

## THE DOSE RATE MONITORING SYSTEM

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**Abstract:** *the contribution deals with design of dose rate monitoring system. The entire system has been implemented for Nuclear Power Station SE-EBO Jaslovské Bohunice. The system consists of mobile unit with GPS, application server and display unit. The system has been developed in Borland Delphi, using ActiveMap components, that allow to develop powerful GIS applications.*

**Key words:** *Dose Rate, Oracle 9i, GPS Garmin, ActiveMap component.*

### 1. INTRODUCTION

The measuring of dose rate by monitoring vehicles is used for radiation situation assignment around SE – EBO in separate phases of emergency monitoring of extraordinary situations.

Dose rate is calculated as division of the rate increment  $dD$  in the interval of time  $dt$  and this interval. (KOŠTIAL, 2005)

$$\dot{D} = \frac{dD}{dt} \quad [\text{Gy} \cdot \text{s}^{-1}] \quad (1)$$

Dose (absorbed dose)  $D$  is specified division of intermediate impart energy  $d\varepsilon$  in given point, imparted by ionizing radiation to any substance and mass  $dm$  of this substance.

$$D = \frac{d\varepsilon}{dm} \quad [\text{Gy}] \quad (2)$$

Where  $\varepsilon$  is impart energy and is calculated as the sum of differences  $(R_{in}-R_{ex})$  and  $(Q_{in}-Q_{ex})$ , where  $R$  are emitted energies of all charged and uncharged ionizing particles, which get in the substance ( $R_{in}$ ) in given space (specimen) and those which get out of it ( $R_{ex}$ ),  $Q_{in}$  is decrement and  $Q_{ex}$  is increment of rest energies of nucleuses and elementary particles at any nuclear variance, which ran through the given space.

$$\varepsilon = (R_{in} - R_{ex}) + (Q_{in} - Q_{ex}) [J] \quad (3)$$

## 2. THE SYSTEM DESCRIPTION

This system was implemented in the laboratory of environment radiation control (LRKO) SE a.s. EBO o.z. Jaslovské Bohunice and it is fully working there in present day.

The system is composed from three basic parts (ELIÁŠ, 2005):

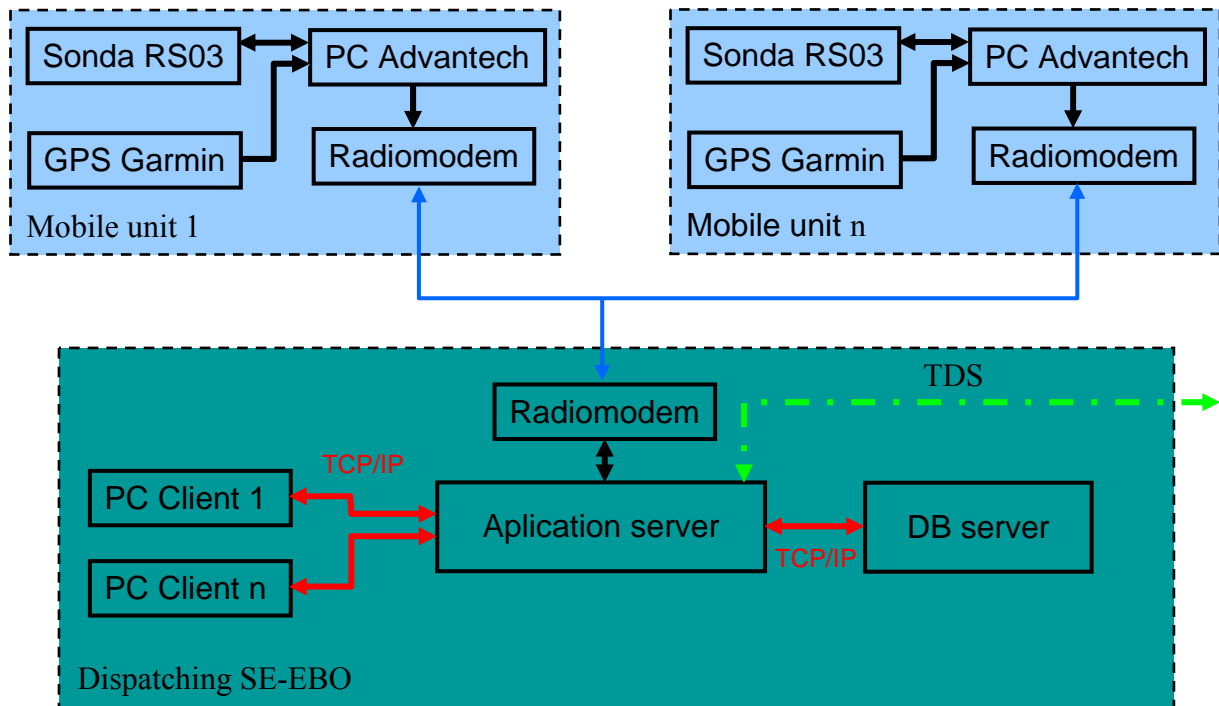
- Mobile unit (off – road vehicle) – which provides the data measuring.
- Application server - which provides the data acquisition from mobile units and theirs storing into the database.
- Displaying unit – displays the actual position and the path of mobile units with included measured data.

We proposed panel PC from Advantech company, as the main part of the mobile unit, which has connection to measurement sampler of dose rate, radio modem and GPS receiver. The software in this computer provides data measuring, position locating and data transfer to the headquarters LRKO in periodic time intervals. We are using the RS03 measurement sampler from BITT Technology, which has very large measure range.

The sampler is made in many variants, which are different in equipment, memory, communication possibilities and software. The supply voltage of the sampler is 12V, that enables its smooth usage in car.

The heart of the sampler is SAB 80C535 T40/85 processor from Siemens company, which is compatible to Intel 8051.

Communication between mobile units and the dispatching office is provided by communication server. Dispatching client stations are connecting to this server using local computer network. To the server is connected RACOM radio modem, which mediates connection with mobile units.



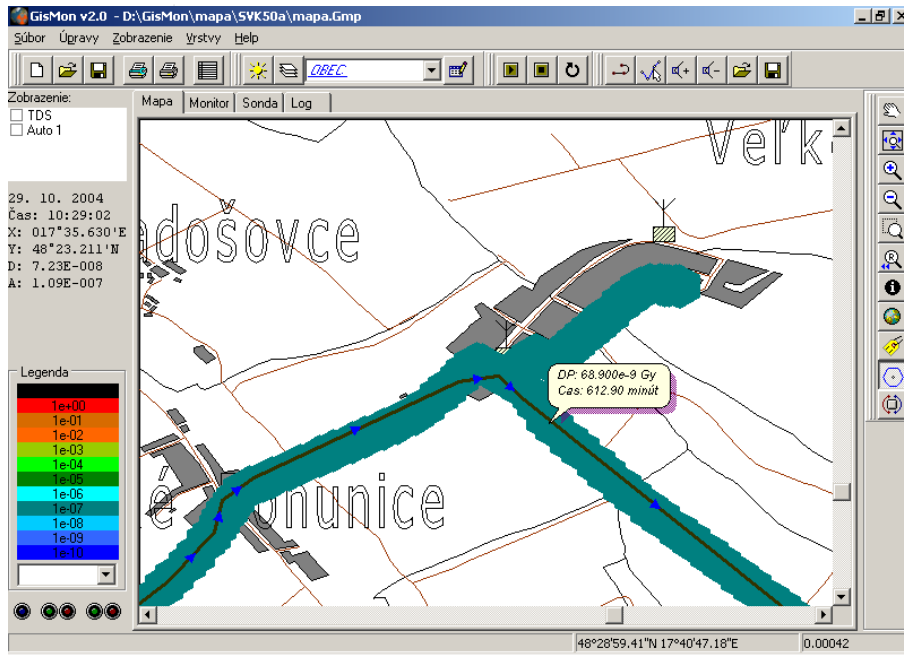
**Fig. 1** *Communication between mobile units and dispatching*

The measured data from mobile units are stored into the database server, which is working under SRBD Oracle 9i. The data could be selected from there by dispatching office. The ability of bidirectional communication is implemented in the system too – dispatching officer can update the data of TDS stations, send a new path to the mobile unit etc. This communication is provided by opening of TCP ports on the server, which are creating a virtual tunnel right into the computer of mobile unit.

This system was developed in Borland Delphi, using ActiveMap components. These components allow us to develop powerful GIS applications.

Application control is similar to the control used in OS MS Windows. In the application window are located some tool panels, then the legend and the main part of the window is taken with the map.

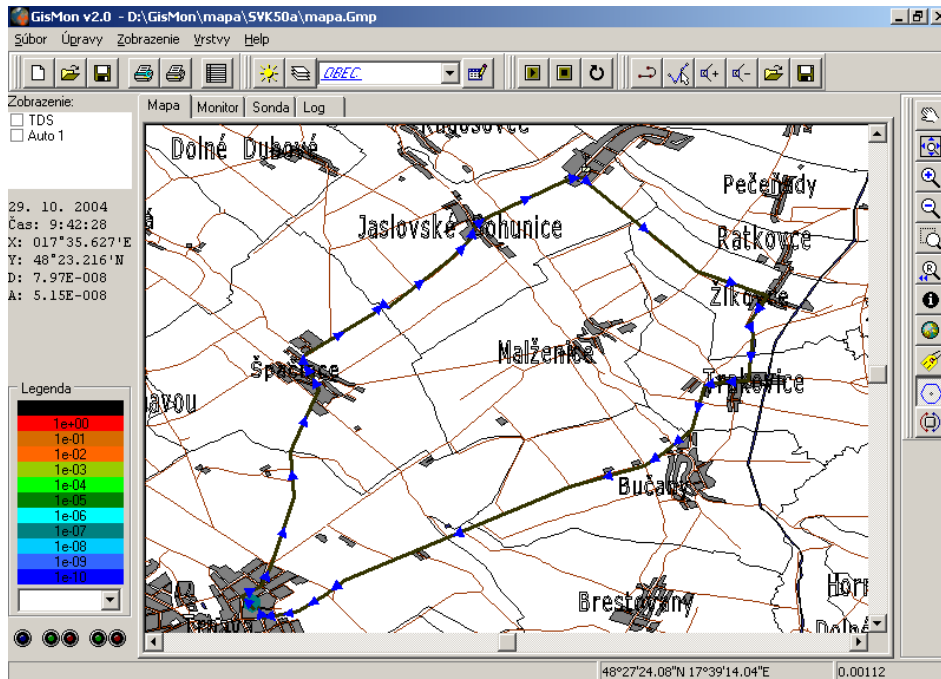
The application is able to create, to save and to load base maps, to browse and to modify their database objects and to define, respectively add or remove separate layers of the base map. The detail of base map with real measured data is shown in the Fig. 2. You can see the TDS station in the right top corner, which color is changing similar as the color of displayed points, depending on the value of dose rate in given area.



**Fig.2** Measured data detail

A record is generated in GIS database to every object; thanks to this we can later browse the individual data.

Another available function in this application is the definition of required paths (Fig. 3). For every variant of emergency plan more paths are prepared, which could be downloaded and displayed right in the base map.



**Fig. 3** The definition of required paths

The main properties of the application (ELIÁŠ, 2005):

- operation in the mode “Central” and in the mode “Vehicle”,
- displaying of the measured data in the real time,
- data and position displaying in the chart background,
- import of the chart background from various formats (ArcView Shapefile,...),
- possibility of definition for diverse colour scales,
- zoom possibility of displayed chart,
- data displaying from 24 TDS stable stations,
- export of displayed data into various formats (shp, dwg, bmp, jpeg,...),
- route definition for vehicles,
- automatic backup of the measured data,
- it was necessary to modify the server for data collection from mobile units in order to data sending from central to vehicles,
- the chart consists of more layers, therefore it is possible to switch on (off) various objects (railways, water-courses etc.).

### **3. CONCLUSION**

One of the most difficult problems, which have been solved, was the correcting of GPS-positions of the vehicles with the map chart. The difficulty was caused by different used standards: The map chart was described by Bessel ellipsoid, GPS has worked with WGS84 ellipsoid.

The more accurate and rapid data evaluation of dose rate was achieved by the implementation of the described system into praxis. The problems of former solutions were removed. The real-time data processing, graphical evaluation of measured data including the possibility to set up the chart-scaling factor and the reliable bidirectional data transmission between the dispatching and mobile units are the most important profits of the described solution.

#### 4. REFERENCES

1. ELIÁŠ Andrej, TANUŠKA Pavol, VAŽAN Pavel. THE DOSE RATE MONITORING SYSTEM THROUGH THE MOBILE UNITS. In *Materials Science and Technology* 5/2005. ISSN 1335-9053.
2. KOŠTIAL Juraj, BUBÁN Peter – Automatické spracovanie dávkových príkonov získaných z monitorovacích vozidiel pri monitorovaní okolia JE EBO. Laboratóriá radiačnej kontroly okolia EBO, SE a.s., AE Bohunice. 2006

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