Experiences in the Field of Radioactive Materials Seizures in the Czech Republic – 14147

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ABSTRACT

In the recent past the amount of radioactive materials seizures (captured radioactive materials) has been rising. It was above all due to newly installed detection facilities that were able to check metallic scrap during its collection in scrap yards or on the entrance to iron-mills, checking municipal waste upon entrance to municipal disposal sites, even incineration plants, or through checking vehicles going through the borders of the Czech Republic. Most cases bore a relationship to secondary raw materials or they were connected to the application of machines and installations made from contaminated metallic materials. However, in accordance to our experience, the number of cases of seizures of materials and devices containing radioactive sources used in the public domain was lower, but not negligible, in the municipal storage yards or incineration plants.

Atomic Act No. 18/1997 Coll. will apply to everybody who provides activities leading to exposure, mandatory assurance as high radiation safety as risk of the endangering of life, personal health and environment is as low as reasonably achievable in according to social and economic aspects. Hence, attention on the examination of all cases of the radioactive material seizure based on detection facilities alarm or reasonably grounds suspicion arising from the other information is important.

Therefore, a service carried out by group of workers who ensure assessment of captured radioactive materials and eventual retrieval of radioactive sources from the municipal waste has come into existence in the ÚJV Řež, a. s. This service has covered also transport, storage, processing and disposal of found radioactive sources. This service has arisen especially for municipal disposal sites, but later on even other companies took advantage of this service - incineration plants, regulatory body like the State Office for Nuclear Safety, etc.

Two years ago orphan source on children playground at the Prague city was found. It was an ancient therapeutic needle containing 226Ra. Dose rates in the source vicinity were increased, but no health acutely hazardous. Source was removed, transported, characterized and stored for further possible use or disposal.

Our many years' experience in the field of ensuring assessment of captured radioactive materials and eventual retrieval of radioactive sources and more information about seized radium needle will be presented in the paper.

INTRODUCTION

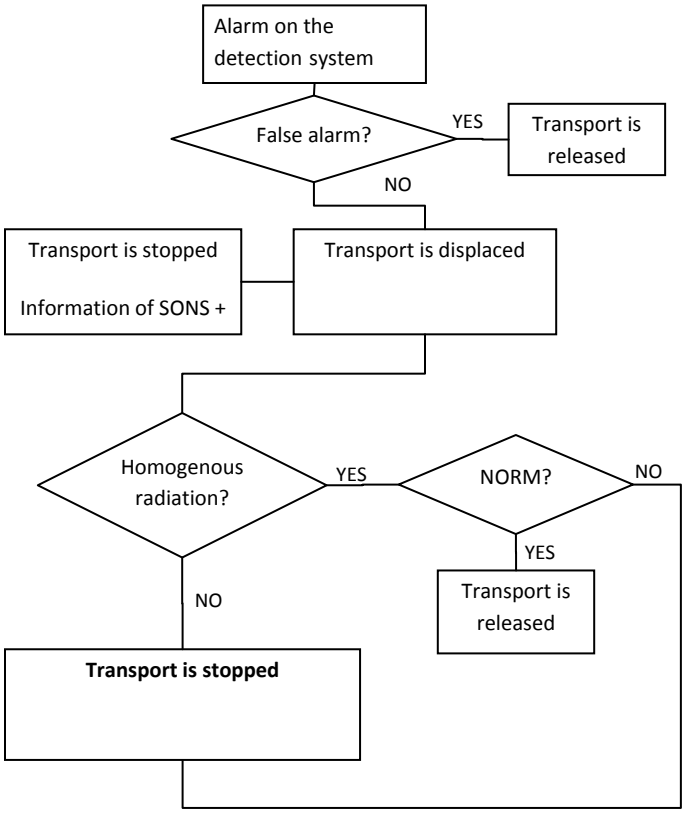
Radioactive materials are used in a wide area of human activities (industry, research, hospitals, nuclear energy, etc.). Sometimes, due to malfunction or unqualified manipulation radioactive source can be lost and released to the environment. For example, a person, who therefore can be hazardously irradiated, can find such source.
Radioactive materials were, more or less, accidentally discovered in the past. Since the middle of the 1990s, the first organizations (metallic scrap yards, iron-mills and similar) were equipped with portable or stationary detection systems in order to avoid production of contaminated

materials, which can lead to a loss of commercial credit and thereby losing a part of the market. Later on, needs of avoiding the illicit traffic of radioactive material have arisen from the legislation and terrorist hazard reasons. Based on previously gained experience on the amount of realized seizures, more organizations were gradually equipped with detection systems (Czech border crossings, municipal landfills, refuse incineration plant, etc.). Nowadays even international airports are equipped too.
At the beginning, the radioactive material seizures were solved by state organizations such as the State Office for Nuclear Safety (SONS) and its regional offices, or the State Institute for Radiation Safety (SIRS) and later on supplemented by even private organizations. Indeed, private organizations provide solving a seizure in cooperation with the SONS and the Police of the Czech Republic, which mostly solves retrieving the radioactive material originator. The UJV Řež, a. s. (UJV) is one of the private companies which can provide complete service from event classification through radioactive material recovering, transport, storage, processing to disposal.

General procedure for radioactive material seizure

The State Office for Nuclear Safety (SONS) published the document “Procedure for radioactive material seizure” in 2002, where the general procedure for radioactive material seizure is described. The main keynote is clearly shown in diagram 1.

Diagram 1: General procedure for radioactive material seizure



System of seizure assurance

The system of radioactive material seizure assurance consists of the following parts:

1. seizure by portable or stationary detection system
2. 24 hours emergency service of the working group
3. event classification, detailed counting a tracking of radioactive source
4. transport of recovered radioactive materials to UJV for storage
5. radioactive source characterization
6. seizure evaluation and protocol providing
7. State Office for Nuclear Safety (further SONS) decree about next procedure

The stationary detection system (detection gate) is usually installed at the entrance to dumps area, metallurgical plants, iron works etc. The detection gate traces changes of vehicle dose rate comparing to the average background by vehicle measurement. If the vehicle dose rate is significantly higher than the average background (usual alarm level is 10-30% above background), the vehicle is held by the gate operator and put aside to a pre-determined place. Seizure is announced to the police of the Czech Republic and to the SONS.
24-hour emergency service is provided by SONS, the police and also by some private companies. One of the private companies with 24-hour emergency service is UJV, which held the emergency service for the purpose of an internal emergency plan in UJV. The working group is involved in the part of emergency services focused on the accident during radionuclide source transportation. It consists of the workers, which have a license for the special professional competence of selected personnel working with sources of ionizing radiation in accordance with section 9 of the Act No. 18/1997 Coll. Departures for the seizure are provided firstly during working hours; only in exceptional cases (vehicle dose rate exceeding 10 uSv/h) departures for the seizure are provided 24 hours a day. Two workers usually provide the departure after phone call activation.
The working group obtains a maximum amount of information about the seized material (measured dose rate values on the detection gate, type of the transported material, etc.) from the contact person after activation. Based on this information the working group does with requested measuring equipment and the requested amount of workers. The working group provides in-situ radiation situation measurement, event classification and if necessary defines safety (dose rate level above 10 uSv/hour) and if needed, dangerous zones (dose rate level above 1mSv/hour). The working group decides whether the vehicle can be released to continue its transportation or to provide detailed counting for tracking a radioactive source on the basis of all collected dates. The found source is transported to UJV for storage, processing and disposal. The UJV provides characterization and a description of the seized source. All this collected information is applied to produce seizure protocol, which is sent to SONS.
After that, SONS decrees about the following procedure with the recovered radioactive material (for example, process it as a radioactive waste and dispose it).
Annual number of seizures since 1997 is shown at fig. 1-2.

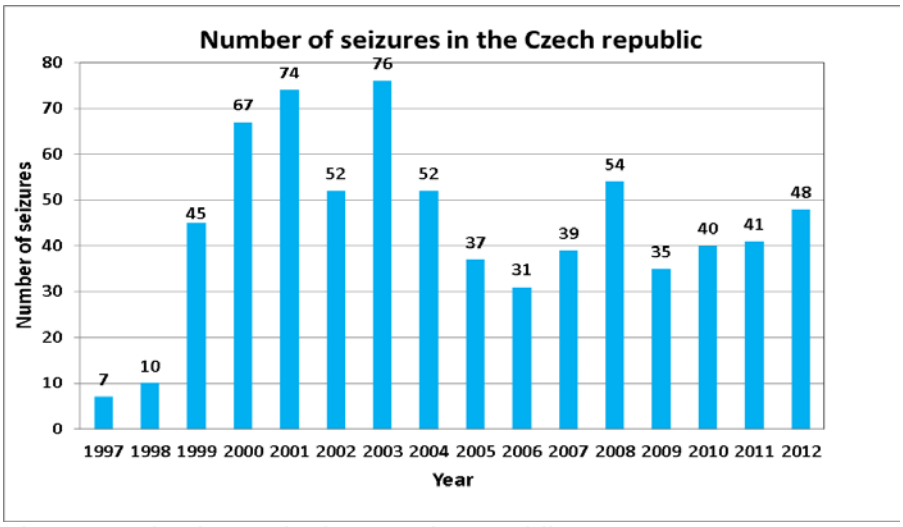


Fig. 1: Total seizures in the Czech Republic

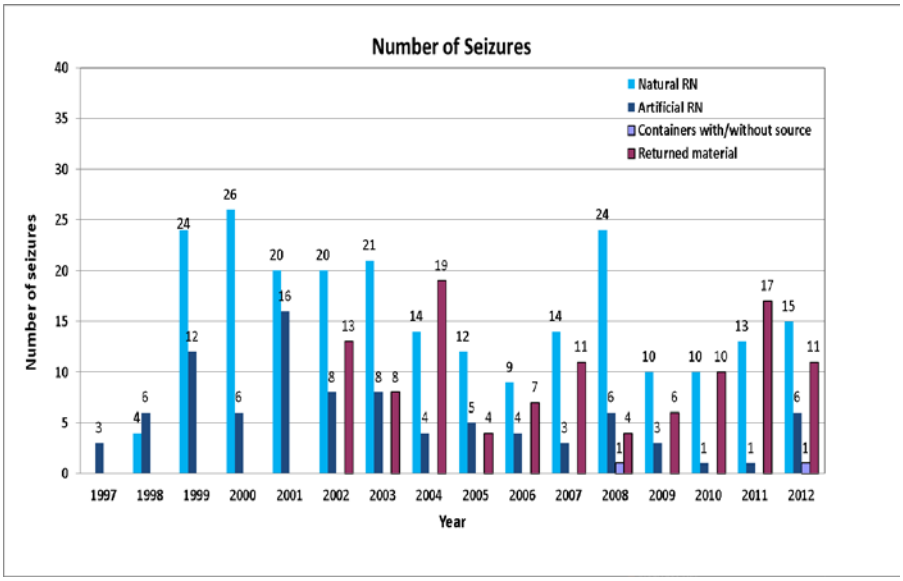


Fig. 2: Composition of seizures in the Czech Republic

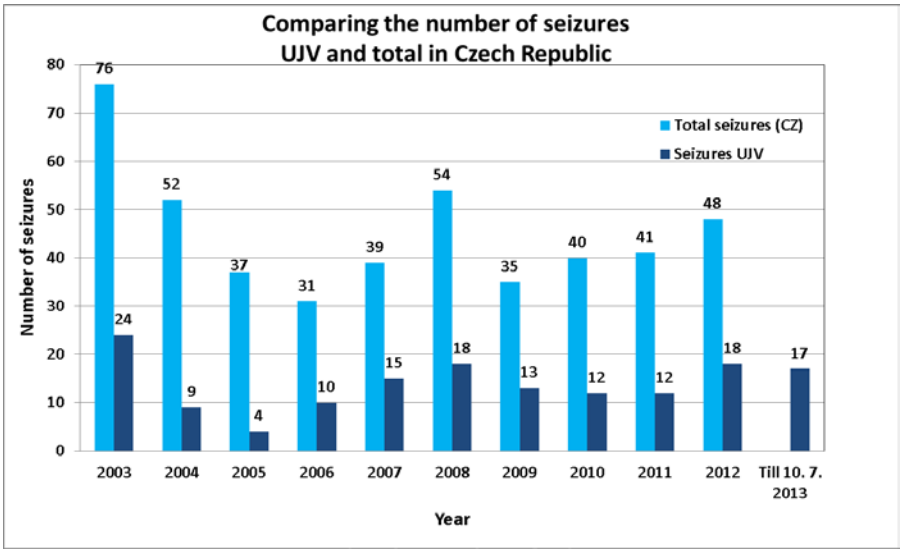


Fig. 3: Comparing seizures managed by UJV to total number of seizures in the Czech Republic

Experiences in seizure assurance

The service was established for municipal waste dump in Prague in 2003, where stationary detection equipment was installed at that time. More than 150 departures have been realized by UJV since 2003, from which 83 cases were natural occurring radioactive material like structural rubble, sand etc. (viz. fig. 3). In the rest of the cases, radionuclide sources were found.
Typical examples of the seized radionuclide sources are: military devices contained ^{226}Ra and miscellaneous minerals from personal collections, fire detectors with ^{226}Ra and ^{241}Am, medical materials contaminated by artificial short-lived radionuclides like ^{131}I, ^{99m}Tc, etc.
In 2011 an orphan source on public place was found. It was very sensitive affair broadcasted on TV. On 2011.9.28 in the evening, a citizen informed police of the Czech Republic that increased radioactivity is located in front of entering the playground in the Prague city. The integrated emergency system began its work and all necessary component of the emergency system of the Czech Republic was activated. The increase in radioactivity was confirmed. The current measurements showed value of the dose rate at the elevated radioactivity ranged from 0.5-1 mSv/h just above the ground. These values , however, can be measured only in a small located area and with distance from that point values drop significantly and are at a level that does not compromise human health. The place was closed and guarded by police.
Next day, after team preparation, the source was located and removed. The source was a very small cylinder containing emitter ^{226}Ra, probably Ra-needle used for radiotherapy in the past. Surface dose-rate was measured 150 mSv/h and dose-rate at 1m distance was 150 uSv/h. Activity of ^{226}Ra was 9,75 GBq.
Using gained data, very conservative scenarios to estimation citizens personal exposure was used – an assumption that someone spent about 1 hour a day throughout the year (including winter - which is unlikely, but corresponds exactly to conservatism) at the nearest suitable place - which was a bench near the place of discovery - the dose was calculated about 3.5 mSv per year - which is basically the dose received from natural background during a year. The event was solved fast and safely because the integrated emergency system in the Czech Republic is well prepared.


Fig. 4: Location of higher dose-rate in front of entering the playground in the Prague city and process of source removing

Fig. 5: Size of removed source and how it looks like before and after cleaning

Conclusions

Our experience shows that stationary detection systems at the entrance to the waste or scrap organizations are reasonable (150 seizures during 10 years). Since the beginning the rate of seizures was going down. It could be due to many reasons. One of the reasons could be the transportation of the risk materials to organization without stationary detection systems. Therefore, the main conclusion is a recommendation to equip all risk organizations (metallic scrap yards, iron-mills, border crossings, municipal landfills, refuse incineration plant, etc.) by stationary detection systems to avoid illicit traffic of radioactive materials and/or orphan source movement.

Fig. 6: Example of a seized military device

Fig. 7: Example of seized metallic scrap

Fig. 8: Example of a drum with ionizing fire detector seized in the scrap yard

Fig. 9: Example of the structural rubble contained naturally occurred radionuclides which is usually released

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