THE DEVELOPMENT OF THE PROMPT SYSTEM OF GAMMA RADIATION MONITORING IN FR YUGOSLAVIA

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ABSTRACT

The needs for and characteristics of the Prompt System of Gamma Radiation Monitoring are analysed. The basic structure of the new system, based on the PC computer is presented. The system consists of the central unit and a number of field stations connected via telephone lines. GM counter is used as a detector. The software is written in Visual Basic. The system is capable of performing a variety of tasks: dose rate measurement (analogue and digital), graphical presentation of the results in the given period of time, data base formation and management, data transmission and preparing reports.

The basic characteristics of hardware and software of the system, performance specifications and future plans are presented in this paper.

INTRODUCTION

Besides large benefit especially as energy resource the nuclear energy represents potential danger for humans and the environment. The main danger is radioactive contamination. In normal working conditions contamination is small, controlled and under regulation levels. But in accidental situations such as Chernobyl accident the situation is quite different. Than we can expect large contamination area and population exposure for a long time.

In situations like those the main task is to protect people from internal and external contamination. There are a lot of possible technical, social, economic and political measures. The cost could be enormous. Because of that, all measures have to be optimised. The main condition for this is very early accident detection. This is the reason why prompt monitoring system must exist. It is very important in the case when accident happens abroad and other systems fails (as it has happened in the case of Chernobyl accident). The information of the prompt monitoring system that an accident have happened somewhere is the basis for the response plan activation.

In this paper basic design goals of prompt system monitoring are analysed as well as the some technical characteristics of the system which is under development in Yugoslavia. An example is given as well.

BACKGROUND INFORMATION GOVERNING THE DECISION ON SYSTEM DEVELOPMENT

Strong regulation demands in nuclear energy applications and rapid technological development in the field of electronics and computers enables qualitative improvements in environmental monitoring systems. Global effects of Chernobyl accident have accelerated the development in this field.

Developed western countries, with strong nuclear industry, are already covered with computerised monitoring networks. There are several commercial possible solutions, depending on selected detector system and requested set of information.

At this time the Yugoslav national system for accidental detection is based on several measuring point, spread over the country. The absorbed gamma dose rate is measured manually every hour and, in the case of exceeding the declared threshold level authorised centre alerted.

Besides those discrete measurements on three selected locations, continual gamma dose rate monitoring by pressurised ionisation chambers (Model RSS-112 Reuter Stokes, USA) is established. Additional two ones have already be planed and they are about to be installed.

Contamination levels and the whole response system in Yugoslavia after the Chernobyl accident practically proved the necessity of the existence of automated monitoring network. Finally, in the process of changing the basic Radiation Protection Act (3) this system is introduced as governmental responsibility.

According to the presented scientific and organisational background information it was necessary to choose further course of action. Taking everything in to the consideration including the finance it was decided to develop one own system. Existing monitors will be incorporated into the developed one.

DESIGN DEMANDS AND GOALS

The main construction demands for the prompt monitoring system are analysed here. The fastest and most convenient way for prompt monitoring is based on gamma dose rate measurement at the background level. It determines the lower measuring range limit. It depends on location characteristics. According to the results of environmental monitoring over years, the value of 100 nGy/h is good enough. If detector enables it is recommended to use a lower value. The upper limit must be above local background variation in the worst case. The isodose lines at Chernobyl accident must be taken into account too. The upper limit of 10 mGy/h is appropriate. But if detector enables it is recommended to use even a higher value.

The measuring error depends mostly on detector and electronics, system function and costs. The compromise leads to standard error of ±20% at ^{60}Co gamma ray energy. The system must measure gamma dose rate in the energy range 0.1-2.5 MeV with energy error of ±30%. Statistical error is in connection with detector efficiency and response time. A value of ±20% is accepted.

Prompt system response time depends on detector response time and transmission time. The appropriate value of detector response time is several seconds and even the value of several tenth of seconds is not critical.

The parts of prompt gamma monitoring system must operate in the field condition. They have to be adjusted to that climatic condition.

Besides of satisfaction of all this demands the goal of Yugoslav prompt system monitoring is to be inexpensive, based on modern electronic components, computers and data transmission infrastructure. At the moment the telephone link is the basic link.

The system consists of a central station and several field stations covering state area. Data transfer between them must be automated. The field station have to send last defined series of measurements on the central station request. Only in the case that the result of measurements at any field station indicate an accident or accident possibility, this station must send measurements results permanently until central station stops it.

Data manipulation and presentation must be at the top level. It means that modern inexpensive PC computers and peripherals as well as its software must be used.

SYSTEM CHARACTERISTICS

According to the above mentioned design demands and goals the prompt gamma monitoring system is developed (1,2). It consists for now of a central station and several field units connected as presented on figure 1.

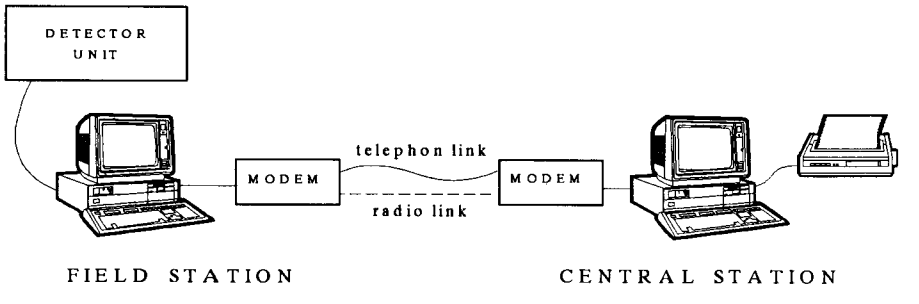

Figure 1 Prompt gamma monitoring system configuration

The detector unit consists of the very sensitive GM counter (ZP1220) with some electronics (high voltage, pulse shaping and forming modules). The pulses are counted in a counter computer card. Ratemeter function is realised by software. By software are realised all other functions as well. One of the important functions is decision making function. Whether the measurement result is a background variation or an accident has occurred ? This function is supported by data base of dose rate measurements at that specific location. This allows the decision function to be self adjusted during the

years and seasonally. The very important software part is communication package. It is based on modern software for PC computers.

Central station have a field station function and an integrating function. All data are here analysed, stored and presented. Decision algorithms are the same as in field station . There is a new software part for area contamination analysing and forecasting. This part is very important in a emergency response plan realisation.

The operation of the prompt system monitoring is very promising on PC computers under Windows™ operating system. So, the program is written in Visual basic™ language. It enables several functions in time: measurement, several types of presentation, data storage, data sending. Besides, data presentation is powerful. Dose rate measurement results are presented in analoguc (gauge or bar) and digital form. Analogue form enables easy viewing of full measuring range and alarm levels. Digital form is more accurate. On the PC display a special window is realised for last 24 measurement presentation in a histogram form. It enables daily changes observing. How a PC display looks like during the measurement on field station is presented on figure 2.

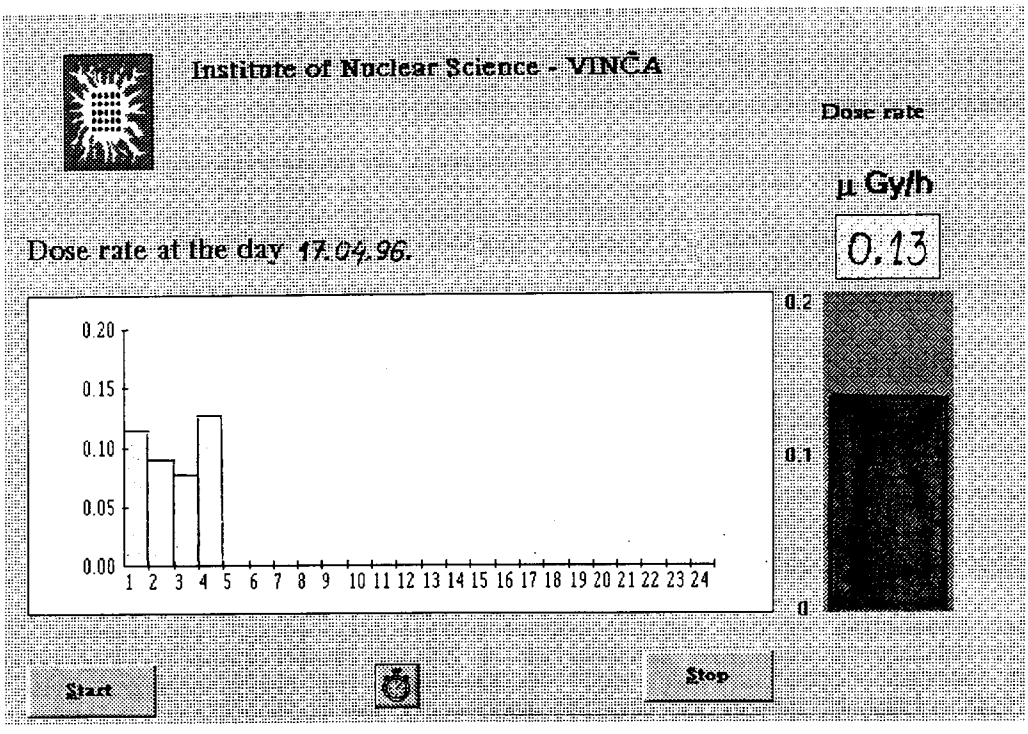

Figure 2. The display of gamma prompt monitoring system during data colection

CONCLUSION

This paper presents new Yugoslav Prompt Gamma Monitoring System for large accident detection. It is based on modern components. Because of this it is cheap, easy for using and with additional capabilities for measurement results presentation, data storing and manipulation and with a appropriate humane-computer interface. It is convenient for small countries.

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