LABORATORY OPERATION DURING RADIATION EMERGENCY

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Buňata M., Tecl J., Prouza Z.
National Radiation Protection Institute

During radiation emergency, a special operation mode of laboratories of the Radiation Monitoring Network (hereinafter RMN) is expected. The principal factors differing the emergency mode from the normal one are the following:

- significantly higher amount of analyzed samples;
- high activities of the majority of the samples;
- higher risk of personal and equipment contamination;
- higher working and psychological demands on laboratory staff.

The assuring of the radiation protection requirements of laboratory staff has to be the primary objective, nevertheless the risk of equipment contamination and of samples cross-contamination of course have to be as well taken into consideration.

The presentation describes the experience of the RMN Central Laboratory of the National Radiation Protection Institute in Prague (SÚRO) which was obtained during realization of field tests, in which a radioactive matter was released. These tests allow us to evaluate the source term or radioactivity dispersal balance based on various detection methods with the aim to estimate exposure of the afflicted persons. Tests provided to simulate emergency working conditions in Central Laboratory - high number of contaminated samples, which have to be analyzed in a short time (short half-time of used radionuclide - ^{99m}Tc) using sophisticated laboratory techniques (gamma spectrometers, aerosols collectors, ..etc.).

A) EXPERIMENTAL BACKGROUND

Some outdoor experiments simulating the radiation emergency were done. The schema of each experiment was similar:

(1) A network of filters, aerosol samplers etc. were prepared.
(2) High but secure amount of ^{99m}Tc was spread out into the air.
(3) After some time, the samples were collected and transported to the laboratory.

The task of the laboratory was to analyze all the samples as fast (and precisely, of course) as possible.

B) LABORATORY PROCEEDINGS

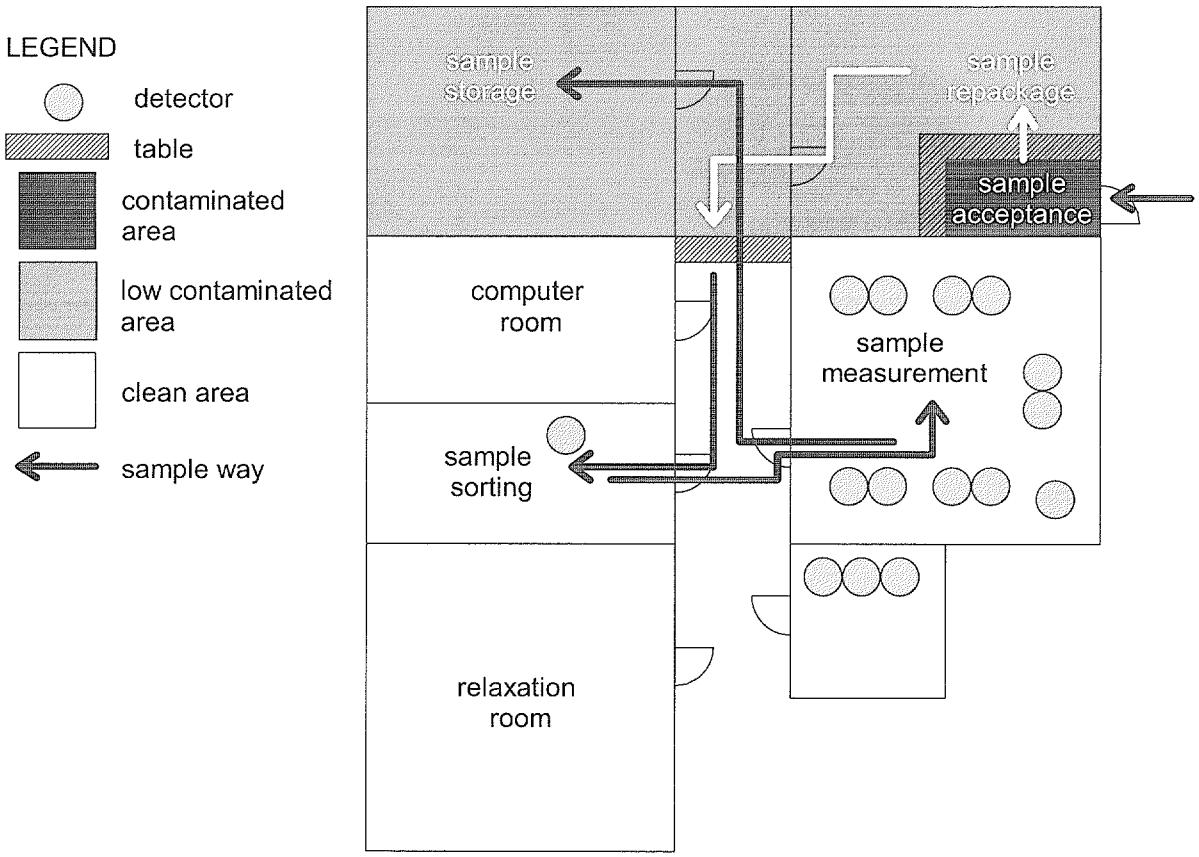
1. Measurement

Before the experiment had been done, the laboratory was prepared for a special operation mode. The scheme of the whole workplace is shown in Figure 1. The pathway of each sample through the laboratory was following:

(1) The samples were collected at the courtyard of NRPI, and then taken to the acceptation laboratory, where they were repacked.
(2) After the repackage, the samples were moved to the sorting room, where they were sorted according to their activity into several groups. A portable HPGe detector connected to Digidart® unit was used as a sorting device, while death time or counts-per-second values served as the sorting criteria. The counting of each sample took about few tens of seconds.

(3) When sorted, the samples continued to the measurement laboratory. The counting proceeded at ten HPGe detectors of relative efficiency from 10% to 150%. The counting time was about ten minutes. Firstly, the samples from low-active groups were counted.
(4) At the same time, the obtained spectra were evaluated and the results were put to the Excel file. Two other computers connected to the measuring one were used for this purpose.
(5) Time after time, a background spectrum was counted to avoid detector contamination.
(6) After the analysis, the samples were moved to the store and left for a few days.
(7) Since some of the samples were too active so that they increased the death time of detectors, they were stored to the following day and measured again.
(8) The half-life of ^{99m}Tc is about 6 hours, so the time interval of several days was long enough to decrease the activity of the samples to the release level.

Figure 1. Laboratory scheme



The laboratory staff consisted of 9 – 11 persons. Their jobs are mentioned in Table 1. The average analysis time was about 1 minute per sample, so the amount of 400 samples was processed in 5 – 6 hours, as an example. The repackage of received samples took about 2 – 3 hours.
With the increasing number of samples the processed time extended nonlinearly (due to the tiredness of laboratory crew). In one experiment, for example, approximately 600 samples were processed in 11 hours. According to this experience approximately 600 samples (measurement details described higher are the same) is the highest amount of samples measurable by one workshift of laboratory staff.

Table 1. Laboratory staff

Job		No. of persons
Sample repackage		2
Measurement	Sample manipulation	2
	Computer staff	1
Sample sorting		1
Sample porter		1
Spectra evaluation		2
Alternate		0 – 2
TOTAL		9 – 11

C) CONCLUSION

The testing shows the availability of the SÚRO laboratory to work during the radiation emergency and to participate on its determination. The suitable settings and the ideal number of staff have been found. The average analysis time was approximately 1 minute per sample and the sample results were available just a few minutes after the counting. Moreover, the settings avoided any danger and kept both the crew and the samples safe and secure from contamination.

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