

Monitoring and Crisis system of radiation safety

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In this contribution we are presenting our realization of working radiation survey system with a crisis centre. The whole system consists of number of stations, from which meteorological and radiation data are collected in the main crisis center of the whole system and archived in RMS Central database. The Lagrangian trajectory model serves for radiation dispersion forecasting or later studying of radiation accidents over endangered locations. The radiations probes of the RP series are the base for stationary stations and for portable, underwater radiation sets.

Introduction

MicroStep-MIS projects, builds and markets monitoring and information systems. The key fields of our activities are meteorology, radiation, crisis information systems, environmental sciences and seismology.

In this paper we would like to share our knowledge and experiences regarding the most complex Radiation Monitoring System we have designed. This system provides a comprehensive solution, that integrates meteorological and radiation monitoring networks and provides environmental and radiation dispersion information to help protect people and save lives during any radiation accidents. The meteorological network consists of already existing meteorological stations. The radiation monitoring network consists of 13 radiation monitoring stations with stationary radiation probe installed, three underwater radiation probes and seven portable radiation probes. The radiation monitoring stations were built as an extension of the meteorological stations by Radiation Monitoring Module. All three types of radiation probes were manufactured by our company. All measured data, meteorological and radiation data are collected by our UDCS¹ Data Collection System, which is located in the main crisis center of the whole system. The main crisis center also contains RMS² Central Database, IMS³ Model Suite workstation and Graphics workstation. The RMS Central database stores all collected data in one unified structure, thus preventing data inconsistencies and discrepancies and enabling standard comfortable data access for all users and other software systems. The IMS Model Suite is a complex software system for prediction of the consequences of environmental pollution, nuclear accident or radiological emergence. At the Graphics workstation, our GIS⁴ based IMS Weather Studio application is running. There are two more crisis centers in the whole system, located at various places and involving the IMS Mode Suite and the Graphics workstations. In the following sections we will introduce the above mentioned parts of the whole Radiation Monitoring System.

Measurement and collection of the meteorological and the radiation data

Stations. Our combined meteorological and radiation station usually consists of number of meteorological sensors, radiation probe, data logger and workstation with IMS Meteorological Station software and Radiation Monitoring Module. The data logger is responsible for data collection and processing according to the given set of sensors. There are various types of data loggers manufactured by our company, which are able to measure tens of variables according to user defined configuration, using multitude of sensors and communication devices.

The IMS Meteorological station software is designed to serve and support all processes related to the work of a professional manned or semi-automatic station. These processes include data processing and archiving, creating meteorological messages etc. The integrated part of this software is a communication

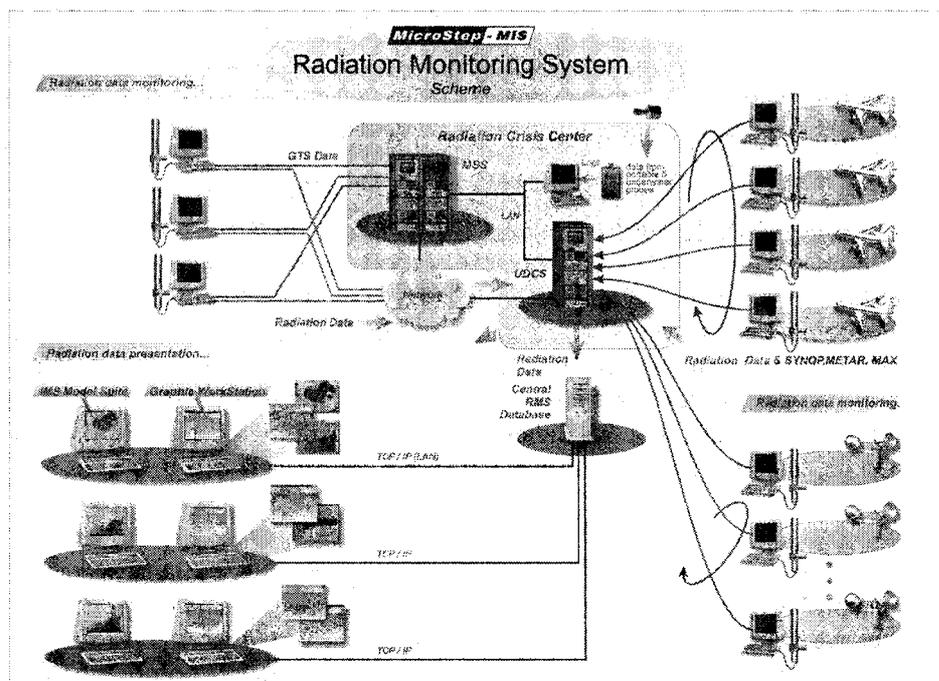
¹ Unified Data Collection System

² Radiation Monitoring System

³ Integrated Meteorological System

⁴ Geographics Information System

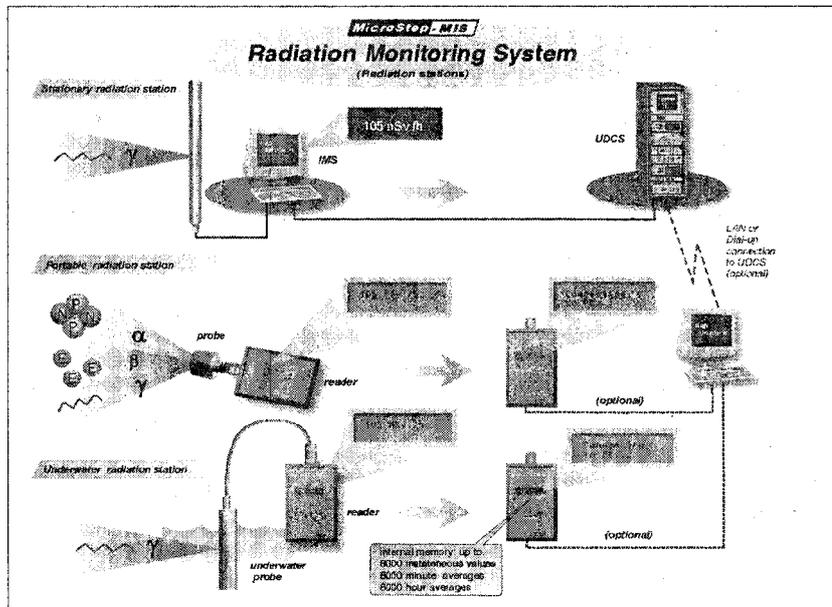
module providing connection to the GTS⁵ network, which enables sending collected data and receiving requested data.



The Radiation Monitoring Module extends the meteorological station by gamma radiation monitoring and reporting. MicroStep-MIS manufactures five types of radiation measurement devices. Which are RPSG-05, RPPR-02, RPPUG-03, RPPA-01 and RPPA-02. RPSG-05 and RPPUG-03 are probes for measuring gamma radiation only.

At the stations the RPSG-05 is used for measuring air kerma dose rate in the range from 10nSv/h to 10Sv/h. Two gamma compensated Geiger-Mueller detectors are supplied from high voltage power supply. The electronic circuitry counts pulses from these GMs every second. Then calculate dose rate according a calibrating curve. Also uncertainty estimation is computed. According this uncertainty a decision is made which tube result is better. This result is logged and automatically sends via RS232 or RS485 (if configured). The integration time is fixed for 1, 10, 60 minutes. There is one another type of measurement and it is called floating measurement. In this measurement a number of counts is fixed and integration time is flexible according to dose rate and sensitivity of GM tube. All four measurements are logged into internal nonvolatile memory. There are 8192 positions for each type of measurement. Along with the data, error and diagnostic flags are also stored. This means that you can find near a month old record for 10 min. measurement. These data can go to database and to next processing stage. This probe is designed to be permanent mounted at the site for continuous measurement.

⁵ Global Telecommunication System of the World Meteorological Organization(WMO)



The measured data (either radiation or meteorological) are sent to the IMS Meteorological Station by the data logger. After the data processing they are collected by the UDCS. The UDCS is a real-time system for the collection of the meteorological data and radiation data from various sources, which provides all functionality necessary to operate and maintain large meteorological networks of automatic as well as manned stations. The UDCS supports wide choice of protocols for communication defined by the WMO manual on the GTS as well as numerous proprietary protocols and formats for communication with automatic stations and data loggers.

The connection between all stations and the crisis centre is done via modems and private computer networks. To achieve higher reliability some data paths have a redundancy.

Portable devices. To complete the radiation measurement at the monitoring stations the following portable devices can be used.

RPPUG-03 is the portable probe for under-water usage. This probe contains one GM counter with high voltage power supply placed in titanium stainless steel housing. RPPUG-03 is delivered as a set with RPPR-02 and 25m cable on a reel. All portable probes made by MicroStep-MIS need RPPR-02 reader.

RPPR-02 reader contains the same electronics like the RPSG-05 plus display and keyboard. RPPR-02 can runs on batteries for five days of interrupted measurement at normal background (100nSv/h). This reader also contains high voltage power supply for powering the external detectors. The user can watch all types of measurement, the probe info, the current error flags and also dose which can be reset. An audible signal will sound when the user dose crosses the threshold for user dose, which can be set from PC via data cable and setting/downloading program (RPEXplorer).

Next portable set consists of RPPR-02 RPPA-01 and RPPA-02. RPPAs are portable probes for measuring alpha, beta and gamma. They also need RPPR-02 for powering and for processing the signals. RPPA-01's range is from 10mSv/h to 10Sv/h. RPPA-02 works from 10nSv/h to 100mSv/h. Detectors in both probes are GM tubes with mica window for alpha measurement. All probes are calibrated with Cs-137. Calibrated data are processed into four parameters. All probes contain nonvolatile memory for storing this calibration data.

All the data from these portable devices can be uploaded to the RMS Central database.

RMS Central Database

The RMS Central database is based on Oracle database product, thus can work on multiple platforms. Data stored in this database are the measured meteorological and radiation data from all stations, the radiation data from underwater and portable radiation probes and the decoded WMO messages (METAR, SYNOP – meteorology, IRIS – radiation). The RMS database can be extended to store satellite or radar images and to store measured data from fields like hydrology, seismology, aeronautical climatology, mountain meteorology etc. It is also possible to store manually entered data by operator as well as older data stored in electronic form. The important part of the RMS database is Quality Control module, which performs the complex checks of stored data. The suspicious or erroneous data are kept in the database but are flagged with appropriate error code and displayed to the data operator, who has sufficient rights to correct it. The next important part of the RMS database is the notification module, which is monitoring the stored data. In the case that some signalization thresholds are exceeded (e.g. exceeded radiation thresholds) the notification module will send warning e-mails, SMS messages or will start warning system (e.g. sirens). The output products of the RMS database consists of number of standard reports (textual or graphical), operator defined reports that are accessible using either standard user interface or web interface. An example of such standard user interface application is our GIS based IMS Weather Studio running on Graphics workstation.

IMS Model Suite workstation

The IMS Model Suite running on the special workstation is a complex software system for prediction of the consequences of environmental pollution, nuclear accident or radiological emergence and is based on the Lagrangian trajectory model. The IMS Model Suite features include:

- modeling of phenomena as release and dispersion of pollutant, atmospheric transport and diffusion under changing weather conditions, wet and dry deposition, radioactive decay,
- continuous or short-term release, emission of multiple simultaneous pollutant species,
- planetary boundary layer concepts,
- pre-defined accident and release scenarios,
- GUI integrated decoding and visualization of meteo data.

The results of the model are maps of surface or volume pollutant concentrations and time-integrated concentrations, single or multiple simultaneous trajectories. The IMS Weather Studio allows 2D or 3D visualization of simulation in various projections and export of images and animations to numerous formats. Some of the results are also published on the web.

Graphics workstation

The IMS Weather Studio is a tool for processing, analyzing and graphics presentation of the surface and upper air meteorological, radiation and climatological data. It provides convenient way for objective analysis and displaying complex data archived from RMS Central database as well as data outputs from dispersion models. IMS Weather Studio allows creating, viewing and printing of the layered maps, which include topography, actual or historical data stored in RMS Central database, satellite or radar information, IMS Model Suite dispersion model outputs, etc.

Conclusion

In this paper we have briefly described our practical experiences with the most complex Radiation Monitoring System we have designed. This system consists of number of stations; those data are collected in the main crisis center of the whole system. The main center integrates RMS Central Database, the IMS Model Suite workstation and the Graphics workstation. The radiations probes of the RP series are the base for stationary, portable sets and for sets measuring underwater radiation. The radiation and meteorological data, which are necessary for reasonable interpretation of radiation data, are archived in RMS Central database. The Lagrangian trajectory model from the IMS Model Suite serves for radiation dispersion modeling.