Emergency response during the radiological control of scraps in Cuba

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Abstract. In the last few years, in the international scene, incidents have been reported due to the presence of radioactive materials in the scrap. This reality has motivated the adoption of measures of radiological security, due to the implications that these incidents have for the public and the environment, as well as for the international trade. Among theses actions is the implementation of the radiological control of scrap, with the additional requirement that this control has to be implemented in the framework of a Quality Management Program.

Taking into account the international experience, our institution designed and organized in 2002 a national service for the radialogical monitoring of scrap, being the clients the main exporting and trading enterprises of this material in the country. During these years, several contaminated materials have been detected, causing incidents that activated the radiological emergency response system.

In this sense, since some years ago, our country has been working in the implementation of a national and ministerial system for facing and mitigating the consequences of accidental radiological situations, conjugating efforts and wills from different national institutions with the leadership of the Center of Radiation Protection and Hygiene (CPHR) and the Center of Nuclear Security (CNSN) in correspondence with the social responsibility assigned to the them.

These incidents propitiate to have not only a system of capacity and quick response oriented to limit the exposure of people, to control the sources, to mitigate the consequences of the accident and to reestablish the conditions of normality, but also a previous adequate planning that guarantees the speed and effectiveness of it.

In these work the experiences reached by the specialists of the CPHR from Cuba during the occurrence of an incident in the execution of the service of radiological monitoring of scraps are exposed.

KEYWORDS: Radiological emergency, scrap, adiological environmental surveillance, public exposures.

1. Introduction

The " International Basic Norms of Security for the Protection against the Ionizing Radiations and for the Security of Radioactive Sources "sponsored among other by OIEA, OMS and OPS international organisms, promote the creation of a response infrastructure in radiological emergencies, to face the accidental diverse scenarios that can occur. While on the other hand the international experience related with radiological accidental events during the processing and commercialization of recycled metals, advises to have a radiological surveillance system of these processes to prevent them and response capacities to radiological emergencies when these occur.

In the country a wide processing and commercialization program of metallic scrap exist, this process is subjected to an established program of radiological surveillance since some years ago, with the purpose of avoiding radiological accidental situations. This system has allowed the radioactivity detection in the processed scrap, due to radioactive contamination of natural or artificial origin.

The characteristics of these accidental scenarios and the circumstances of their occurrence determine the magnitude and severity of their consequences, on the human health and the environment, being created

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in occasions situations of radiological emergency, where a rapid response oriented to control the created situation and at least to minimize their consequences is imposed.

To achieve satisfactory results in these accidental situations, it is necessary to have an appropriate planning and organizational structure that guarante the speed and effectiveness of the actions, reasons that motivate to present our experience in such circumstances.

2. Methodologies

In the planning and organization for the responses in situations of Radiological Emergency, it has been taking into account the recommendations of internationals organisms and the national own experience, using as basis the methodology indicated in the technical document IAEA. TECDOC - 953 [1-4], carrying out the pertinent adaptations to the conditions of the country. The structure of the response to radiological emergencies is based on legal and technical criterias.

During these years the response infrastructure to radiological emergency has been in constant improvement and invigoration, in such way that every time is more effective the preparation and answer of its components. During this process they have been defined approaches and essential levels for the preparation and organization of the response to radiological emergency, in correspondence with the accidental different scenarios identified in the country.

Chart 1: Organization and preparation of the response to radiological emergencies.

Organizational levels	Organization criteria and preparation for the response
To the instance of institution user of nuclear technical	Through the internal emergency plan that contains the possible accidental scenarios, consequences and main measures to execute for their own structures of response to emergencies
To the instance of the regulatory authority and of its institution of technical support	Through the emergency plan that contains the most outstanding possible accidental scenarios of the national environment, the consequences and main measures to execute for their infrastructure of high technical level for the fast and effective intervention in situations of radiological emergencies in the whole country
To the instance of other intervener institutions	Through the insertion of the attention to radiological accidental events in the system and national plan designated for the attention to situations of catastrophes, organized and directed by the Central Administration of the State through the Civil Defense with the participation of all the government's instances, ministries and organizations of the country.

Regarding the preparations for the response to radiological emergencies during the elaboration of the national plan and its insertion in the national system against catastrophes, the performances to be followed for the potential accidental scenarios of more severity taking into account impact and magnitude of the required intervention were planned, inside our territorial environment and jurisdictional waters as well as for transborder effects of accidents occurred in neighboring territories.

This plan has as purpose the establishment of a national coordinated and interinstitucional capacity for the management of the radiological emergency, capable of acting with immediacy and organization in function of the protection of people, the goods, the economy and the environment [4].

As well as the implementation of qualification actions and training of human resources and identification of material resources to make in front of a radiological emergency.

In the elaboration of the national plan of radiological emergency, the most current international recommendations in the matter and the interrelation of the same one with other plans were considered.

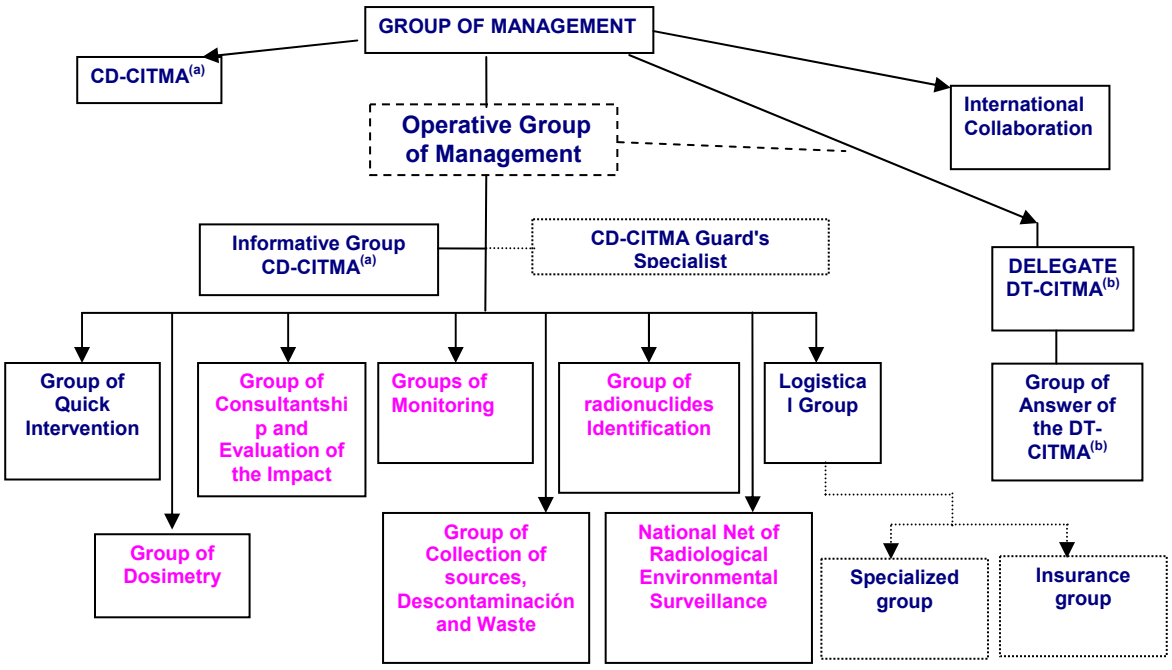
The National structure of Response to Radiological Emergencies is designed based on the integration of efforts, wills and capacities of all the government entities linked to the response to radiological emergencies, with a clear definition of their functions and coordinated by the entity nationally responsible with the coordination of the response to disasters in general. The current structure of response to radiological emergencies is shown in chart 2,

Chart 2: It structures current of response to radiological emergencies.

Intervention groups	Funciones	Infrastructur
Collection of sources, decontamination and radioactive waste.	Recuperation, management and protection of the sources, consultant ship for transport and storage of the sources, carry out tasks of environmental decontamination, collection of radioactive waste.	Qualified humans' recourses installation for the acondicionamiento and temporary storage of the radioactive waste.
Medical-Dosimetric.	Evaluation of medical consequences, diagnosis and medical treatment, to recommend actions for the decontamination and prevention of exposures to radiation of people, to coordinate the transfer of patient to specialized centers, dose evaluation received person using techniques of external, internal and biological dosimetry.	Qualified humans recourses, secondary laboratory of dosimetriccalibration , laboratory of occupational dosimetry for the determination of the doses of external irradiation, laboratory with full-length accountant for the determination of the dose for internal contamination with radionuclide, laboratory of biological dosimetry, medical care center in radiological accidents.
Assesory and evaluation of impact.	To collect and to validate information, calculations of people's dose and critical groups, to model, to calculate and to evaluate the radiological consequences., to recommend the strategies for measurements and protectives actions , activation of answer groups.	Qualified humans recourses, computer and computation programs, national net of radiological environmental surveillance for the detection of the immediate impact of an accident with transborder effect and also allows a quick evaluation of the radiological situation and to give a space pursuit and timely of the contamination.
Identification of radionuclides.	Identification and determination of radionuclides.	Qualified human's recourses, laboratory for the determination of the radionuclide concentration in environmental samples.
Radiological Monitoring	To detect and to locate polluted areas and lost sources, monitoring of dose rate and collection of environmental samples.	Qualified human's recourses, dosimetric equipment.

The technical fundamental elements of the answer to the emergencies are concentrated on the Ministry of Science Technology and Environment (CITMA) that has qualified human resources and technical infrastructure, as is shown following.

Figure 1: Structural organization of the Ministry of Science Technology and Environment (CITMA) for Answering to Radiological Emergencies.



(a) CD-CITMA: Council of Address Ministry of Science Technology and Environment.
(b) DT-CITMA: Territorial address of the Ministry of Science Technology and Environment.

2.2 Definition of accidental scenarios

The definition of potentials the radiological accidental scenarios of more severity for the country were elaborated starting from the methodology outlined in the technical document [1-3], with the corresponding adjustments to the national experience, in this process the following scenarios were identified:

- complex accidents in facilities that manipulate sources and/or radioactive materials.
- transport accident in which radioactive materials intervene.
- loss, robbery or decontrols of a radioactive source that finishes in the public medium; contamination and/or found radioactive source.
- transborder liberation of radioactive material in nuclear power plants near to the national territory that can provoke radioactive contamination of the land and jurisdictional waters.
- contamination of marine jurisdictional waters provoked by ships that transport or use nuclear material.
- impact on the national territory and the jurisdictional waters of space satellites of nuclear power.
- nuclear accident or radiological emergency outside of the country that can affect Cuban personnel that offers service in the area affected by the event.
- bitchy activities, criminal acts or of terrorism that involve radioactive and nuclear materials.
- importation of foods, materials and contaminated consumption products from countries that have been affected and where a nuclear or radiological accident has occurred.
- contamination of consumption water or foods as a consequence of accidental or deliberate events.

Additionally for each one of these potential scenarios they were established the bases for their planning and organization of the answer actions, in agreement with their consequences.

2.3 Description of accidental event

The country by means of the system of radiological control of the export processes, import and derived scrap prosecution of the recycled industry of metals, carries out the monitoring of scrap in the following circumstances [2].

- Scrap collected in trucks,
- Scrap collected in open and closed spaces,
- Scrap collected to bulk for ship.
- Scrap collected in containers,

During the execution of this service, several radiological incidents have occurred, associated to the discovery of radioactivity presence.

Chart 3: Examples of incidents happened during the execution of the Service of Measurement of Radioactivity in Scraps.

No.	Identification of the detected material
1-	Is detected a polluted device (River 3) that contains a source of Strontium-90 that is used to measure the grade of freezing of the wings of the airplanes.
2-	Watches and luminescent gauges that contain painting of Radio-226.
3-	Smoke detectors that contain sources of Americio-241.
4-	Retortas of foundry with residuals of refractory bricks.
5-	Stainless steel pipes that contain Radio-226.
6-	Source container used in Industrial Gammagrafía that contains Impoverished Uranium.

Among these incidents is the one happened, when it was detected during the process of radiological surveillance of the scrap a container with radioactive contamination that had arrived to the country loaded with powdered milk (**Figure 1**). This event classifies inside the bases of planning of the national plan as a scenario in there is decontrols of a radioactive source that finishes in the public medium creating contamination or as the importation of polluted foods, without discarding a bitchy action.

Figure 1: Container detected with radioactive contamination

During the process of evaluation of the created situation it was found an identification that indicated that this container had transported a dangerous substance (**Figure 2**).

Figure 2: Identification of the container

In correspondence with the actions defined in the national plan of radiological emergencies, for these circumstances, the corresponding authorities were notified and activated the answer groups.

It is notified to the National Center of Nuclear Security and Ministry of Health in their character of regulator's organizations regarding radiological security and of sanitary control of foods, respectively. The situation was also communicated to the Civil Defense as coordinator of the answer before disasters, the authorities of the Ministry of the Interior for carrying out the corresponding investigations and to the importer company of the container to specify details on the transported goods.

On the other hand the technical groups of the Center of Protection and Hygiene of the Radiations related with the organization of the radiological emergency response, the radiological environmental surveillance, the monitoring and the radionuclides identification were activated.

Among other actions there were executed in situ measurements of the container, the gathering of remnants of milk, for their later analysis in the laboratory of environmenta radiological surveillance and the realization of the radiological monitoring of the area where the container was located. Measures were guided on the part of the corresponding authorities of not to distribute the stored milk and to begin the radiological control of samples.

3. Results of the actions

The mensurements carried out during the monitoring of the container detected contamination in the of it and in remnants of powdered milk. The radionucleidos found in the metallic bottom of the container and in its wooden base were Ra-226 and Th-232 in the solid waste.

Chart 4: Activity values obtained from the measurements carried in the laboratory of gamma spectrometry:

Samples of Ashy Wood		
Identification of the sample	Th-232 (KBq/Kg)	Ra-226 (KBq/Kg)
M-1 Wood	18.4 ± 0.5	----
M-2	25.1 ± 1.3	21.8 ± 0.9
M-3	31.4 ± 1.5	27.9 ± 0.9
M-4	39.4 ± 0.8	0.93 ± 0.2
Samples of powdered milk		
Identification of the sample	Th-232 (Bq/Kg)	Ra-226 (Bq/Kg)
M-1	<16.9	< 112.9
M-2	< 17.7	< 86.0

The radiological monitoring of the area where it was located the metallic floor and polluted woods, allowed the obtention of values in the range 8,7 - 12,3 cps. The measurements inside the container were of 9 cps.

Later it was executed the decontaminations of the polluted parts using the vacuum cleaner and with humid rubs. After this it was carried out a new measure, getting finally equivalent values of environmental radioactive background. The actions were concluded after having verified the results by the regulatory authority in charge of nuclear security.

4. Derived teachings of the event

The radiological event allowed implementing in the practice the measures of planning and answer defined previously for these accidental scenarios [1-3]. Being adopted the correctives measures for the continue improvement of the answer and the precision of the responsibilities of the different authorities and involved organizations.

On the other hand this event allowed checking the operability of the plans of emergencies in these situations, as well as the capacity of the human resources and the availability of material resources necessary for the answer.

In the retrospective evaluation of the acquired experiences of the radiological incident, irregularities were identified in the decision of actions to face these anomalies that were considered as negative aspects, among these are:

- Non definitions and inadequacies in the action plans that should assume the sanitary and importing of foods authorities before these accidental scenarios with presence of polluted foods, demonstrating the necessity to revise and to homogenize approaches in the plans to different instances.

- Coordination flaws existed in the articulation and activation of the answer.

- National regulations don't exist for the definition of permissible levels of consumption of polluted foods with natural radionuclide.

- The radiological emergencies should not be treated in an isolated way but as a unique system able to offer a harmonic and coherent answer.

- It was demonstrated also the lack of culture regarding radiological security and an inadequate perception of the risk for the people.

5. Conclusions

The risk of radiological accident is never null, for what all the actions that we make to prevent them will always be necessary, for what we should assume a critical and reflexive attitude for the planning and evaluation of the answer before situations of radiological emergencies.

The radiological described event has demonstrating the convenience of having systems of radioactivity monitored in scraps. Additionally it is convenient to have capacities for the answer to radiological emergencies that respond with effectiveness to the accidental scenarios postulated in the process of planning.

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