HR9800171

EARLY NOTIFICATION MONITORING SYSTEM

Stipe Lulić, "Ruđer Bošković" Institute, Bijenička 54, 10000 Zagreb, Croatia

ABSTRACT

Nuclear accidents are unexpected events characterized by losing of control over the sources of radiation. This may, directly or indirectly, create a danger to human life, health or property. In certain nuclear accidents, such dangers may be of a limited scope, which means that they constitute a threat only to those persons who work directly with the sources of radiation, or the equipment that comprises such sources, and their immediate working environment. Under certain conditions, as a consequence of major nuclear accidents, the broader population and considerable property might be endangered as well.

The way in which nuclear accidents with the sources of ionising radiation may occur, the intensity of doses that may exist in the radiation source environment, the nature and quantities of radioactive materials which might spread in the environment, the level of radiation exposure of the staff and the population due to a nuclear accident – all these may be considerably different in case of a nuclear accident with different radiation sources. Depending on the category of nuclear accident, major environmental pollutant releases are possible in such situations.

GENERAL OUTLINE OF RADIOLOGICAL MONITOR NETWORK

The proposal for the establishment of a network of early notification monitors in the Republic of Croatia leans upon:

- a description of similar networks in Europe,
- the experience gathered during previous work with the existing monitors on the territory of the Republic of Slovenia,
- direct experience of the three continuous radiological monitors established on the territory of the Republic of Croatia ("Ruđer Bošković" Institute, Sljeme-Puntijarka and Velebit-Plješivica).

Generally, there is a non-professional opinion that the elaborate "early notification monitoring network" represents a system, which supervises the environment on its own to a satisfactory extent and thus considerably reduces the need for specific measuring of various media (e.g. air, food, water, etc.) – which is not true. At best, such a system covers only one of at least three transfer means (external radiation, inhalation, ingestion) of man's radiation exposure and its relative importance is very much varied.

Due to the above mentioned, the network of continuous monitors of the external radiation level may perform the following four tasks at the most:

Early notification of the unusually high radiation intensity is the network's important and indispensable function. In most cases, such intensity increase is a consequence of the transfer of radioactive matter by atmosphere and in some cases of the increased release of radon and thorium – natural radionuclides – from soil. It is good to know that for "geometrical reasons" an increased radioactivity may be recognized only after the sedimentation of radioactive matters on the soil surface (e.g. with rain) and in a considerably less extent

(almost two scales), or not at all, while such radioactivity (i.e. radionuclides bound to aerosols) is diffusely distributed in a high cloud.Precise temporal recording of occurrence and development of contamination due to the atmospheric transfer is important not only for the emergency alarm but also provides the possibility for a more realistic estimate of doses caused by e.g. inhalation of short-living radionuclides, whose kind and activity in the practice may be determined only with a certain delay; in certain situations it also enables the expert to determine the direction of contamination.

The network provides the possibility for a relative comparison of sediment values after the case of contamination by means of sediments on various locations over a larger territory. In order to be able to carry out such a comparison, the monitors must be equally sensitive (calibrated) and, which is even more important, located in equally emitting environments (e.g. mildly slanted plains). The reliability of such estimates depends on the network density, although only to a certain extent, because stationary points cannot display all possible important local variations. Fieldwork mobile units are much more reliable in this respect.

By means of determination of the dose rate, i.e. doses – the monitors forecast or measure the external radiation exposure of man. In such case the monitors must be adjusted to certain units – usually the units of dose equivalent (Sv).

The monitors provide a possibility of early notification of the population about the situation in local environment – which is particularly important in cases of suspicion about possible contamination and has a psychological role.

FUNCTIONAL REQUIREMENTS

On the basis of earlier experience it may be said that the elements of such a network should meet the following requirements:

MONITORS, connected to a network, must have the following characteristics to perform their notifying function:

(a) direct "readability" and "readable" printed record (unencoded and user-friendly) of the values measured (which are transferred to the central PC station "in real time"), and on the location of measuring;

(b) individually adjustable alarm level (with regard to the local, "natural" basic radiation), which apart from the alarm on the location of measuring also provides the possibility of more frequent receipt of information by the central PC station. This may have its independent alarm system, which also includes certain selection algorithms (e.g. sounding of multi-level alarm depending on the number of received alarm notifications, etc.);

(c) communication output through buffer memory, which is used for connecting with the central PC station and saving of data in case of shorter or longer interruptions in data transfer;

(d) self-diagnosis of possible functional errors, readable also on the location of measuring (emergency intervention).

DETECTORS must be equally adjusted to the units of dose equivalent of gamma rays (Sv) and the use of exponents in numbers must provide the possibility of saving the permanent selected mark for the scale (e.g. permanent mark "micro Sv") at all radiation levels.

NETWORK. A network of monitors and a "central unit" (basically a PC) must be established for the supervision of a certain territory. The central PC station periodically controls all points in the network, collects and processes the obtained data and notifies about permitted exceeding. An important function of PC data processing is the "reduction of data" (e.g. presentation in form of summary graphs) because no other method is available to

supervise successfully the large quantity of data which are received – which may considerably harm the supervision process.

In the usual structure, the "collecting PC station" contacts all monitors in equal intervals and receives data from them. In case that some of the monitors displays a value higher than the permitted one, it directly contacts the PC station and consequently increases the frequency of calls (e.g. every 20 minutes). According to previous observations, the most frequent cause of the fall of information and their delayed reception is the overload of telephone lines. It is necessary to point out that a high percentage of the centrally collected data in a network does not mean that such data are transferred "in real time" and not with considerable delays.

Since it is often needed to transfer the early and reduced data to several locations (institutions), the "central PC" is additionally connected (through modems and commuted telephone lines) with "terminal PCs" of other users. Such a series (monitors – "central PC" – "terminal PCs") provides the possibility of avoiding additional overload of telephone lines leading to monitors.

THE EXISTING MONITORING SYSTEM

Until June 1997 there were three radiological monitors of the MFM-202 system (Multi Functional System) on the territory of the Republic of Croatia ("Ruđer Bošković" Institute, Sljeme-Puntijarka, Velebit-Plješevica), established independently by "Ruđer Bošković" Institute since 1993. During 1996, through technical assistance of the IAEA, the Ministry of Economy acquired other five sets of that kind and their installation began in the second half of 1997, to be put in operation in October 1997. In this moment there are eight monitors MFM-202 installed on the territory of the Republic of Croatia, which are used to measure the dose rate.

In selection of the five new locations for radiological monitors, acquired by the Ministry of Economy, special care was taken to install them on those locations which are suitable for early notification of nuclear accidents that might occur in the surroundings of Croatia, i.e. Nuclear Power Plant Krško – location Stojdraga (Location 4) and location Sveti Križ (Location 5); in the close vicinity of Nuclear Power Plant Paks in Hungary – location Bilogora (Location 7) and location Osijek (Location 8); the southernmost part of the Republic of Croatia – location Dubrovnik (Location 6). Special attention was also paid to the fact that such locations must be permanently supervised; for that reason they were located mostly near radar centres (Hydro-meteorological Institute of the Republic of Croatia) or telecommunication centres (HPT, Croatian Post and Telecommunications). The position of eight monitors MFM-202 on the territory of the Republic of Croatia is displayed in Map 1.

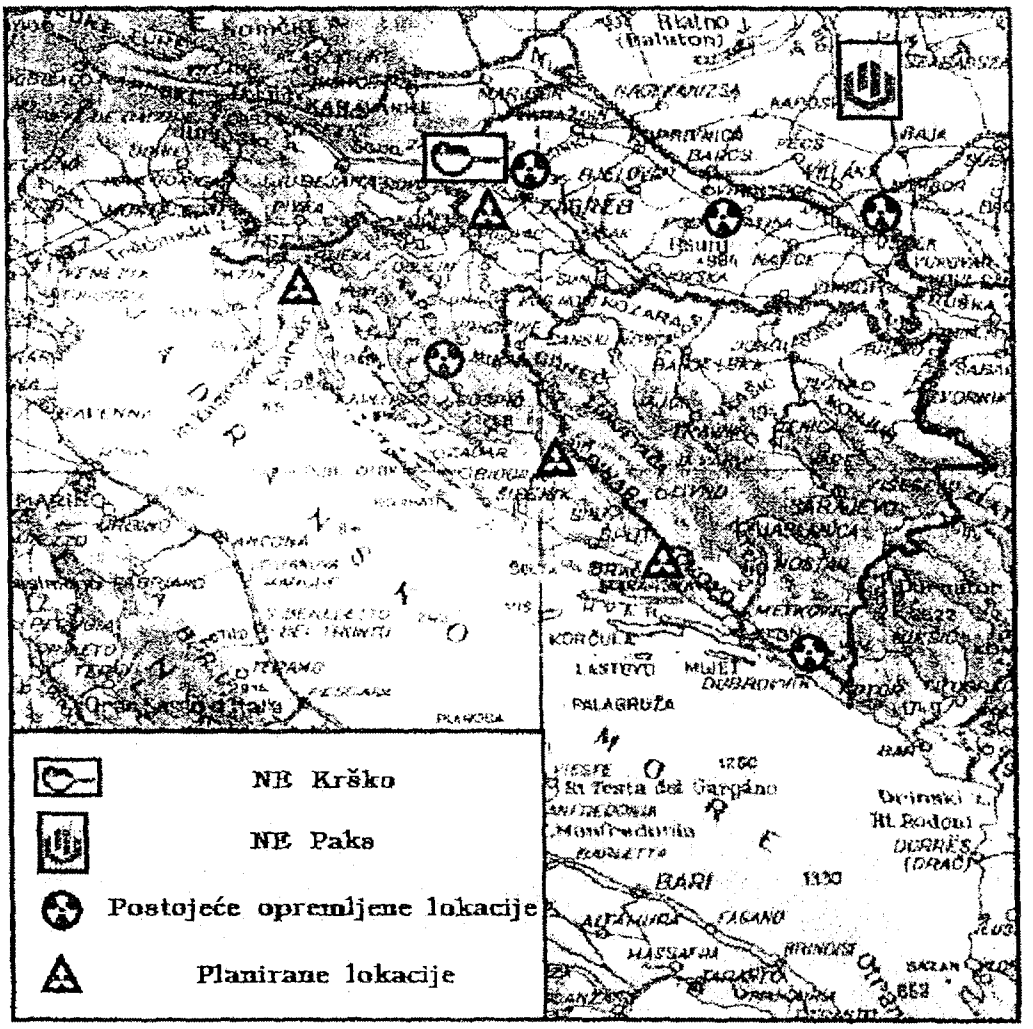
The network of monitors (Figure 1) for early notification of nuclear accidents with radiological consequences consists of:

- centre with communication computer and
- measuring locations with multi-functional gamma monitors MFM-202

The network centre consists of a communication computer and the local network to which the computer is connected. The data collected through the local network in the database are available to the broader public. The communication computer receives the data from the monitors on dislocated measuring points through the public telephone network.

The communication computer comprises the following:

- communication program, which in certain intervals establishes connections with measuring locations through modem and the public telephone network and receives the data for a certain interval;
- storing program, which archives the obtained data in the database on the local disk of the communication computer (in case that the local network is out of operation) and on the disk of the local network server;
- displaying program, which provides the possibility of numeric and graphic presentations of the collected data and listing of messages. Working stations of the local network, which have access to the database on the server, may have the above mentioned displaying program, as well as other program tools for processing of the collected data or programs for the transfer of the selected data to the broader computer network.



MAP OF THE EXISTING AND PLANNED LOCATIONS FOR RADIOLOGICAL MEASURING IN CROATIA

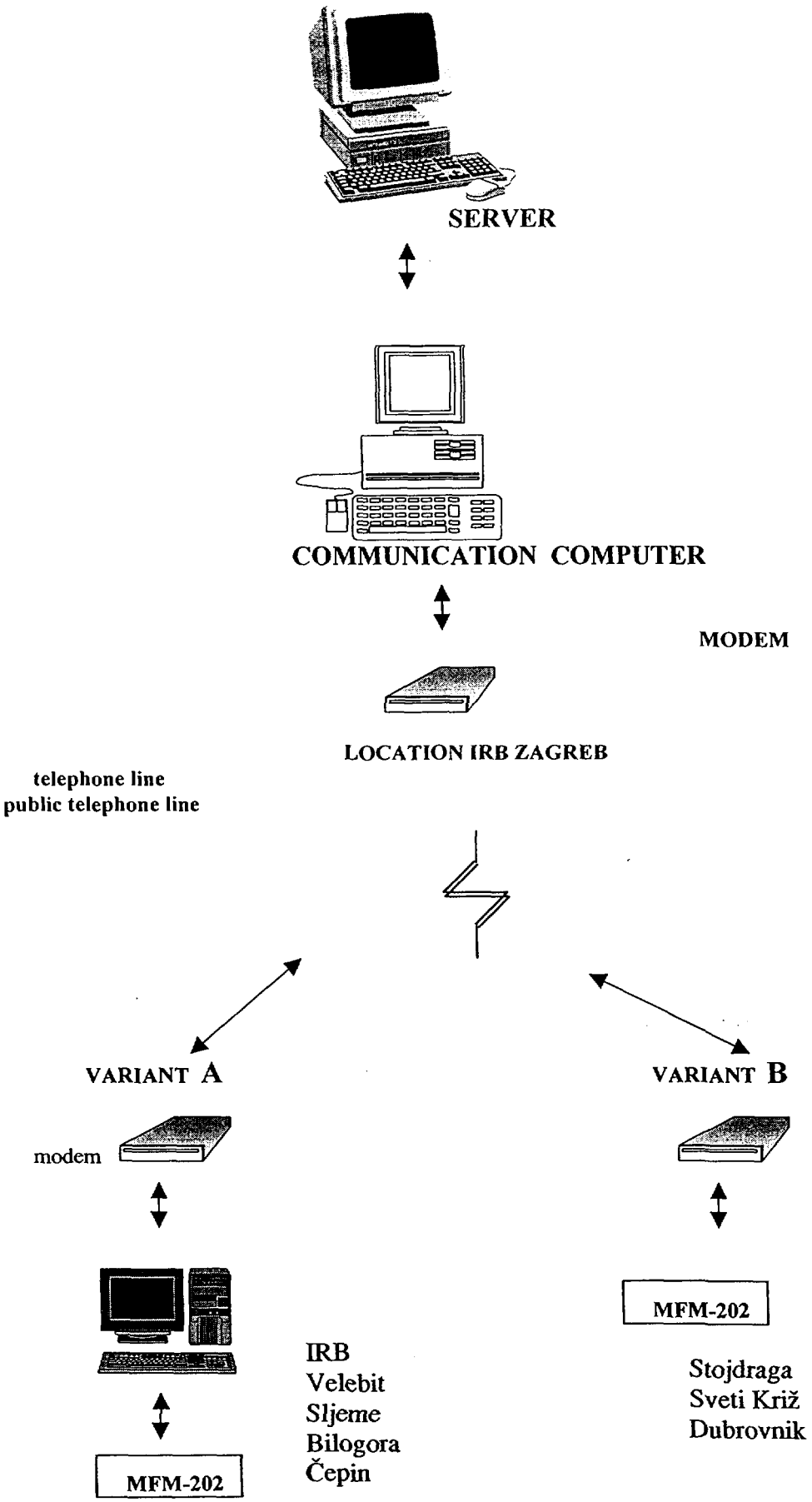


FIGURE 1. SCHEMATIC PRESENTATION OF MONITOR NETWORK

SOFTWARE OF THE CENTRE

The monitor MFM-202 may transfer the measured results to the users in two forms: the results are printed on paper through the serial printer port immediately (or subsequently after connecting) and (or) the results are sent to the central computer through the series line to be saved, processed and displayed there. On its backside the monitor has a connector for the serial port (RS-232) for direct or modem connection with the central computer. The monitor program includes:

a) variant – standard protocol KERMIT, which enables communication with the central computer at a speed adapted to the telephone line quality;

b) variant – protocol for communication with the central computer with the communication program KOM_MFM.EXE.

The microcomputer of the MFM-202 monitor stores all measured values in its memory. It disposes of enough space to store approximately 130 measured dose rates (DOSE RATE). With the parameter adjusted to A PRESET COUNT: 1400 in the monitor MFM-202, and at a normal activity of the basic radiation, the memory always saves the measured results for about a week. Since the database is circular, the memory always keeps the latest data, while the earlier ones are deleted. Upon request from the central computer, the monitor may pass the latest measured (current) results or half-an-hour values. These half-an-hour values may be those from the last interval or from any other half-an-hour interval which is still stored in the memory. This enables the filling of the database in the central computer despite poor communication lines.

The software of the communication computer is used for:

- receiving of data from local units through the serial port on the computer (monitor MFM-202, meteorological station);
- receiving of data from the sub-system through the serial port on the computer, a modem and a continuous telephone line;
- receiving of data from dislocated monitors MFM-202 through the serial port on the computer, a modem and a continuous telephone line;
- storing of the received values in the database organized on the disk.

The above mentioned software runs on Windows platform.

PLANNING OF ADDITIONAL MONITOR LOCATIONS

Respecting the existing network of eight monitors MFM-202 for dose rate measuring (MAP 1), their distribution density - aimed at locating as close to the existing nuclear power plants NPP Krško and NPP Paks as possible, soon it would be necessary to install additional monitors for the same purpose. Since the acquisition of the monitors – five identical additional monitors for dose rate measuring - by mediation of the Ministry of Economy of the Republic of Croatia is already under way, their installation on the following locations is proposed:

- Location 9 – Klanjec, the closest location possible between the Republic of Slovenia and the Republic of Croatia,
- Location 10 – Jastrebarsko, the highest point possible at a local farmer
- Location 11 – HPT Telecommunication Centre Učka, Istria
- Location 12 – HPT Telecommunication Centre Sv. Jure, Biokovo,
- Location 13 – meteorological station of the Hydro-meteorological Institute of the Republic of Croatia in Knin