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All-State Radiation Monitoring Network in the Czech Republic

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ABSTRACT

Requirements of the All-State Radiation Monitoring Network in the Czech Republic have been established by Regulation No. 319/2002 Sb, and its function and organisation are described in Regulation No. 27/2006 Sb. The All-State Radiation Monitoring Network in the Czech Republic consists of two components–permanent monitoring and emergency monitoring. The activity of the whole network is provided by the State Office for Nuclear Safety. The selected central authorities of the state administration participate in operation and providing particular components. There are two different modes of the operation of these components–normal and emergency. The modes of operation are controlled by the State Office for Nuclear Safety. The activity of whole network is focused on continuous monitoring of the radiation situation in the Czech Republic and on early detection of radiation accidents in and around the country as well as beyond it. The acquired data shall serve as a basis for adopting urgent and subsequent radiological protection provisions.

Keywords: Radiation monitoring network, radiation situation, permanent components, emergency components

1. INTRODUCTION

Monitoring of the radiation situation in the area of former Czechoslovakia was initiated in the 1960s and was intensified after the Chernobyl Nuclear Power Pant accident in April 1986. After this accident, an extensive radiation-monitoring network was built according to the decision of the Czech government No. 478/2001, which included the document 'Safeguarding and Renewal of the All-State Radiation Monitoring Network'. The decision also served as a basis for amendments to appropriate provisions of the Atomic Act[1-4].

Requirements of the All-State Radiation Monitoring Network in the Czech Republic have been established by Regulation of the State Office for Nuclear Safety No. 319/2002 Sb and its function and organisation are given in Regulation No. 27/2006 Sb[2].

The regulation defines and explains some basic terms[3] as follows:

- *Radiation situation monitoring*: The measurement of quantities and evaluation of results of measuring quantities for radiation regulation purposes
- *Monitoring network*: A system of measurement points and system of tools at relevant expert technical and professional levels organisationally interconnected to fulfill requirements for monitoring the radiation situation in the Czech Republic
- *Common radiation situation*: Any situation except extraordinary radiation situations
- *Data transmission system*: A system for transferring data within the framework of the monitoring network;
- *Information system*: System for the collection, verification, filing, and presentation of data transferred by the data transmission system and for their transfer within the Czech Republic, and to foreign countries, as well as for making them public.

2. RADIATION MONITORING NETWORK IN CZECH REPUBLIC

The monitoring network provides the key to the control of the radiation situation in the Czech Republic that includes the data transmission and management of the information system necessary in the assessment of radiation situations for the following purposes:

- Monitoring and evaluation of the irradiation condition;
- Making decisions concerning provisions that lead to reducing or averting irradiation in the case of a radiation accident;
- International exchange of information and data on the radiation situation; and
- Providing information to the public on the radiation situation in the Czech Republic[5].

This monitoring is provided by the State Office for Nuclear Safety, relevant ministries, holders of Authorisation for Operation of Nuclear Facilities or Working Sites of Category IV (Section 4, Paragraph 12 Law No. 18/1997 Sb.), and legal and natural entrepreneurial people[1-4].

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As to the organisation, the monitoring network consists of two components–permanent component and emergency component.

2.1 Permanent Component

The permanent component includes the following parts:

Network of Early Detection: It comprises a system of measurement points carrying out continuous measurements of the dose rate in area of the Czech Republic and providing information on possible elevation of the dose rate above common levels (Fig. 1). This network is formed by 54 measurement points with automatic operation and transmission of the measured values. Their operation is provided by

- The Regional Centres of the State Office for Nuclear Safety and National Radiation Protection Institute- 9 points.
- The Czech Hydrometeorological lnstitute- 38 points
- The Fire and Rescue Service of the Czech Republic- 7 points.

The system is supplemented by a network of 12 permanent measurement points of the Armed Forces of the Czech Republic. The network performs single-dose rate measurements twice a day under normal conditions and regularly sends the data into the central database of the Radiation Monitoring Network. In emergency situations, operation is switched to intensive mode depending on the requirements of the State Office for Nuclear Safety. Next to the activity of the permanent points of the Armed Forces of the Czech Republic, there is a system of emergency points, which are put in operation in accidental situations based on instructions issued by the Emergency Staff of State Office for Nuclear Safety. The All-state Radiation Monitoring Network also includes a teledosimetric system for systematic continuous monitoring of doses, dose rates, activities of radionuclides and their time integrals in areas of nuclear facilities with the aim to detect and evaluate releases of radioisotope into the atmosphere and water streams in the case of existing or suspected extraordinary radiation situations. These are teledosimetric systems of Dukovany and Temelin Nuclear Power Plants[3,6,7].

Network of Thermoluminesce Dosimeters: It is a system for the measurement of gamma-ray doses in the area of the Czech Republic (Fig. 2). It comprises 184 measurement points situated both in the open air and in buildings. Next to these,are local networks of thermoluminesce dosimeters with total of 21 measurement points in the surroundings of the Dukovany and Temelin Nuclear Power Plants. This network is operated by the State Office for Nuclear Safety and National Radiation Protection Institute. Local networks of thermoluminescence dosemeters with a total of 88 measurement points in the surroundings of the Dukovany and Temelin Nuclear Power Plants are operated by Laboratories of Radiation Control of Surroundings of particular uclear power plants. The collection, distribution, and evaluation of thermoluminescence dosemeters is provided once every quarter[3,6,7].

Points for Measurement of Atmosphere Contamination: These are designed for the measurement of dose rates, for taking samples of aerosols (once a week) and fallouts and for simple determination of activities of radionuclides in these samples. This network comprises 10 measurement points for sampling aerosols operated by regional centres of the State Office for Nuclear Safety, National Radiation Protection Institute,Czech Hydrometerological Institute and National Institute for Nuclear, Chemical and Biological Protection. This network is supplemented by a system of 14 measurement points for

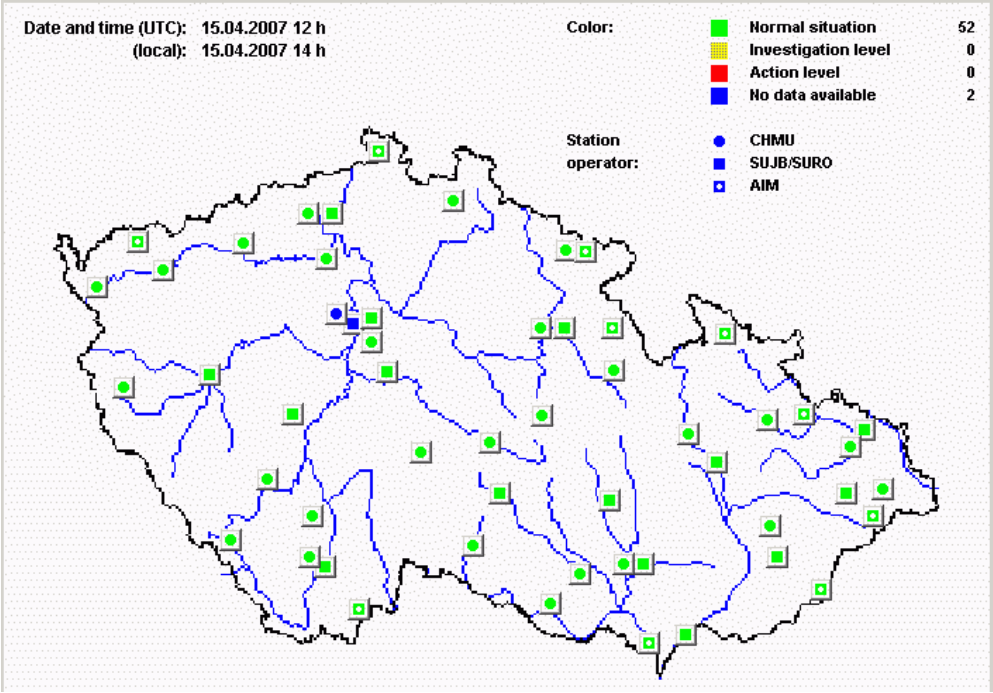

Figure 1. Network for early detection (www.suro.cz).

Figure 2. Network of thermoluminescent dosemeters (www.suro.cz).

sampling the fallout. Local networks of points for measuring atmosphere contamination are operated by Laboratories of Radiation Control of Surroundings of the Dukovany (6 points) and Temelin (7 points) Nuclear Power plants[3,6,7].

Points for Measurements of Water Contamination: These serve for taking samples of water, river sediments and fish for the determination of the activities of radionuclides. These points are contractually provided by the State Office for Nuclear Safety (with a participation of the Ministry of Environment through the mediation of the T G Masaryk Research Institute of Water Management and Czech Hydrometerological Institute)[3,6,7].

Measurement Points at Border Crossings: These are for acquiring data on personnel radionuclide contamination, transportation means carrying goods, objects, and material at border crossings. They are provided by the Ministry of Finance-General Directorate of Customs[3,6,7].

Mobile Groups: They pursue field monitoring of doses, dose rates, and radionuclide activities, by taking samples of environmental components and distribution and replacement of dosemeters in networks of thermoluminescence dosemeters. Mobile groups are provided by sectors of the Ministry of Internal Affairs (1 mobile group of the Formation for Disclosure of Organized Crimes, 5 mobile groups of General Directorate of Fire and Rescue Service of the Czech Republic), Ministry of Finance-General Directorate of Customs (8 mobile groups), Armed Forces of the Czech Republic (3 mobile groups) (Fig. 3), Local Laboratories for Control of Surroundings of the Dukovany and Temelin Nuclear Power Plants (4 mobile groups), Regional Centres of the State Office for Nuclear Safety (15 mobile groups), and the National Radiation Protection Institute (2 mobile groups). The mobile groups are equipped with a measurement system, GPS, notebook and measurement probe (Fig.4)[3,6-8].

Air Groups: They perform field monitoring of doses, dose rates, and radionuclide activities. The Air Groups are provided by the Armed Forces of the Czech Republic (aircrafts) and National Radiation Protection Institute (instrumentation, dosimetry)[3,6,7].

Laboratory Groups: They collect environmental samples and carry out spectrometric or possibly radiochemical analyses of environmental samples, with the aim to determine activities of radionuclides in these samples. There are 13 laboratories provided by regional centres of the State Office for Nuclear Safety, local laboratories for control of surroundings of the Dukovany and Temelin Nuclear Power Plants, T G Masaryk Research Institute of Water Management, and State Verterinary Institute[3,6,7].

Figure 3. Landrover of the Armed Forces of the Czech Republic mobile group.

Figure 4. Equipment of the mobile group.

2.1.1 Central Laboratory of Monitoring Network

It coordinates measurements of samples taken by the laboratory and mobile groups, and carry out selected measurements of these samples, and evaluation of the results, with the aim to provide basic data for making decisions concerning provisions resulting in reducing or averting irradiation of people, and coordinating and carrying out measurements of internal contamination of people. This is a laboratory of the National Radiation Protection Institute, Prague[1,7,9].

2.1.2 Meteorological Service

This service acquires meteorological data necessary for the evaluation and prognosis of the radiation situation with the use of models of propagation of released radioactive nuclides, in the atmosphere. Meteorological data are provided by the Czech Hydrometeorological Institute[3,6,7]. The emergency component comprises[3,6,7] the following parts:

(a) *Mobile Groups*
(b) *Laboratory Groups*
(c) *Air Survey Tools*- for field monitoring of doses, dose rates and radionuclide activities
(d) *Points for the water contamination measurement*
(e) *Points for the measurement of the contamination of foodstuffs*–serve the determination of radionuclide activities in links of food chains. Sampling procedures are provided by the Ministry of Agriculture through the mediation of the State Agricultural and Food Inspection, Research Institute of Forestry and Game Management, Central Control and Testing Agricultural Institute and the State Veterinary Institute;
(f) *Measurement points at border crossings*
(g) *Measurement points at restricted areas*–collect data on dose rates and radionuclide contamination of persons, transport means, objects and materials, at limits of restricted areas and in the vicinity of sites of radiation accidents.

The monitoring network operates in normal or emergency mode. The normal mode is typical for common radiation situations and it is operated by permanent components of the monitoring network. The monitoring is particularly aimed at following the time and space distribution of doses, dose rates, and radionuclide activities in environmental components with the aim to establish long-term trends and early detection of deviations from the trends. It also serves the maintenance of the organizational, technical and personal preparedness of the monitoring network components for the monitoring operation in the emergency mode. After a radiation accident, the monitoring in its normal mode also provides evaluation of long-term effects of the accident[1,3].

2.2 Emergency Component

Monitoring in the emergency mode occurs either in the presence of an extraordinary radiation situation, or if its organisation is suspected. It is also carried out with a participation of emergency components of the monitoring network, and it is particularly focused on the demonstration of the occurrence of an extraordinary radiation situation, and on the question, whether this is an extraordinary radiation situation that originated in the area of the Czech Republic. If this is a radiation accident at a nuclear facility or workplace of category IV (radioactive waste depository, workplace with unsealed radionuclide sources in accordance with Section 15 of Regulation of the State Office for Nuclear Safety No. 307/2002 Sb)[10], the activity is focused on the estimate of the further development of the radiation accident and propagation of radionuclides. It is furthermore focused on the identification and characterisation of the release, on the estimate of personal doses, as well as on the evaluation of the resulting radiation situation, and compilation of basic data for making decisions concerning provisions leading to reducing or averting the exposure of people, including the determination of areas, in which these provisions are recommended due to the resulting extraordinary radiation situation. The efficacy of protecting provisions implemented is evaluated and the development of the radiation situation is predicted[1,3].

The monitoring in emergency mode occurs at two stages. At the first stage, which includes the period before the release of radionuclides into the environment, when the radionuclides are being released into the environment, and the period immediately after the end of the release, simple monitoring methods are primarily used, mainly the measurement of dose rates and doses; the monitoring procedure is focused on rapidly providing the basic data necessary for making decisions concerning urgent protecting provisions. The urgent protecting provisions include sheltering, iodine prophylaxis, and evacuation. At the first stage, including the period after the end of the release more tedious and sensitive methods aimed at the determination of radionuclide activities in environmental components are employed. The monitoring is directed to prove basic data necessary for decisions concerning subsequent protecting provisions, such as the relocation and regulation of the use of the food, water, and possibly forage contaminated with radionuclides[3,9,11].

Data from this monitoring is transferred by the State Office for Nuclear Safety into the information system by the data transmission system and is transmitted in the form of data files through the mediation of appropriate technical carriers: continuously, in the case of early detection, and immediately, after the determination of results of monitoring in the other cases of monitoring. After a control has been set, the data is transmitted to the Czech Republic, and to other foreign countries[1,3,4,6,7,9,11].

The activity of the All-State Radiation Monitoring Network is provided by the State Office for Nuclear Safety. It controls the activity of permanent components of the monitoring network in common radiation situations, and switches the monitoring network to the emergency mode in the case of the occurrence of an extraordinary radiation situation, thus activating emergency components of the monitoring network. In the case extraordinary radiation situations, it controls the activity of permanent and emergency components of the monitoring network with providing the determination of the particular extent and method of monitoring appropriate to the situation encountered. After its termination, it controls the switch of the monitoring network back to its normal mode, while terminating the activity of emergency components[1,3,4,6,7,9,11].

3. CONCLUSIONS

The Radiation Monitoring Network in the Czech Republic uniformly covers the whole area of the country and it is ready for early detection of any radiation accident, and subsequently to evaluate the irradiation of people and to regular food chains. The network is being permanently updated and all its components are regularly examined during repeated trainings, which steadily demonstrate their high preparedness and professional quality. In the course of these trainings, only the particular components (Mobile Groups, Laboratory Groups, Air Groups) of the Radiation Monitoring Network are examined due to financial and certain organisational reasons. For the same reasons, it is impossible to train several people for positions of individual members of these groups.

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