, sea or railroad;
- at the entrance and exit of metal scrap warehouses;
- at enterprises for processing (fragmentation) and melting of scrap (including outgoing production and technological waste such as slag from the melting furnaces, purification filters from the ventilation systems, etc.);
- at border check points of the country during the import and export of metal scrap.

4.2. The control of the metal scrap includes the following three forms:

- **administrative control** – evaluates the probability for the presence of radioactive metal scrap in the delivered load (consignment) while all the documents dealing with the origin, the radiation purity, the sellers and the buyers of scrap are checked very carefully, as well as consultations are conducted with competent persons and additional documents are required, clarifications and checks are performed, if required;
- **visual control** – a thorough outside inspection of the metal scrap batch is carried out for establishing the presence of characteristic signs and inscriptions of radioactive danger on the scrap content i.e. details, objects, packages or containers, as well as for finding of equipment resembling a container or a package for radioactive sources, which may arouse suspicion for the presence of radioactive source.
- **Radiation control** measurement with suitable devices, for finding increased radioactivity in a metal scrap batch is carried out and the background near the metal scrap is checked and immediately next to various details and objects in the scrap is measured.

4.3. The managers of the facilities working with scrap, determine by an order the responsible persons for control of metal scrap at the respective facilities. The managers of the facilities may consult NRA and Border Police about the organisation and implementation of the control of metal scrap.

4.4. The Border and Custom authorities carry out the control of the metal scrap upon import/export through the border check points of the countries.

4.5. Upon carrying out the administrative control of the metal scrap a special attention should be paid to the documents connected with the origin of the metal scrap, the supplier of the scrap and its previous bargains, the preliminary radiation control, done by vendor or the supplier. According to this information the buyer of the metal scrap (the consignee of the scrap) may judge beforehand what is the probability of the scrap to be radioactively contaminated and accordingly to inform and to consult with other competent officials at the facility, responsible for the control of the metal scrap.

4.6. The typical cases when the responsible persons for receiving and controlling the metal scrap should be informed are:



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- a shipment of scrap is received without a document (certificate) for the carried out radiation control before its shipment or during its transport;
- a shipment of scrap is received from a supplier for which there is information that in previous cases has supplied to the buyer radioactive scrap;
- a shipment of scrap is received from a supplier who is not known to the buyer and to other companies or organisations working with scrap;
- a shipment of scrap originates from a place which is known to be associated with storage of radioactive sources and materials before and at present;
- The documentation, associated with the delivery of the shipment of scrap, contains contradictory or false data, signatures and stamps are missing or it is in a sloppy or illegible form (special attention should be paid to the document/protocol verifying the radiation purity of the metal scrap).

4.7. During the visual control of the metal scrap a very detailed external examination should be performed of the details, the objects and the equipment loaded or unloaded, transported and the stored metal scrap with the aim to establish visually indication for the presence of radioactive substances (radioactive signs or inscriptions, containers or packages of radioactive sources). It should be taken into account that the metal scrap may consist of radioactive details or objects which do not have visual indication for radioactivity (i.e. without signs and inscriptions for radioactivity), however if during the visual control there appears a doubt (supposition) for their presence, a radiation control of the suspicious shipment of scrap is performed immediately.

4.8. Upon establishing visual indication for the presence of radioactive substances in scrap, the person performing the visual control should immediately notify the respective responsible persons, including the manager of the facility.

4.9. During the radiation control of metal scrap are used standard devices for measurement of ionising radiation (portable and stationary devices, “portal monitors”, alarm threshold individual dose meters) which have undergone metrological check and are registered in the “State register for measurement devices allowed to be used in the country”. The results of the radiation control of each shipment of scrap should be recorded and archived at the respective facilities working with scrap. The radiation control is carried out on site where the metal scrap is stored or processed as well as during the loading and unloading of scrap shipment, which is further transported by road, railway, river or sea.

4.10. In all cases, when, as a result of administrative and visual control, it is established or suspicion arises, for the presence of radioactive source or material in a shipment of scrap, it is compulsory to carry out detailed investigation and radiation control of the shipment of scrap with the available devices at the facility. If the facility does not possess at the moment with suitable devices, the manager of the facility should ask external expert assistance in order to establish the presence (or absence) of radioactive source or material in the scrap under question. Until clarifying the case all work with the scrap should be terminated and the access of all persons be temporarily forbidden, for this aim enclosures and warning signs should be placed. Depending on the case the manager of the facility may call for expert opinion and should consult NRA and Civil Protection.

4.11. In all cases, when in the process of measurement, it is established that the gamma background of a given shipment of scrap is higher than the natural background, characteristic for the site of the facility, it is necessary to carry out additional radiation control and a detailed investigation for the cause, in order to find the possible source or material in the shipment of



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scrap. (For example if the characteristic gamma background of the site is 0.15 $\mu\text{Sv/h}$, while near to the scrap 0.20 $\mu\text{Sv/h}$ /or greater/ is measured, which is by 30% or more above the local background of the site, it is compulsory to carry out additional measurements to establish the reason for this.). Depending on the case the manager of the facility may call for expert opinion and should consult NRA and Civil Protection. Always, when it is established, that in a given shipment of scrap a radioactive source or material is found, the manager of the facility must inform immediately for this the NRA and Civil Protection as well as stop the access of all persons at the incident site.

4.12. The shipments of scrap should undergo radiation control at the sites where the scrap originates before being loaded for transport. The owner of the facility where scrap originates (the seller) should submit to the carrier a document (protocol) verifying that there are no radioactive materials in the scrap. The responsible person for the transport of a given shipment of scrap should require such a document from the owner of the scrap (consignor) before the transport is carried out. If such a document is not submitted, the carrier requires from the scrap owner (the seller) to perform preventive radiation control of the shipment of scrap or undertakes measures to carry out of such control using its own potential or through buyer (purchaser, consignee), and performs as well the administrative and visual control of transported shipment.

4.13. Each owner of a facility from which metal scrap originates (enterprise, plant, warehouse, company, organisation, association), should ensure:

- to perform a preventive administrative, visual and radiation control of the shipment of metal scrap before being shipped to the respective buyers;
- issue of a document (protocol) for each shipment of scrap confirming that the given shipment of scrap has undergone radiation control and does not contain radioactive sources and materials;
- appropriate devices for radiation control and trained personnel for operating these devices, including its technical maintenance (the radiation control may be assigned to a competent external organisation);
- conducting of initial and subsequent periodic training of the personnel for radiation protection, control of metal scrap and response to incidents with radioactive scrap;
- emergency plan (procedure), coordinated with NRA and Civil Protection, for response upon finding radioactive sources or materials in metal scrap;
- expert assistance from competent external organisations (through concluding an agreement upon eventual incidents with radioactive scrap and for personnel training in this field).

4.14. The radiation monitoring at the land and sea border check points (BCP) is carried out with the aim to prevent and discover illicit trafficking of radioactive sources and materials, including radioactive scrap. Through preventive control (administrative, visual and radiation control) carried out at the BCP radiation incidents are averted in the country and the protection of the population from radioactive sources and materials (found in scrap accidentally or deliberately) is ensured for commodities transported through the BCP.

4.15. The results of the radiation control at the BCP are kept, archived and reported by the respective border and customs officials following the set rules.

4.16. The border and customs control authorities undertake measures for:

- for implementing administrative, visual and radiation control of metal scrap and other materials during import/export;



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- ensure means for radiation monitoring devices and their maintenance;
- the training and preparation of the respective employees for finding radioactive sources and materials in metal scrap or other commodities and for response in case radiation incidents in accordance with the approved emergency plan (procedure).

4.17. The volume of the radiation control at large scrap warehouses and facilities for treatment and melting of scrap is determined according to the scale and the nature of their activities. The radiation control at these facilities is necessary to be performed by automatic stationary monitors (portal type, “arch”) mounted at the entrance and the exit of the facility as well as by portable radiography devices. The use of alarm threshold individual dose meters for some persons of the personnel at the facility is also necessary.

4.18. The volume of the radiation control at large metallurgical plants and loading and unloading facilities for scrap may be extended by detectors for radioactivity mounted at the grippers of the cranes, at conveyor belts, in slug collecting places from the melting furnaces for scrap melting, in dust cleaning and ventilation systems and other technological equipment.

4.19. Every owner of a warehouse for scrap and the owner of a facility for treatment (fragmentation) or melting of scrap should ensure:

- performing of the preventive administrative, visual and radiation control of the incoming and outgoing shipments of scrap at the site;
- suitable devices for radiation control and trained personnel for operating these devices, including the technical maintenance (radiation control may be delegated to competent external organisation);
- conducting of initial and the subsequent periodic training courses for the respective personnel responsible for radiation protection, the control of the metal scrap and response to the incidents with radioactive scrap;
- coordination with NRA and Civil Protection of the emergency plan (procedure) for actions at finding radioactive sources and materials in metal scrap;
- expert external assistance from a competent organisation (by concluding of an agreement for such assistance for possible incidents with radioactive scrap as well as for training of the personnel in this field)
- Including the principle “polluter pays” in the signed contracts for delivery of scrap, which obliges the consignor to assume the financial expenditures for liquidation of possible incidents with the delivered by him radioactive scrap.

4.20. Each owner of facility for melting of scrap (manager of a metallurgical enterprise) organises performance of periodical radiation control of the site, in the premises, of the installations and equipment used melting the scrap, including the ready metal production and at places where the technological waste is collected (slag, dust collection filters, etc.). This control is carried out according to a program, approved by NRA and Ministry of Health and may be assigned to a competent external organisation.

4.21. The managers of facilities working with scrap document, archive and inform NRA (periodically or at demand) the results of the radiation monitoring.



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5. RESPONSE TO INCIDENTS WITH RADIOACTIVE METAL SCRAP

5.1. On the sites where activities with metal scrap are performed, radiation monitoring of the metal scrap (sites, from where the metal scrap originated, storehouses, facilities for treatment and melting, load and unload handling operation, border check points) as well as is conducted preliminary developed and coordinated with the NRA and GDNSCP response plan (emergency procedures) should exist in case of:

- Detection of radioactive source or material fell into the metal scrap;
- Detection of container or package with radioactive source or material into the metal scrap;
- Determination of increased levels of the gamma background near by metal scrap, final metal production, technological equipment or productions refuses on the site;
- Determination of radioactive contamination in premises, buildings or on the site of the facility or yard;
- Receiving of information (call, report or other) for eventual presence of radioactive source or material into the metal scrap consignment.

5.2. The response plan should determine the responsible personnel and allocate their functions and responsibilities in case of incidents with radioactive scrap, as well as the order of notification and technical means foreseen for implementation of the plan. The response plan should be periodically updated by the managers of the site at least once pre two years and should be submitted to the NRA and GDNSCP.

5.3. The involved personnel on the sites should be preliminary appropriately trained to implement the response plan (emergency procedures).

5.4. The response plan (emergency procedures) for action in case of incidents with radioactive scrap should be activated in case of:

- Detecting with the hand-held detector that the dose rate measured near by the consignment of the metal scrap is above the natural gamma background specific for the site;
- Turning on the alarm system of the automatic radiation monitoring system for metal scrap control (portal monitors, “arches” for scrap monitoring) installed on the entry/exit of the facility;
- Turning on the alarm signalisation of the individual dosimeter used by the personnel performs activities with metal scrap on the facility;
- Founding during the visual monitoring a container, package or detail in the metal scrap which contains precautionary label or sign for radioactivity and it is determined that in side a radioactive source or material is available;
- Detecting of increased level of gamma background or presence of radioactive materials on the working places, premises or territory of the object.

5.5. In that cases the person discovered the event should notify immediately the corresponding managers of the scrap yard. The designated person for the control of metal scrap and for response in such events instantly performs actions for clarification of the situation and for verification of the information for arising of radiation event on the site.

5.6. The event should be declared as untrustworthy if the preliminary information on found radioactive scrap or radioactive contamination on the site is not confirmed (the event should be



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treated as “false alarm”), but despite of these the manager of the scrap yard should inform the NRA for such event (“false alarm”).

5.7. After determination the fact that radiation incident occurred on the site of the scrap yard the manager should notify instantly, but not later than 1 hour, the NRA or GDNSCP and should activate the response plan (emergency procedures). The manager is leading the organisation activities for liquidation of the incident in compliance with the response plan and undertakes urgent measures as:

- Discontinue the work in the area of the incident and release the non involved staff;
- Restrict the access to the area of incident;
- Setting barriers and warning labels around the incident place;
- Use in case of incident the foreseen intended means for radiation measurement, radiation protection and communication;
- Conduct operational consultations; with NRA and GDNSCP and fulfils the received recommendations;
- Notification and involving the corresponding external organizations for liquidation of the incident with whom the object has sign an agreement for granting expert and technical assistance in case of incidents.

5.8. The manager of the scrap yards in case of radiation event co-ordinate with NRA, GDNSCP or MI the subsequent activities and measure for:

- Mitigation and liquidation of eventual radiation consequences caused by the event and evaluation of the situation by the radiation protection standpoint;
- Provision of appropriate place on the site for temporary storage of radioactive sources and materials found in metal scrap prior to transferring them to SERAW
- Clarification and analysis of the causes and circumstances for the event, planning of measures for avoiding of similar events in the future.

5.9. The manager of the scrap yard within his jurisdiction provides human and financial resources for liquidation the consequences of the incident.

5.10. During at the time of control and investigation of the metal scrap consignment for radioactive sources and material the following circumstances should be taken into consideration:

- The metal details in the scrap shielding the gamma-emitting radioactive sources or materials (the shielding effect decrease the radiation and hamper the discovering of radioactive materials in the scrap in particular when the source is into container or package);
- The metal scrap can contain materials consist by small amount of radioactive substances, which are excluded (or can be excluded) by the regulatory control and accounting and which cannot represent risk for the people by the radiation protection standpoint. Existence of such materials in the metal scrap consignment can lead to activation of the alarm signalisation of the radiation monitoring equipment and to increasing of the gamma-background levels in the metal scrap proximity. In such cases the material that caused the increasing of the radiation levels should be found and removed and subsequently second measurement should be performed and if no elevated radiation level were detected the scrap can be allowed for further treatment.

5.11. The manager of the scrap yard should involve the external experts for investigation of the materials subject for release form regulatory control found in the metal scrap during the performed radiation monitoring.



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5.12. The managers of the scrap yards should be able to assign to the external organisations and experts competent in the field of radiation protection to perform:

- Radiation measurements of the consignment metal scrap, reprocessed metal, final production, technological equipment or generated refuses;
- Analysis and assessment qualitative and quantitative gamma-spectrometric analysis of radioactive materials found in non processed, reprocessed or melted metal scrap, work premises or on the site of the yard;
- Removal and safety storage of the radioactive sources and materials found in metal scrap, as well as performing other activities for liquidation of the incident with the radioactive scrap including the cases when the site is not able to manage the event with own resources;
- Evaluation of the radiation situation and the radiation consequences in case of incidents with radioactive metal scrap;
- Prepare documentation (protocols, reports, surveys, etc.) on the performed activities by the yard or for the radioactive incident;

5.13. The manager of the site where the incident with radioactive metal scrap has been detected should organise in coordination with NRA the temporary storage of founded radioactive sources and materials or metal scrap consignment radioactively contaminated.

5.14. The manager of the BCP where has been detected radioactive scrap should organise in coordination with NRA the temporary storage of the corresponded scrap consignment.

5.15. The radioactive source, materials or radioactively contaminated scrap consignment found in the scrap yard should be returned back to their owners, which should apply to the NRA for permission for safety transportation and appropriate storage place. The radioactive sources and materials are declared as radioactive wastes subject of deposition in accordance with the established procedures.

5.16. In case of spread of radioactive materials within the premises, equipments or buildings located in the area of the incident with radioactive scrap the manager of the affected site should organise the decontamination of the corresponding places and RAW collection generated during the incident. The RAW should be delivered in coordination with NRA to the SERAW.

5.17. The radiation protection measures during the liquidation of the incident consequences, decontamination activities and RAW treatment in the area affected by the incident should be coordinated with NRA, SANS and MH. If necessary the manager of the site should temporary discontinue the manufacturing process on the site (or spread process) until the end of the liquidation activities of radiation consequences.

5.18. In case of determination of radioactive materials in final metal products and if this products are distributed to the markets, the GDNSCP, MI, MH and NRA should undertake measures for tracing down and seizure the products, informing the general public and ensuring the radiation protection.

5.19. In case of incidents with radioactive scrap, as well as during the liquidation of the consequences of such accident, the managers of the scrap yards should notify in due time, but not later than 1 hour the NRA and GDNSCP by phone or all other approachable communication mean (fax, telegram, e-mail, mail or forward message/information through bearer). Also, the NRA



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and GDNSCP should be notified in due time in cases of detection of radioactive contamination in final product, equipment or technological refuses from the reprocessing enterprises.

5.20. The NRA and GDNSCP are maintaining on-duty emergency phones (+ 359887277434 or +359 885860086 for NRA and + 359 2 9601062 for GDNSCP), which are assessable always twenty-four hours.

5.21. After the initial notification for radiation incident, the manager of the corresponding scrap yard should periodically, as well as by request, submit orally or in written form to the NRA and GDNSCP information, reports and data about the incident and during the process of the liquidation of the consequences.

5.22. The initial notification should be based on the available information in the beginning of the incident. Periodically during the liquidation activities additional information should be presented. In **Annex 3** is given template for initial written notification (Form 2) for notification the NRA and GDNSCP in case of incident with radioactive scrap (radioactive sources or materials found in metal scrap). The initial notification (Form No.2) should be submitted to NRA and GDNSCP by the manager of the scrap yard in which the accidents has been detected within 24 hours after the occurrence of the event. The next reports for the incident can be provided to the NRA and GDNSCP in free stile.

5.23. The scrap yard manager should provide to the NRA and GDNSCP report with the investigation results and analysis of the incident not latter than 30 days after the detection of the incident.

5.24. The reports, analysis and assessments of the incident with radioactive scrap are requisite to the corresponding organisations and institutions for planning and implementing measures prevention and liquidation of such incidents, taken into consideration the lesson learned.

5.25. The competent state authorities (NRA, GDNSCP, MH, MI) are participating in liquidation activities of the consequences of the incident with radioactive scrap in compliance with their legal rights and requirements of the legislation in the area. NRA determines the conditions and orders for safe storage of radioactive sources and materials and their safety transportation within the country. NRA coordinates the activities for returning the radioactive scrap or the radioactive sources or material found in the scrap to the country of origin.

5.26. In case of likelihood or real transboundary radioactive contamination (for instance, in case of release of radioactive substances into the atmosphere due to melting of radioactive scrap in ferrous or non-ferrous production enterprise, in case of determining radioactive contamination in metal scrap consignor during import/export or in final metal product distributed to different users), the NRA should instantly notify the IAEA, as well as the regulatory authorities of neighbouring and other countries that is likelihood to be affected by the incident.

5.27. The information for such incidents that represents potential hazard for other countries should be by the NRA to the IAEA Incident and Emergency Centre in compliance with the obligations following by the ratified conventions, contracts and agreements.

5.28. The NRA should distribute in accordance with the established procedures the information on occurred within the country incidents with radioactive scrap to all interested institutions, organisations, enterprises, societies and companies, as well as to the Bulgarian public.



6. ADDITIONAL GUIDANCE TO PERSONNEL WORKING ON SITES HANDLING METAL SCRAP

6.1. TO IMPROVE YOUR OWN AND OTHER PEOPLE SAFETY, when:

- in the working process with metal scrap YOU SEE containers, objects, boxes, chests, vessels or other details marked with the radiation trefoil or labelled with text for radiation risk, which looks like the photos given in **Annex 4**;
- YOU see metal products (containers, articles) which looks like those from **Annex 5**, but they do not have marks of radiation trefoil or labels with text for radiation risk;
- YOU observe unusually heavy in comparison with their size articles, vessels, packages;
- During working with metal scrap the alarm systems of your individual dose meter is activated;
- During radiation monitoring is detected increasing level of the radiation gamma-background nearby the metal scrap consignment.

THE FOLLOWING ACTIVITIES SHOULD BE PERFORMED:

- Move away immediately from the scrap consignment for which indications or suppositions for presence of radioactive materials is determined!
- Do not touch and do not approach the articles in scrap which are marked with the radiation trefoil or labelled with text for radiation risk or you have doubts that they are radioactive! Do not try your own to find out what is or what contains such article (detail, package or vessel)!
- Instantly warn your colleagues close to you and report to the manager of the scrap yard or to your direct manager on the fact that you found indications on or supposed presence of radioactive materials in the metal scrap!
- Discontinue work and ask for instruction your manager. Do not show initiative!
- Do not allow external persons to assess the area of the incident until arrival of the corresponding competent personnel to clarify the situation and to perform future actions!
- Do not leave the area of the event without permission of your manager and until you are waiting stay far away from the bountifully scrap consignment!

6.2. The site manager should perform the following after receiving the announcement for indications of radioactive materials in metal scrap:

- organize and manage the activities for immediately verification the authenticity of received information with own resources and means and involve external experts for clarification of the situation if ns not able to do itself;
- instantly notify NRA and GDNSCP following the affirmation that on the site was found radioactive metal scrap;
- restrict the access to the place of event for external individuals and instruct the staff for the future activities that should be performed;
- activate the site response plan (emergency procedures) and manage the activities for liquidation of the incident based of the consultations with NRA and GDNSCP, follows theirs recommendations and periodically inform them for the progress of the situation on the site;
- assure the radiation protection measures for the staff on the site participating in the liquidation activities following the NRA and MH instructions;



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- provide human and material resources in the frame of his abilities until final liquidation of the incident and normalisation of the situation in the site involve external organisations and experts, provide access and assistance to the competent state authorities during performance of their duties;
- undertake activities for clarification of the origin of the radioactive metal scrap and other important facts relevant to the incident.

6.3. The site manager is responsible for precisely and duly performance of activities and measures, planned in the response plan (emergency procedures) in case of incident with radioactive metal scrap. In case of unforeseen circumstances during the incident the site manager should ask for advise the NRA and GDNSCP and should follow their instructions.

6.4. The site manager announces the end of emergency incident after approval by NRA and GDNSCP. All performed activities during the liquidation of the incident should be recorded. After liquidation the incident the site manager should organise investigation for determine the causes of the event and circumstances lead the incident and performs corrective measures and other legally actions according to the specific case.

6.5. In general the methods and means for radiation protection during working process in ionising radiation environment and in particular in case of incidents wit radioactive metal scrap includes:

- Reducing and mitigating the remaining time and work near by source of radiation (for instance radioactive source or material failed in metal scrap) – the dependency is directly proportional (i.e. less remaining time or work respectively less exposure dose);
- Increasing the distance between the source of radiation and person carrying out manipulations with these source (the exposure dose decrease inversely proportional of the distance square, i.e. 2 time higher distance form given point source the accumulated dose will be 4 times less);
- Using of protection means (barriers) which many times decreased the radiation form given radioactive sources in dependency of the layer thickness and density of the used protective material, respectively decreased the exposure dose (the rate frequency of decreasing of gamma-rays is proportionally of the density of the material, for instance, in case of equal thickness of the iron and lead shield the protection form the lead will be about two times more effective because his density is about two times greater than the iron one);
- Using of equipment for radiation monitoring and individual dose control for evaluation of radiation situation and the expose in the premises and working laces (in **Annex 6** are shown different types of some mostly used devices for radiation control and individual dose control, which are appropriate for the scrap yards)
- Using of individual protective means averting the intake of radioactive materials (the intake ways are by inhalation, injection or through the skin);
- Using means for decontamination of radioactively contaminated equipment, premises and section in the correspondent scrap yards (i.e. removal the radioactive materials form the given surface often by chemical solutions, water or others);
- Applying others technical and organizational means including administrative one to ensure the radiation protection (the scale and type of measures should be defined in accordance with the specific event and in dependence of the level of the radiation risk during the incident).

6.6. The manager of the scrap yards should distribute as leaflets, brochures or posters the photos given in Annexes 4, 5 and 6 and corresponded instruction to the staff for preventing of



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incidents with radioactive metal scrap based on this guide. The leaflets, brochures and posters should be placed at visible place in the sites performing activities for reception, storage, loading, fragmentation and melting of metal scrap.



7. ABBREVIATIONS

BNRA	- Bulgarian Nuclear Regulatory Agency
GDNSCP	- General Directorate National Service Civil Protection (Civil protection)
BCP	- Border Check Point
MTCSA	- Metrological and Technical Control State Agency
GM	- General Management
NSSA	- National Security State Agency
SERAW	- State Enterprise Radioactive Waste
EEC	- European Economical Commission
EU	- European Union
ASUNE	- Act on the Safe Use of Nuclear Energy
IAEA	- International Atomic Energy Agency
ME	- Ministry of Emergencies
MH	- Ministry of Health
MI	- Ministry of Interior
MIE	- Ministry of Industry and Energy
MEW	- Ministry of Environment and Water
BPNS	- Border Police National Service
LSA	- Low Specific Activity
NCRRP	- National Centre for Radiobiology and Radiation Protection
UN	- United Nations
SCO	- Surface contaminated object
RAW	- Radioactive Waste
NORM	- Naturally Occurring Radioactive Materials
NRC	- National Regulatory Commission
WCO	- World Custom Organization



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8. REFERENCES

- [1] Regulation on Emergency Planning and Preparedness to Nuclear and Radiation Emergencies, promulgated in the State Gazette No.71 of 13 August.2004.
- [2] Regulation of the Conditions and Procedure for Notification of the Nuclear Regulatory Agency about Events in Nuclear Facilities and Sites with Sources of Ionizing Radiation, promulgated in the State Gazette No.71 of 13 August 2004.
- [3] Regulation on Basic Norms of Radiation Protection, promulgated in the State Gazette No.73 of 20 August 2004.
- [4] Disaster Protection Act, promulgated in the State Gazette No.102 of 19 December 2005.
- [5] Act on the Ministry of Interior, promulgated in the State Gazette No.17 of 24 February 2006.
- [6] Health Act, promulgated in the State Gazette No.70 of 10 August 2005.
- [7] Recommendations on Monitoring and Response Procedures for Radioactive Metal scrap, UN, New York and Geneva, 2006, published by the United Nations Economic Commission for Europe.
- [8] United Nations Economic Commission for Europe, Report on the Improvement of the Management of Radiation Protection Aspects in the Recycling of Metal Scrap, co-sponsored by the International Atomic Energy Agency and the European Commission, UNECE, Geneva, (2002).
- [9] Handbook for Response to Suspect Radioactive Materials, U.S. Department of Energy, National Nuclear Security Administration, Office of Defence Nuclear Non-proliferation, 2005.



ANNEX 1 - GENERALIZED ANALYSIS OF PROBLEMS ARISING FROM RADIOACTIVE METAL SCRAP

The reprocessing of metal scrap (recycled scrap material) is increasingly used worldwide in the metallurgical industry. This is the way to save energy and natural resources and to decrease the harmful influence to the environment.

In 2004, the worldwide consumption of metal scrap was estimated of the order of 440 million tones out of which around 184 million tones were traded internationally. Worldwide the more than 50% of the volume of these products within the ferrous metallurgy (steel and cast iron) is produced by metal scrap. This fact shows the huge importance of the metal scrap as raw material resources for human race.

The rise in the importance of metal scrap as a resource has been paralleled by an increase in the frequency that radioactively contaminated metal scrap, activated metal scrap and metal scrap with radioactive source(s) or substances contained within it (hereafter referred to as “radioactive metal scrap”) is detected in metal scrap shipments. Scrap yards, steel works and nonferrous metal smelters and refiners are increasingly detecting radioactive substances in incoming metal scrap as the result of losses, accidents or inadvertent disposal of radioactive material. In the USA alone, over 5,000 incidents were recorded in 2004 that involved various types of radioactive metal scrap. Of these, about 53% involved the detection of naturally occurring radioactive material (NORM – according to the terminology introduced by IAEA), 7% were due to radium, and less than 5% were due to artificially produced radionuclides (orphan sources, abandoned sources, accidentally failed in scrap consignment). Some of this radioactive metal scrap 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.

Table No.1 gives summarised data on incidents discovered during the last 25 years connected with melting of radioactive metal scrap in different countries over the world. In the period after 1983 in USA totally 30 events had been registered on melting of radioactive sources in metallurgical enterprises (20 events in factories for steel reduction and 10 events in factories for non-ferrous metal production). In the same period in other 18 countries have been detected 30 events of melting of radioactive metal scrap. As it seen by the Table No.1 in 1994 such event happened in Bulgaria, also (it is supposed that in steel production factory in Pernik town radioactive source cobalt-60 with activity 3,7 GBq was melted and later the steel consignment was exported to USA where has been detected that it is radioactively contaminated).

On fig.1 is shown the summarised data about the incidents with radioactive metal scrap registered in Bulgaria for the period 1998 – 2006. For these 9 years the number of the incidents with radioactive metal scrap in total is 125. In 120 cases details containing naturally occurring radioactive material were found and in 5 cases abandoned radioactive sources (caesium-137 and cobalt-60) were found. In all these cases no radiation consequences for the Bulgarian population and the environment were caused, but regardless of this such events are extremely undesirable and indicate that additional measures and efforts on national level for their prevention are required.



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Table 1. Summarised data during the last 25 years on incidents with melted radioactive sources in different countries in the world

No.	Year	Metal	Place	Isotope	Activity (GBq)
1.	— ^a	Gold	New York	²¹⁰ Pb, ²¹⁰ Bi, ²¹⁰ Po	Unknown
2.	1983	Steel	Auburn Steel, New York	⁶⁰ Co	930
3.	1983	Iron/Steel	Mexico ^b	⁶⁰ Co	15 000
4.	1983	Gold	Unknown, New York	²⁴¹ Am	Unknown
5.	1983	Steel	Taiwan ^b	⁶⁰ Co	> 740
6.	1984	Steel	US Pipe & Foundry, Alabama	¹³⁷ Cs	0,37 - 1,9
7.	1985	Steel	Brasil	⁶⁰ Co	Unknown
8.	1985	Steel	Tamco, California	¹³⁷ Cs	56
9.	1987	Steel	Florida Steel, Florida	¹³⁷ Cs	0,93
10.	1987	Aluminium	United Technology, Indiana	²²⁶ Ra	0,74
11.	1988	Lead	ALCO Pacific, California	¹³⁷ Cs	0,74 - 0,93
12.	1988	Copper	Warrington, Missouri	Unknown	Unknown
13.	1988	Steel	Italy ^b	⁶⁰ Co	Unknown
14.	1989	Steel	Bayou Steel, Louisiana	¹³⁷ Cs	19
15.	1989	Steel	Cytemp, Pennsylvania	²³² Th	Unknown
16.	1989	Steel	Italy	¹³⁷ Cs	1000
17.	1989	Aluminium	Russia	Unknown	Unknown
18.	1990	Steel	NUCOR Steel, Utah	¹³⁷ Cs	Unknown
19.	1990	Aluminium	Italy	¹³⁷ Cs	Unknown
20.	1990	Steel	Irland	¹³⁷ Cs	3,7
21.	1991	Steel	India ^b	⁶⁰ Co	7,4 - 20
22.	1991	Aluminium	Alcan Recycling, Tenecy	²³² Th	Unknown
23.	1991	Aluminium	Italy	¹³⁷ Cs	Unknown
24.	1991	Copper	Italy	²⁴¹ Am	Unknown
25.	1992	Steel	Newport Steel, Kentucky	¹³⁷ Cs	12
26.	1992	Aluminium	Reynolds, Virginia	²²⁶ Ra	Unknown
27.	1992	Steel	Border Steel, Texas	¹³⁷ Cs	4,6 - 7,4
28.	1992	Steel	Keystone Wire, Illinois	¹³⁷ Cs	Unknown
29.	1992	Steel	Poland	¹³⁷ Cs	Unknown
30.	1992	Copper	Estonia/Russia	⁶⁰ Co	Unknown
31.	1993	Unknown	Russia	²²⁶ Ra	Unknown
32.	1993	Steel	Russia	¹³⁷ Cs	Unknown
33.	1993	Steel	Auburn Steel, New York	¹³⁷ Cs	37
34.	1993	Steel	Newport Steel, Kentucky	¹³⁷ Cs	7,4
35.	1993	Steel	Chaparral Steel, Texas	¹³⁷ Cs	Unknown
36.	1993	Zinc	Southern Zinc, Georgia	U (depleted)	Unknown
37.	1993	Steel	Kazakhstan ^b	⁶⁰ Co	0,3
38.	1993	Steel	Florida Steel, Florida	¹³⁷ Cs	Unknown
39.	1993	Steel	RSA ^c	¹³⁷ Cs	< 600 Bq/g
40.	1993	Steel	Italy	¹³⁷ Cs	Unknown
41.	1994	Steel	Austeel Lemont, Indiana	¹³⁷ Cs	0,074



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No.	Year	Metal	Place	Isotope	Activity (GBq)
42.	1994	Steel	US Pipe & Foundry, Alabama	^{137}Cs	Unknown
43.	1994	Steel	Bulgaria ^b	^{60}Co	3,7
44.	1995	Steel	Canada ^d	^{137}Cs	0,2 - 0,7
45.	1995	Steel	Czech Republic	^{60}Co	Unknown
46.	1995	Steel	Italy	^{137}Cs	Unknown
47.	1996	Steel	Sweden	^{60}Co	87
48.	1996	Steel	Austria	^{60}Co	Unknown
49.	1996	Lead	Brazil ^b	^{210}Pb , ^{210}Bi , ^{210}Po	Unknown
50.	1996	Aluminium	Bluegrass Recycling, Kentucky	^{232}Th	Unknown
51.	1997	Aluminium	White Salvage Co., Tennessee	^{241}Am	Unknown
52.	1997	Steel	WCI, Ohayo	^{60}Co	0,9
53.	1997	Steel	Kentucky Electric, Kentucky	^{137}Cs	1,3
54.	1997	Steel	Italy	$^{137}\text{Cs}/^{60}\text{Co}$	200/37
55.	1997	Steel	Greece	^{137}Cs	11 Bq/g
56.	1997	Steel	Birmingham Steel, Alabama	$^{137}\text{Cs}/^{241}\text{Am}$	7 Bq/g
57.	1997	Steel	Brazil ^b	^{60}Co	<0,2
58.	1997	Steel	Bethlehem Steel, Indiana	^{60}Co	0,2
59.	1998	Steel	Spain	^{137}Cs	>37
60.	1998	Steel	Sweden	^{192}Ir	<90

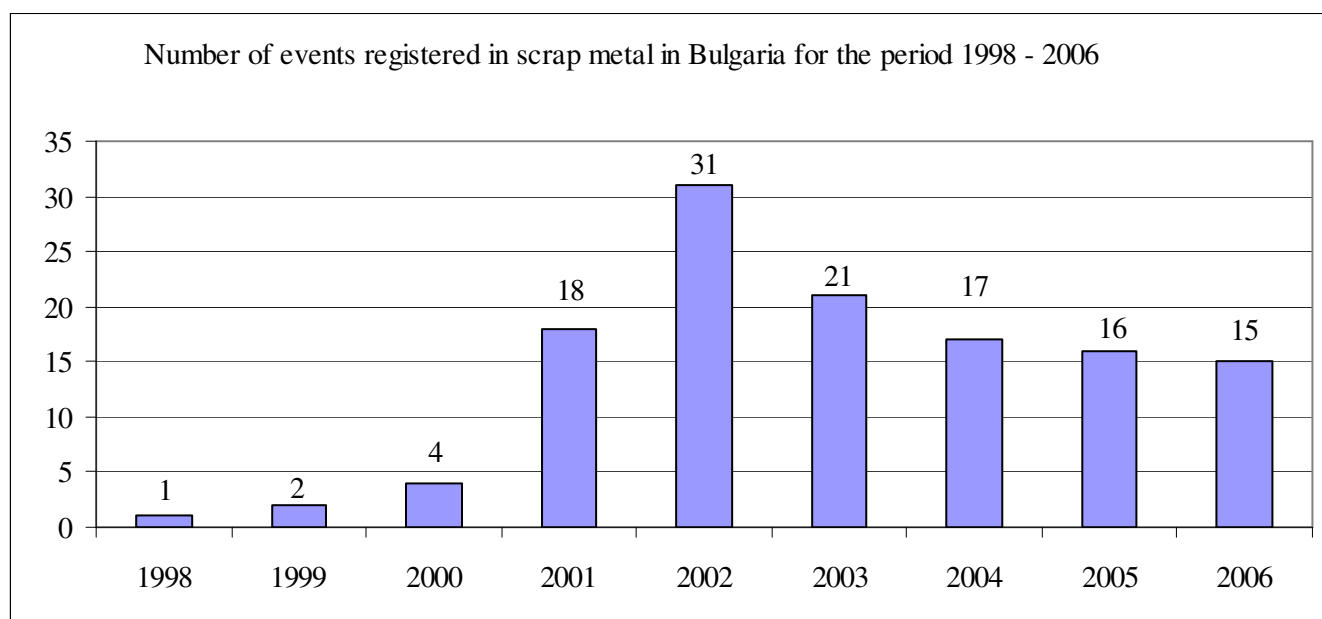
Remarks:

^a Multiple cases reported, earlier about 1910.

^b Contaminated product exported to USA.

^c Contaminated vanadium slag exported to Austria: detected in Italy.

^d Contaminated by-product (electric furnace dust) exported to USA.



Note: Totally 125 events from which 120 - materials NORM's and 5 – radioactive sources (^{60}Co and ^{137}Cs).

Fig. 1. Summarised data on incidents with radioactive metal scrap in Bulgaria



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The presented facts indicate the scale and nature of the problem with radioactive metal scrap. They do not exhaust all incidents with radioactive metal scrap detected all over the world. Others cases with radioactive metal scrap had happened, but they has not been reported or registered and subsequently such metal scrap were melted or reprocessed in different countries (except those mentioned in Table No.1).

Other types of incidents are likelihood to occur in which as a result by the recycling of radioactive metal scrap consumer goods contaminated with radionuclides may appear on the marked. As an example the following cases can be described (based on the data published by IAEA):

- In 1998 in USA has been found 133 golden jewels radioactively contaminated with polonium-210, lead-210 and bismuth-210 (daughter progeny of the radon-222);
- In 2000 in France accidentally has been discovered radioactive contamination with cobalt-60 of metal watch-chain;
- In the beginning of 2007 accidentally has been discovered radioactive contamination with cobalt-60 of metal details intended for ladies bags, produced in India.

IAEA developed and maintain special informational system for registration of all reported emergency events and incidents with radioactive sources all over the world, including incidents with radioactive metal scrap or lost and theft radioactive sources, illicit trafficking of nuclear and radioactive materials, detection of radioactively contaminated customer goods, etc. The information is distributed by IAEA to competent authorities of the members-states, including the NRA.

On 1998 during the International Conference in Dijon (France), organised by IAEA, European Union, INTREPOL and World Custom Organisation has been reported that there have been more than 300 incidents related to the melting of radiation sources during the last ten years.

The reasons and premises for occurring of such type of accidents have been analysed deeply by IAEA and other competent authorities in the world. They can be summarised as following:

- Inadequately and not effective regulatory control or lack of such control over the radioactive sources and materials within certain country;
- Inadequately and carelessly performance of the responsibilities and duties on observing the requirements of safety use and storage of radioactive sources and materials and ensuring the physical protection and security in the facility and sites using radioactive sources and materials;
- Lack or shortage of financial resources for ensuring the safety and physical protection of radioactive sources or materials (this apply mainly for the facilities in bankruptcy or in process of privatisation and liquidation);
- Lack or shortage of RAW repository facilities (the result is compulsive and long storage of unconditioned disused radioactive sources in temporary storages), impossibility for returning back to the producer the sealed radioactive sources and high state taxes for disposal of radioactive sources declared as RAW (based on all this facts the licensees especially those in bankruptcy storage the sources occasionally an inappropriate and hazardous conditions);
- Ineffective physical protection (or absence of such) during the storage, transportation and use of radioactive sources, lack of emergency response plans, as well as adequate radiation monitoring during activities, which are directly or indirectly connected with radioactive sources or materials;



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- Replacement of the property frame and reconstruction of the enterprises used radioactive sources and materials during the economical reforms in many European countries after the 1990 (the transferring process of the state property into private one and the economy reconstructions creates during the transitional period conditions for inappropriate and hazardous management and storage of radioactive sources and materials in some enterprises which can lead to full loss of control over them);
- Abandoned, thrown and theft of radioactive sources and materials or malicious act with them (sabotage, trafficking, terrorist acts, etc.);
- Human errors during activities with radioactive sources and material, non-adherence of the safety procedures and requirements, emergencies, disasters or catastrophically events (fires, explosions, floods, etc.);
- Increasing of the amount of metal scrap and other materials excused form regulatory control during decommissioning of nuclear facilities and other sites using radioactive sources;
- Bankruptcy, liquidation, insolvency of enterprises that use and storage radioactive materials, vacate (or death) of the owners or other personnel responsible for the radioactive sources and materials, which has been used or in storage;
- Increasing of illicit trade and trafficking of radioactive materials during the last years (based on IAEA data from 1993 till now has been registered more than 300 events and the corresponding competent authorities has been captured and averted illicit carriage of radioactive substances as 30 of them were nuclear /fission/ materials);

All these factors lead to increasing of the probability for accidentally or deliberately failing of radioactive sources or materials in metal scrap because of loses of control over them, i.e. leads to increasing of the incident frequency with radioactive metal scrap. The analysis shown that the mainly reason for failing of radioactive source or materials in metal scrap are:

- Non-observance or careless performance of the requirements and procedures for safety use and storage of radioactive sources as well as accounting and control of these sources and human errors;
- Existence of unknown and unadjusted radioactive sources or materials which are used in activities excluded by regulatory control (the practice shows that in many countries with weakly regulatory control in the past or in the present the number of radioactive sources is not exactly known);
- Existence of abandoned without control and physical protection radioactive sources (i.e. orphan sources);
- Emergencies in the enterprises that caused loss of control over the radioactive sources or uncontrolled radioactive contamination on the site (the number of personnel working in nuclear industry and with radioactive sources all over the world is extremely high – more than 1 million people and hence the likelihood for occurrence of emergencies because of human errors, wrong activities or other subjective factors increased);

Others factors less likelihood for failing of radioactive sources in metal scrap are:

- Illicit trade and trafficking of radioactive sources, nuclear or radioactive materials;
- Loss and thefts of radioactive sources, nuclear or radioactive materials.

Based of the data of the World Custom Organization during the period 1993 – 1998, i.e. only 6 years extension period has been detected 234 cases of illicit trafficking (smuggling) of nuclear and radioactive materials – 66 % of the events are registered in the countries of former East Europe (Russia – 52 events; Poland – 18 events; Ukraine – 17 events; Bulgaria – 10 events; Czech Republic – 7 events) and 30 % of the case – in Western Europe (Germany – 67 events).



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Frequently subject of smuggling is the uranium (natural, enriched and depleted) – 129 cases were registered and recorded for the mentioned period. Rarely are the cases of illicit trafficking of caesium-137 (53 cases) plutonium (10 cases), radium (5 cases) and americium (3 cases).

Based on the data of the International INTERPOL up to 1996 have been registered more than 100 individuals involved in illicit trafficking of uranium, plutonium, iridium-192, caesium-137, cobalt-60 and others. The most striking cases are the capture of 3 kg high-enriched uranium (90% uranium-235) in Russian Federation (Petersburg town) in 1993 and 560 g uranium-plutonium mixture (more than 360 g of plutonium) in 1994. In Bulgaria in 1999 at Ruse town has been averted illicit trafficking of 4 g high-enriched uranium (72 % uranium-235).

Germany is a typical example of transit country for illicit trafficking of radioactive materials between the Eastern and Western Europe. During the 1991 – 1997 in Germany have been registered about 1000 criminal real or suspected cases of illicit trafficking and offering of radioactive materials (including “false” radioactive materials for instance “red mercury”).

In case of absence of real buyers or final consumers the radioactive materials subject of illicit trading or trafficking with great probability in the long run may fail in metal scrap as a result of their discarded or hidden.

Based on the data of the NRC (USA) annually about 200 incidents has been reported with theft, lost of abandoned radioactive sources but it is considered that this is only the top of the iceberg – the real number of such incidents is bigger because of many reasons not every think incident is reported to NRC. The described radioactive source with big probability may be found in the metal scrap.

During the conference in Dijon (France) in 1998 organised by IAEA has been reported that the average number of incidents with radioactive metal scrap worldwide is about 30 per year.

The possible ways for failing of radioactive source or materials in metal scrap can be summarised as following:

a) Dismantle or decommissioning of industrial enterprises for reprocessing of raw containing increased level of naturally occurring radionuclides.

In this group belong the facilities for 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 metal scrap.

b) Decommissioning of nuclear installations (such as nuclear power plants and other nuclear fuel cycle facilities) and other facilities.

During these activities significant amounts of various metals is produced. A fraction of this materials used in the branch of nuclear applications has been a subject of exposure (radioactively activation) or contaminated with radioactive materials. As a rule they are decontaminated prior to be transferred as metal scrap or disposed as radioactive waste. On occasions, because of mistakes or non-effective control such materials may fail in metal scrap. It is important to note that some of these materials containing artificial or naturally occurring radionuclides in quantities below the clearance levels may be released by the regulatory control and recycled as metal scrap only



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after receiving permission by the correspondent regulatory authority (for Bulgaria these authority is the Nuclear regulatory Agency).

c) Loss of theft of radioactive sources and consequently failing in metal scrap.

In some cases because of non-observance of the requirements for safety storage, control and physical protection the radioactive sources can be lost or placed at inappropriate location or theft. As a result they can failed in metal scrap with the shielding containers, which are made by lead, steel or depleted uranium. Rarely there are cases in which in the metal scrap failed unshielded radioactive sources. The radioactive sources used in industrial radiography for sources are used for control welds, in instance during construction of pipelines, may be lost, abandoned or theft during use or storage in the field or other conditions. Radioactive sources used in medicine can be loss of theft also. Most frequently the reason for having such incidents is the non-observance and carelessly performance of the requirements and procedures for safety use, storage and accounting of radioactive sources.

d) Dismantle of installation in which radioactive sources have been used and consequently failing in metal scrap.

Radioactive sources have extremely large applications in medicine, science and industry (e.g., radiotherapy, diagnostic applications, irradiator facilities, radiography, gauges, scientific research and experiments). Based on IAEA data worldwide about 20 000 licensees have been registered using high activity radioactive sources in more than: 10 000 medical installations for therapy (the sources periodically are replaced with new one); about 12 000 industrial radiography (the sources are replaced annually with new one); approximately 300 industrial irradiators (for food irradiation, medicine and other purposes). Because of omissions or careless is possible the build in sources to be forgotten or unnoticed in the gauge (apparatus) and consequently failing yin in metal scrap and melted in metallurgical plant.

e) Delivering as metal scrap of devices, goods and articles containing radioactive materials or radioactive sources remaining out of regulatory control or containing naturally occurring radionuclides.

Parts of such devices and goods (watches, compasses, etc) have been covered with luminescent paint containing radioactive substances (usually radium-226, tritium). In others a radioactive sources have been boiled in, in instance lightning roads used in large number in former Yugoslavia and other European countries. Besides this there are devises and goods with increased levels of naturally occurring radionuclides (thoriated lenses, details and pipes from the uranium mining, oil and gas industry, etc.). Some goods and articles containing artificial radionuclides are not subject of control because the quantities of the radioactive substance are less that the legislatively defined exemption levels for release from regulatory control. As a practice in such cases the metal scrap can be allowed for melting (recycling) in the metallurgical plants bun only under the regulatory control of the competent authority.

The metallurgical plants with available sensitive dose measurement equipment can detect presence of small amounts of radioactive substances in the metal scrap and in every case the regulatory authority should be notified.

As a rule the potential radiation hazard for public health and environmental in case of incidents with radioactive metal scrap is small as in the most of the cases the detected radiation levels are low, but never then less the risk shall not be neglected from radiation protection point of view.



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Rarely there are cases in which the radiation consequences from the incidents with radioactive metal scrap were extremely heavy to the individuals from the population and to the environment. Information for such incidents that have been registered in the world is published by IAEA – 15 incidents were registered with 31 deaths as a result of overexposure from radioactive sources out of control. The following cases can be described as an example for possible radiation consequences as a result of abandoned or left without control radioactive sources in metal scrap:

1. Mexico, 1983

In 1977 a medical centre in a city of Juarez (Mexico) purchased a second-hand radiotherapy unit and later the equipment is left without control for 6 years. In 1983 a technician who worked at the medical centre dismantled the unit without authorization and decided to sell it for a metal scrap. The dismantled unit is the container with radioactive sources (cobalt-60 with activity 37 TBq in the form of 6000 cylindrical metal pellets in size of 1 mm x 1 mm). It was loaded on the pick-up truck to a scrap yard and during the transportation the pellets drop by chance from the container and were scattered on different locations, as well as on the site of the scrap yard. Most of the pellets went to the metal scrap consignments and then to various foundries, where the activity was incorporated in metal detail for wide consumer use (table legs and reinforcing bars for concrete). The incident was found by chance at the beginning of 1984 when a lorry carrying such radioactively contaminated details pass close to radiation detection system of the Los Alamos National laboratory (USA). A large-scale investigation of the event has been started, as well as liquidation and mitigation of the consequences in Mexico and USA. As a result from the radioactive contamination of large areas within the Juarez town 16 000 m³ of soil and 4 500 t of metal were collected, as well as 814 houses were demolished. Some 4 000 people were exposed because of the spilled radioactive pellets and 5 people received doses from 3 Gy to 7 Gy and 795 people – from 5 mGy to 3 Gy. Thankfully no fatalities were registered. In USA were found 2 500 radioactively contaminated metal details (table legs) which has been sold to 1 400 customers. All the items have been collected and sent back to Mexico for storage as RAW in repository.

2. Brazil, 1987

A medical installation for teletherapy (gamma exposure) containing radioactive source cesium-137 (activity 51 TBq in the form of caesium chloride – dispersible salt with high solubility) was abandoned without control within premises of the former hospital in Brazilian town Goiania. The installation was partly demolished and the source was removed and ruptured by local people, which carry out the metal details with the aim to sell as a metal scrap. Within several weeks the ruptured radioactive source leads to a high level of radioactive contamination of large areas within the city as a result of the spread of the cesium chloride (49 highly radioactively contaminated with cesium-137 places were found within the city). Many people were externally and internally exposed, 21 people received doses about 1 Gy and 4 dead were registered. Also, 28 people suffered from radiation surface skin burns. 200 people from 41 houses were evacuated and 7 houses were demolished and 85 houses were decontaminated. The decontamination activities took about 6 months and 3 500 m³ radioactive wastes were collected.

3. Turkey, 1998

Two radioactive sources cobalt-60 intended for teletherapy were left for storage in premises in Istanbul town. The premises became property of the person who didn't know what is inside of



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the metal package (container with radioactive sources) and sold the package to a person collecting metal scrap. The members of the family of the buyer rupture the container with the sources and were overexposed – 10 people received dose between 1Gy and 3 Gy. Thankfully there are no lethality consequences. Only one radioactive source cobalt-60 with activity 3.3 TBq was found. The second one was not found despite the performed efforts.

4. Spain, 1998

On 30 May 1998 in the Spanish stainless steel factory Acerinox an unknown source was melted. On 1 June starts planned periodic cleaning of the filter system of the electrical furnace and 270 t of dust were collected and transported for reprocessing to other two factories. On 2 June by chance was discovered that the dust is radioactively contaminated with cesium-137 (the alarm was given by a radiation detector on the Acerinox factory during pass of an empty truck back from carrying the dust). Investigation of the event has been started, as well as liquidation of the consequences. Traces of cesium-137 were found only in 6 people from 400 exanimate workers of the factory. As a result of the transboundary transport of radioactive contaminated air the increased concentrations of cesium-137 in the atmosphere were detected in France and Italy – the measured values were about 1000 times above the usual background one and reached 2 mBq/m³. Through the IAEA the system for emergency response was activated in several countries because of transboundary contamination, as well as the ECURIE. During the liquidation of the consequences of the incident about 1000 m³ radioactive wastes were collected in the three affected factories (where the source was melted and the two others where the radioactively contaminated dust were transported). The financial losses caused by the incident were estimated to a 26 million USD.

The practice from liquidation of incidents with radioactive metal scrap show that in all cases arises severe and unforeseen in scale economical and financial consequences to the metallurgical enterprises and companies handling and trading with metal scrap. The economical losses for the metallurgical plants in USA as a result of melting of radioactive source failed in metal scrap are estimated average about 8-10 millions USD as only in one of the events the losses were about 23 millions of USD. The damages by the incident in Spain in 1998 (melted metal scrap with radioactive source caesium-137) are about 26 millions USD. In such incidents the confidents of the buyer (customer) may be lost, the trade contacts can be decreased or interrupted and subsequently the company or enterprise may bankrupt or waste the metal scrap market positions. The discovery of radioactive contamination in almost reprocessed metal (i.e. after melting radioactive metal scrap) or in good produced by contaminated scrap in particular in any cases leads to interruption of the activity and shut down of the sites. These require implementation of large-scale and high expensive measures for liquidation of the radiation consequences and for decontamination of production issued on the market.

The social consequences of the incident with radioactive metal scrap should not be underestimated as in such cases the result may lead to increasing of social tension, psychosis and panic within the population because of radiation fear.

Based on the prognosis of the EU European Economical Commission is expected that the number of events on detection of radioactive metal scrap will continue to increase independently from the efforts worldwide for improving the control and security of radioactive sources, prevention the incidents with radioactive metal scrap and illicit trafficking of radioactive materials. This prognosis is based on the following considerations:



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1. Retain the trend of increasing the amount of used metal scrap as secondary raw materials for production of steel, cast-iron and non-ferrous materials;
2. Continuously the number and efficiency of the equipment for radiation monitoring of metal scrap in the reprocessing facilities is increasing by reason of what is possible in time to detect radioactive substances and materials into the metal scrap. The radiation monitoring of metal scrap in the metallurgical enterprises is already large-scale practice following the incident in Spain in 1998 lead to transboundary radioactive contamination in air (before the incident such control were performed incidentally in single courtiers. In the both main recycling enterprises in Bulgaria the radiation monitoring of the reprocessed metal scrap were implemented in 1994 following the registered by USA case of radioactive contamination of steel with cobalt-60 produced in Pernik town);
3. The age of used metal scrap in more cases cab be older that 20 years when in general no adequate regulatory control over the radioactive sources in given country has been performed or the control were weak and ineffective that create conditions for accidentally fall of radioactive sources and materials in scrap consignment. As a result of implementation of preventive radiation monitoring in reprocessing enterprises becomes possible to detect radioactive sources and materials in due course which has been failed no one knowing how and when in the metal scrap. That is the way to prevent potential likelihood to occur radiation incidents and to found threw, loosed, abandoned and unknown radioactive sources by past activities and as a result such sources are fool-proved and deposit under the control of the competent authorities. This is in really form of “cleaning” of the given country from earlier unknown orphan sources failed in metal scrap;
4. The existence of adequate regulatory control over the radioactive sources and effective equipment for preventive radiation monitoring of the recycled metal scrap is necessary but not enough condition for adverting incidents with radioactively contaminated metal scrap, because always exist the probability to failed radioactive source or material into the metal scrap (independently from his age) by reasons of human errors or carelessness, irresponsible or incapability performance of duties, malicious or illegal acts, accidents or other unpredictable events;
5. The number of used and storage radioactive sources worldwide are extremely high and exceed several millions (only in USA are registered more than 190 000 licensees that owners mote than 2 millions sources) however not everywhere the storage conditions and physical protection are adequate. In such conditions with great possibility because of badly keeping of the sources they can became subject of violations (thefts or other malicious and illegal acts) and to failed accidentally or deliberately into metal scrap. As a rule theft, loosed or orphan radioactive sources finally may failed into the metal scrap with all negative consequences.

Radioactive material may failed into other types scrap (besides metal scrap), but most serious is the problem with radioactive metal scrap because of the scale of recycling industry, objective difficulties for detection of radioactive materials into the scrap because of metal shielding effect and the probability of following failing to the market as final product after reprocessing of the scrap.

The increasing of the numbers of events with radioactive metal scrap and appearance on the marked radioactively contaminated goods produced after recycling of such scrap is actual and sharp for the developed countries, as well as for developing one. Potential risk form incidents with radioactive metal scrap are extremely high for the countries where the adequate regulatory control over the radioactive sources is not performed (or such control is missing) as well as



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preventive radiation monitoring of the recycled metal scrap (absence of radioactive sources or materials into the scrap).

Relevantly to these the competent international organisations (IAEA, EU, EEC – UN, Interpol, WHO) and the national competent authorities give special attention and undertake measures to resolve globally the problems with radioactive metal scrap. In 2001 the IAEA, EU and EEC – UN prepared report for increasing the effectiveness of the measure for radiation protection during recycling metal scrap with the main aim to avert incidents with radioactive metal scrap and non-admission of the opportunity for failing of radioactive materials into the metal scrap reprocessing system. In 2004 under the aegis of the EEC – EU and with support of the USA Government has been discussed and adopted strategy for averting of incidents with radioactive metal scrap including procedures for monitoring and ensuring the safety during international trade and transportation of scrap.



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**ANNEX 2 - FORM 1 TEMPLATE OF PROTOCOL (CERTIFICATE) FOR
RADIATION MONITORING OF METAL SCRAP**

The seller (supplier) of metal scrap provides to the buyer of carrier protocol (certificate) of performed radiation monitoring, which certifies that the shipments of metal scrap do not contain radioactive materials. It's requirement that such a requirement is embraced within the contract between supplier and buyer. The radiation monitoring should be done before the shipments leave the premises of the supplier form, which the metal scrap originates (the storehouse of the delivery company or site, where the metal scrap were yield). The protocol for conducted preventive radiation monitoring is an obligatory document for realization of the deal for selling, transportation, supply and receiving shipments of metal scrap.

PLACE OF CONDUCTION OF RADIATION MONITORING:	
Location of the shipment:	
Name of organization/company and person conducting the radiation monitoring:	
Address:	
Telephone:	
Fax:	
E-mail:	
DESCRIPTION OF SHIPMENT:	
Country of origin:	
Origin of load - supplier of merchandise (address, contact person and telephone):	
Destination of load (contact details of recipient - address, contact person and telephone):	
Amount and labeling of the shipment (reference to transit documents being carried with the load):	
Means of transport (identify truck, ship, container, rail-may, etc.):	
Details of carrier (contact details address, contact person and telephone):	
MEASUREMENTS RESULTS:	
Details of the monitoring equipment used (type, identification number):	
Average dose rate value measured at 1 metre from the surface of the load ($\mu\text{Sv/h}$):	
Maximum dose rate value in contact with the outer surface of the container, truck or wagon, in $\mu\text{Sv/h}$ (identify position):	
Naturally occurring background radiation value in the area, in $\mu\text{Sv/h}$	
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, name and signature of the person	



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**ANNEX 3 - FORM 2 TEMPLATE FOR REPORTING DETECTED
RADIOACTIVE MATERIAL IN METAL SCRAP TO BNRA
AND GDNSCP**

1. Preliminary data of found radioactive metal scrap

Date and time of detection of radioactive metal scrap:	
IDENTIFICATION OF EQUIPMENT, INSTALLATION OR DETECTION LOCATION:	
Place of measurement:	
Company / organization and person name, performed the measurement:	
Address:	
Telephone:	
Fax:	
E-mail:	
DESCRIPTION OF SHIPMENT:	
Country of origin of the metal scrap: Names, addresses and telephones of the buyer (recipient) and other data:	
Origin of the metal scrap - names, addresses and telephones of the buyer (recipient) and other available data:	
Amount and labelling of the shipment of the metal scrap in according with the documentation and visible content (pipes, valves, large-scale details, metal vessels or plates, iron sheet, cables or other goods):	
Means of transport (plate number of car, ship, truck, container, rail-may, etc.), names, addresses and telephones of the carrier or other available details:	
PRELIMINARY DATA OF THE RADIATION MEASUREMENTS:	
Dose rate (average values) in $\mu\text{Sv/h}$, measured in contact with the shipment of the metal scrap and at distance 1 m around the shipment:	
Naturally occurring background radiation value in the area, in $\mu\text{Sv/h}$:	
Place of the load with detected increased dose rate value, measured in contact to the outer surface of the metal scrap load or car, wagon, hold (specify the exact place with increased radiation levels):	
Maximum measured value of the dose rate in contact with the outer surface of the load or car, wagon, hold in $\mu\text{Sv/h}$ (specify the exact place of the values):	
Maximum dose rate measured in driver's cab - in $\mu\text{Sv/h}$:	



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2. Information for found radioactive source or material in metal scrap and for undertaken first measure for liquidation of the incident

UNDERTAKEN ACTION IN CASE OF FOUND RADIOACTIVE SOURCE OR MATERIAL IN METAL SCRAP (circle the right answer):		
Unloading and segregation from the rest of the load the part of the metal scrap with supposed radioactive source	Yes	No
Identification of the radioactive source or material in the unloaded metal scrap	Yes	No
Providing measures for radiation protection and fulfilling the instructions given by NRA, GDCPNS and MH during the implementation above mentioned measures	Yes	No
Providing temporary safety storage of found radioactive source or material on the site (list the performed activities: access control, use of protection shields, protection containers or packages, plastic coated, etc.)	Yes	No
Involving outside organizations and experts for assistance for liquidation of the incidents (list specificity)		
DATA OF FOUND RADIOACTIVE SOURCE OR MATERIAL:		
Description of the source or material based on visual signals (outward form, container, package or article with or without radioactive trefoil sign and labels, other special features):		
Photos of the source or material:	Yes	No
Approximate size and mass, quantities and numbers of radioactive sources or materials found:		
Physical condition of the radioactive source (untouched, damaged, corrosive, shielded/packaged sources or source without container):		
Type of the material (lead, steel, cast iron, ceramics, brass, aluminium, copper, iron or other impurity):	Yes	No
Description and photos of the existing labels and signs on the found radioactive source or material:		
RESULTS FROM THE PERFORMED MEASUREMENTS:		
Dose rate measured at the surface of found radioactive source or material:	μSv/h	
Dose rate measured at 1 m distance from found radioactive source or material:	μSv/h	
Measured surface beta/gamma contamination of the radioactive source or material:	Bq/cm²	
Measured surface alpha contamination of the radioactive source or material:	Bq/cm²	
Identified radionuclides in the found radioactive sources or material (through gamma spectrometric analysis):		
Total specific activity of the radioactive material by which the radioactive source or material compounds:	Bq Bq/g	



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3. Information about the incident with found radioactive sources in final products, premises, technological equipment or generated refuses in the metal scrap yards

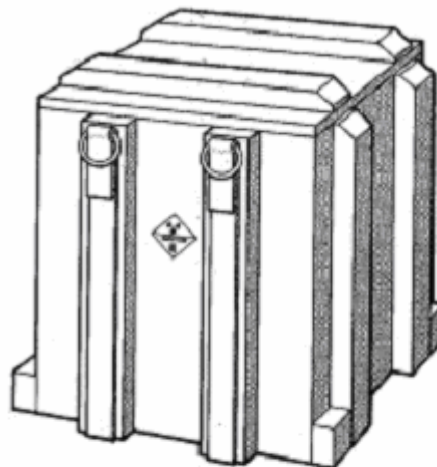
DATA AND TIME OF INCIDENT:		
TYPE OF THE MEASUREMENT EQUIPMENT AND PLACE OF MEASUREMENTS:		
Place of measurement and type of survey:		
Company name and person performed the measurement:		
Address:		
Telephone:		
Fax:		
E-mail:		
DATA ON THE INCIDENT AND PERFORMED ACTIVITIES FOR LIQUIDATION OF THE CONSEQUENCES:		
Brief description of the event (when, where and how is detected, type of used instrumentation, and obtained radiological results):		
Type, quantity and other data for the final products, contaminated with radioactive substances:		
Results from the performed measurements for evaluation of the radiation situation on the site where the is detected radiation contamination or production refuses after the scrap has been processed:		
Isolation of the contaminated lots, partial all fully shutdown of the production process until clarify the causes and liquidation the consequences from the incident (list in details):	Yes	No
Isolation of the products and materials on the site for which is determined that are radioactively contaminated (describe the place and the method for their storage):	Yes	No
Assistance for external organizations and experts for clarification of the incident circumstances (describe the date and time of notification and the time of beginning of actions):	Yes	No



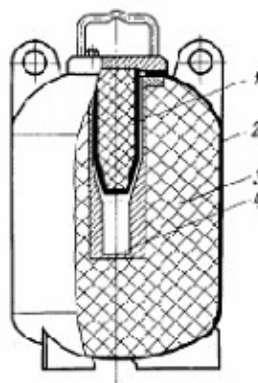
**ANNEX 4 – GENERAL OUTLOOK (PHOTOS) OF DIFFERENT TYPE
OF CONTAINERS FOR RADIOACTIVE SOURCES**



Lead container

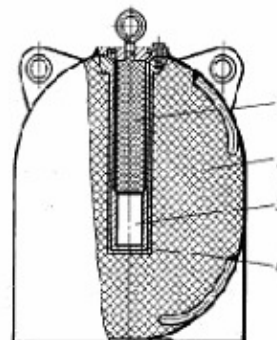


Wooden chest



KIZ-1000

**KIZ-1500 and
KIZ 500**



General view of containers type KIZ



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Transport container type "GAMMARID"



GAMMARID-25



GAMMARID-23



STAPEL-5M



TC type KIZ-5M



TC type KIZ-3M



TC type KIZ-12



**Small lead
container type R-10**



**Transport package
type R (can type)**



Transport kit



TC type KIZ-34



TC type KL-65

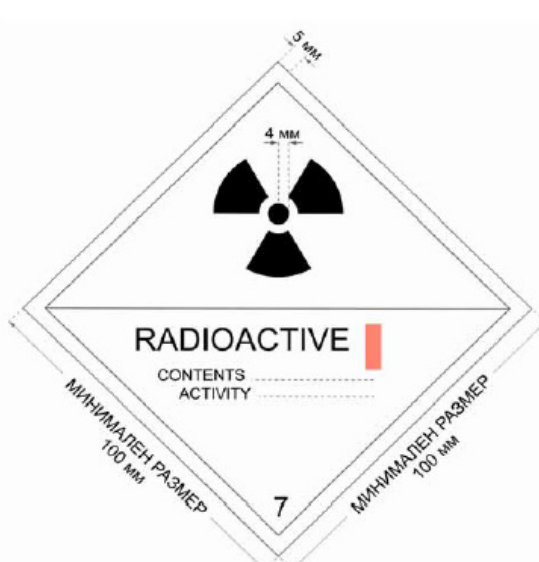


TC type KIZ-50M

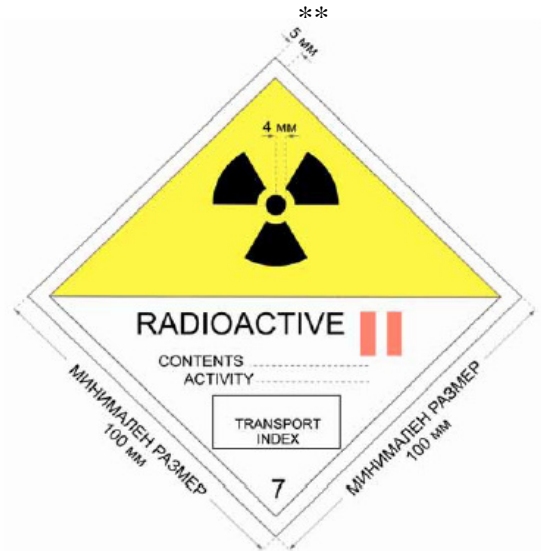


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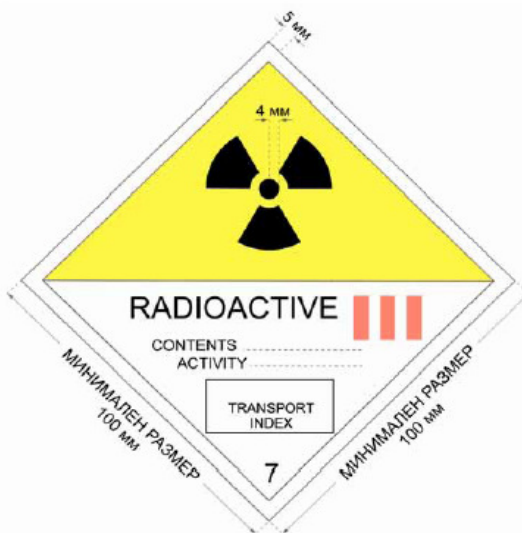
ANNEX 5 - STANDARD SHAPE (PHOTOS) OF RADIOACTIVE SIGNS USED FOR LABELING OF RADIOACTIVE SOURCES AND THEIR PROTECTION PACKAGES DURING TRANSPORT, STORAGE AND USE



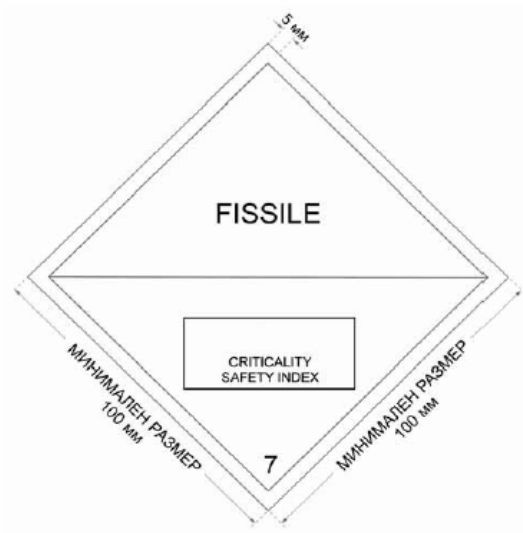
$Pd^* \leq 0,005 \text{ mSv/h}$
 $TI^* = 0$



$0,005 \text{ mSv/h} < Pd \leq 0,5 \text{ mSv/h}$
 $0 < TI \leq 1$



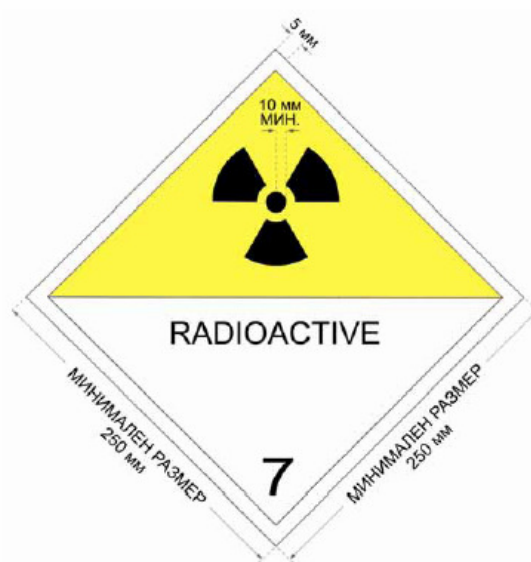
$0,5 \text{ mSv/h} < Pd \leq 2 \text{ mSv/h}$
 $1 < TI \leq 10$



* Pd – dose rate; **TI – transport index



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Precautionary sign for radiation risk used for labeling the transport packages of radioactive loads (dangerous load class 7, according to the international classification)



Example of the sign for UN number during transportation of radioactive sources and materials

** ← 250 mm → minimal size



ANNEX 6 - GENERAL INFORMATION AND PHOTOS ON THE MOSTLY USED HEND-HELD DETECTORS AND STATIONARY DEVICES FOR RADIATION MEASUREMENTS

The radiation monitoring of radioactive materials at the borders check points and reprocessing companies can be performed by several different types of equipment. The most common are:

- **Personal Radiation Detectors (PRD).** This is a radiation detector approximately the size of a pager (poked size). Mainly the staff performing border control uses the devise. The devise can provide a flashing light, tone, vibration or a digit display that correspond to the level of radiation present. The dosimeters can vary in size and shapes. Information on the sensitivity of the devise for different dose rates as well as other characteristics can be obtained from the manufacturing specifications.



- **Hand-held Survey for Radiation Monitoring.** These are radiation detectors used to identify the location of radioactive source or material and they are more sensitively than the personal radiation detectors. They can provide an alarm and digit display to the dose rate, as well as accumulated dose. Disadvantages of these types of devises are that they are less sensitive than the devices for detection of surface contamination and may not efficiently detect some types of contaminations.



- **Radiation Portal Monitor (RPM).** The exanimate objects pass trough the portal detector typically consisting of two pillars containing radiation detectors and monitored from a display panel. The detector can provide alarming capability to indicate the presence of radioactive source or material if the dose rate is above the preset limit. These devises are equipped with neutron counters also.



- **Radiation Isotope Identification Devises – spectrometer type (RIID).** This is a detector for radiation who can analyse the energy spectrum of the radiation form by the radioactive source or material. Based on these the device can provide information of the radionuclides isotopes. They can be used as survey instruments to locate the radioactive source or material..

