QUALITY ASSURANCE OF GAMMA SPECTROMETRY IN MONITORING NETWORK OF CSFR

I. Malátová, D. Drábova, I. Bučina

Centre of Radiation Hygiene Institute of Hygiene and Epidemiology,
Prague, Czechoslovakia

On the basis of the Chernobyl experience the Czechoslovak government decided in July 1986 to set up Czechoslovak Monitoring Network and to assign the Centre of Radiation Hygiene of the Institute of Hygiene and Epidemiology to be its headquarters (Centre of Czechoslovak Monitoring Network). The requirements for emergency monitoring are stated in the document The principles of Monitoring for Protection of Public Health in case of a Radiation Accident approved by the Czechoslovak government in April 1987. Assignments of components of the Network, equipment and technical support required, aims of their activities and chronological order of their activation are stated in the document Requirements on Monitoring, Setting up and Equipment of the Czechoslovak Monitoring Network drawn up by the Centre and approved by the Czechoslovak Governmental Commission for Coordination of the Measures in Case of a Radiation Accident in April 1988. It should be noted, however, that basic principles of environmental monitoring aimed at obtaining the complete information of radiation situation, discharges and releases of radionuclides both during the normal operation and in case of an accident were worked on since putting the first PWR-type NPP in Czechoslovakia into operation in 1979. In March 1986 the Instruction for Emergency Monitoring was approved by the Commission. The existence of this Instruction and corresponding professional, technical and organizational preparedness of organizations departments responsible for monitoring manifested its positive impact especially in the situation after the Chernobyl accident. This fact refers especially to institutions of hygienic service and nuclear power engineering. National and international experience gained after the Chernobyl accident led to some elaboration in the organization of monitoring and to more precise definition of its conception.

Laboratories forming now the dosimetric part of the Network can be from the point of view of their activities carried out in the process of monitoring divided roughly into three groups:

A. Laboratories of Regional Hygienic Service - they are to fulfill

monitoring plans ensuring proper and regular monitoring of the radiation situation on the whole territory both in normal conditions and in case of an accident.

B. Laboratories of environmental dosimetry of the NPP's having more extensive monitoring plans in connection with operation of NPO, they work continuously.

C. La b oratories of research institutes, universities, veterinary inspection etc. activated only in case of an accident and carrying out specialized measurements or helping to mange analyses of numerous samples in a short period of time.

In case of an accident either the whole Network or its relevant territory part is activated to perform tasks needed for emergency monitoring and decision making.

Within the Network a group of 25 germanium gamma spectrometry laboratories performs the nationwide measurement programs aimed at determination of activity of gamma radiation emitting radionuclides in environmental samples, food and agricultural products. Results gained in individual laboratories serve among other things as a basis for the assessment of the impact of Chernobyl accident on the Czechoslovak territory. The reliability of the results is regularly verified. The accuracy is checked by the means of quality control exercises organized by the Centre being responsible also for the methodical guidance of laboratories participating in the work of the Network.

When monitoring of Chernobyl accident begun, the network has not been in its present shape yet. The laboratories of semiconductor gamma-spectrometry were operating in the the regions with a NPP a in some regions in neighborhood of a NPP. Some of these laboratories has had longer tradition already and they had taken part in some international or nation-wide intercomparison runs. Laboratories which didn't go through such exercise had to pass it during after-Chernobyl monitoring. Without certification from such exercise the results from gamma-spectrometry were not included in the Network database.

Quick intercomparisons were done using samples of contaminated foodstuff or environmental samples. Results gained by a new laboratory were compared with those from the Centre. Other purpose of these intercomparisons was to check some laboratories providing measurements for export purposes. For these measurements simple techniques were used and demands on the accuracy were not so high as for semiconductor spectrometry. The main aim was to ensure that lower limit of detection for such simple instruments was much lower than demanded limits of activity.

Soon after the accident several nation-wide studies on environmental radioactivity were started and the necessity of more elaborated and regular quality assurance occurred. The basic information on intercomparison runs organized by the centre is summarized in Tab. 1.

TABLE 1. Intercomparisons organized in gamma-spectrometric laboratories of Czechoslovak Monitoring Network

Date	No. of labs	Type	Sample	Sample type	Radionuclides	Activity levels
Jun. 86	6	A,C	milk	ES	^{134}Cs, ^{137}Cs	10 Bq/l
Aug. 86	16	A,B,C	solution	RMC	^{134}Cs, ^{137}Cs, ^{144}Ce, ^{95}Zr, ^{95}Nb	100-1000 Bq/l
	16	A,B,C	soil	ES	^{134}Cs, ^{137}Cs, ^{103}Ru	10-100 Bq/kg
					^{110m}Ag, ^{125}Sb	1-10 Bq/kg
Aug. 87	7	B,C	solution	RM	^{134}Cs, ^{137}Cs	100 Bq/l
Mar. 88	18	A,B,C	solution	RMC	^{54}Mn, ^{60}Co, ^{144}Ce, ^{137}Cs	100-1000 Bq/l
					^{22}Na	10 Bq/l
Oct. 89	12	A	air filter (simulated)	RM	^{60}Co, ^{133}Ba, ^{137}Cs, ^{210}Pb	100-1000 Bq

RMC - reference material with certified values of activity of individual radionuclides
RM - reference material - values of activity only recommended
ES - most probable values of activity determined from statistical evaluation of results of individual laboratories taking part in the intercomparison
Laboratory type - see text

Reference material with the same or very similar composition as measured samples but with higher activity was provided by a metrology institution and distributed by our laboratory. Agreement between certified and observed values was then a direct measure of accuracy and samples could serve as calibration standards eventually.

Especially important was the quality assurance during the survey of surface contamination done through sampling and measurement of about 1300 surface soil layer samples from the whole country taken in June, 1986. For finding systematic errors in early evaluation the ratio of ^{134}Cs and ^{137}Cs

activity served as an indicator. In such a way systematic error was discovered in one laboratory using spectrometric system of not good enough quality, where one peak of ^{134}Cs was evaluated together with peak of ^{214}Bi.

Later on real soil samples were prepared in our laboratory which were similar in concentration of radionuclides to the samples routinely analyzed. The homogeneity of activity concentration in samples was carefully tested. The agreement of results received from a laboratory with the most probable value obtained from statistical evaluation of all the results after the elimination of outliers was then the measure of accuracy.

One of important tasks of spectrometric laboratories in the case of radiation accident of any type is to be able to determine quickly the radionuclide mixture composition and amounts of individual radionuclides in samples with non-standard measuring geometry. The preparedness of the laboratories to perform such a quick, correct and accurate analysis was tested in the last intercomparison exercise with parts of simulated air filters provided by IAEA, as well as the ability to detect and measure a minor component in a rather sophisticated mixture.