EQUIPMENT OF HIGH SENSITIVITY TO DETECT SMUGGLED RADIOACTIVE MATERIALS TRANSPORTED ACROSS THE "EAST-WEST" BORDER

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Abstract

An equipment specially developed for the customs radiation control is described. Its sensitivity is higher than requirements of western countries. The equipment ensures an alarm when a radioactive source (both shielded or not) is found in the controlled area, localizes and identifies the source detected, and provides the radiation protection of customs personnel. Most of devices have a non-volatile memory where the radiation situation history is stored and then transferred to PC. The equipment may be used by personnel of special services for secret detection of radioactive materials. Some Belarussian and Russian documents specifying measures to prevent an unauthorized transportation of radioactive materials are discussed.

1. INTRODUCTION

The CIS western border is the western border of the Republic of Belarus and a demarcation line between "East" and "West". The Republic of Belarus is a "non- nuclear" state, has no enterprises of nuclear industry, does not produce radioactive and nuclear materials. So, a control of these materials is caused to a considerable extent by their transportation through the state and across state borders. It should be noted that the western border of Belarus (adjoining the Ukraine, Poland and the Baltic states) is also the border of the customs Union that includes the Russian Federation, Belarus, Kazakhstan and Kirghizstan. Mining and production of radioactive and nuclear materials (including special nuclear materials) are mainly concentrated within the territories of the said countries. Some part of these materials may be transported (illicitly as well ) to the West along the shortest way - across the Belarus borders and through its territory. Many cases of such a smuggled transportation are known.

Furthermore, a considerable part of the Belarus territory (about 20%) suffered the Chernobyl NPP accident. There are many evacuation zones in some radionuclide-contaminated regions where living is prohibited. However, there are numerous sites where conventionally radioactive and low radioactive wastes are buried. So, there is a danger of an unauthorized import of various radioactive wastes from neighbouring countries and their burial in these areas. On the other hand, numerous cases of export of substances, things, foods, etc. from contaminated areas outside Belarus are known.

Various countries have different state institutions that are responsible for the control of unauthorized transportation of radioactive materials. The State Customs Committee is such an institution in the Republic of Belarus. So, a great attention is centered on the Customs Control of transportation of Radioactive Materials (CCRM).

As early as in 1994, at the IAEA symposium a participant from Belarus was one of the first experts who arose a problem of CCRM realization using special equipment [1]. In the same year, Belarus was the first country in the CIS that installed fixed radiation monitors at the Belarus-Poland cross border point.
At present, about 20 similar monitors are installed - mainly at the "East-West" border. In 1998, a state programme has been elaborated in Belarus to provide all cross border points with CCRM equipment.

2. CONCEPTS OF CCRM REALIZATION

At present, a unique legislative basis was developed for CCRM in the Russian Federation. Russia begun the elaboration its own programme of CCRM within 1995-1996. In 1997, a "Guide for customs control of fissionable and radioactive materials" was elaborated and accepted. Nowadays, customs services are intensively equipped with appropriate devices.

At the beginning of 1998, Belarus as a member of the Customs Union also accepted its own "Principles of the customs control of radioactive substances" that are based on the above Guide. Other members of the Customs Union are going the same way.

Requirements to CCRM are based on the recommendations of IAEA, ICRP and also on the principles stated in "United automated State system of radiation situation control " accepted in Russia in 1996.

The documents of Belarus and the Russian Federation have some distinguishing features as compared to those of the other states. The main features are as follows:

- organization of specialized departments in the customs services: CCRM departments;
- strong regulation of the order of CCRM realization (including export control);
- elaboration of technical requirements to the equipment, including those of minimum detectable masses and activities;
- determination of a recommended list of appropriate devices.

Furthermore, a great attention is paid to the control of an illicit transportation of special nuclear materials. All the above resulted in the much more strict Russian and Belarussian requirements to the parameters of the equipment [2, 3] as compared to, e.g., requirements of the USA Standards [4-6] and the ITRAP programme of IAEA [7]. These may be seen from Table 1.

So, according to the Belarus and Russia documents, CCRM consists of some steps.
1. Initial CCRM. It is mainly carried out by fixed radiation monitors. These monitors operates in automatic mode and should have both the gamma and neutron detectors.
2. Additional CCRM. It involves the localization of sources that were detected by the fixed monitors.
3. Fundamental radiation inspection. It involves the identification of sources under field or laboratory conditions.

The radiation protection of the personnel is provided on each step.

Based on the said documents, the technical requirements to the CCRM equipment were elaborated.

3. EQUIPMENT FOR CCRM

It should be noted that the problem of elaborating the radiation control equipment was successfully solved during the creation of nuclear industry in the developed countries. The equipment is used as component of the physical protection of facilities. The leading world companies produce fixed radiation monitors to control vehicles and pedestrians, various portable devices and personal dosimeters; a number of this equipment may be used to provide customs radiation control.

However, the experience of the Republic of Belarus and the Russian Federation shows that a specialized equipment should be elaborated for CCRM.
Such a specialized equipment is used in Belarus [8]. These devices have a high sensitivity, especially for special nuclear materials, the correlated technical characteristics and can solve tasks as follows:

1. **Alarm** when a radioactive source is found in the controlled area with detection of not only gamma sources but also of special nuclear materials including those in a shield. The PM-5000, PM-5310 radiation monitors with gamma and neutron detectors are used for these purposes. So, the vehicle monitors PM-5000 detect up to 4.2 g of $^{239}\text{Pu}$, 250 g of $^{235}\text{U}$, and also 50 g of shielded $^{239}\text{Pu}$.

2. **Localization** of the source is ensured by the alarming ratemeters and dosemeters PM-1401, PM-1402, PM-1703 (up to 2 g of $^{239}\text{Pu}$ at 1.5 m). It should be noted that these devices may be used for secret detection of radioactive sources by officers of special services.

3. Fast **identification** to determine the type of the source (natural radionuclide, artificial isotope, special nuclear material, etc.), to evaluate the alpha- and beta-contamination of surfaces, to record and store gamma-spectra and searching for neutron sources. The survey meter-spectrometers PM-1501, PM-1402 are used to solve this task.

4. **Radiation protection** of personnel of customs services. A family of personal dosimeters PM-1203, PM-1603, PM-1620 provide this protection. Note that personal dosemeter PM-1620 provides also a protection of customs officers who carry out luggage checking using X-ray equipment.

It should be pointed out that most of devices have a non-volatile memory to store automatically the information about the current events - alarms when detecting sources, background, sharp increase of the dose rate, dose levels, etc. The information stored may be then transferred to PC through the RS-port or IR-interface. These features enable an objective control that is not dependent on mistakes and unauthorized actions of personnel using these devices.

Thus, the Republic of Belarus has both the legislative basis and specialized equipment to provide an effective detection of an unauthorized traffic of radioactive materials. The realization of the State Programme of providing of all cross border points with CCRM equipment will ensure that nuclear smuggling across the "East-West" border will be practically stopped.

It should be pointed out that the same equipment may be used by personnel of special services to prevent unauthorized transportation of radioactive materials across the boundaries of various nuclear facilities, scrap processing plants, nuclear power plants, etc.

4. **REFERENCES**


Table 1.
Minimum detectable amounts of radioactive materials for vehicle radiation monitors

<table>
<thead>
<tr>
<th>Radioactive material (radionuclide)</th>
<th>Equipment used in Russia and Belarus</th>
<th>Requirements of the ITRAP programme</th>
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</thead>
<tbody>
<tr>
<td>$^{137}$Cs, $\mu$Ci</td>
<td>10</td>
<td>270</td>
</tr>
<tr>
<td>$^{239}$Pu in the lead shield</td>
<td>50</td>
<td>300</td>
</tr>
<tr>
<td>$^{239}$Pu, g</td>
<td>4-10</td>
<td>-</td>
</tr>
<tr>
<td>$^{235}$U, g</td>
<td>250-1000</td>
<td>-</td>
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