User Interface Features of Information-Analytical System for Radiation Safety of Personnel on the Example of Northwest Center for Radioactive Waste Management "SevRAO" – 14625

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ABSTRACT

Algorithms for radiation protection services and regulators was developed. They provide guidelines for choosing actions in planning the elimination of accidents. The method is based on work with a grid of radiation field (this grid is with constant spacing along axes in the plane and every point has the value of the dose rate), which is obtained by interpolation of the measured values. Based on these algorithms, a software program with a graphical representation of the original data and the results of calculations was developed. It allows the quantitative evaluation of the quality of information received from the monitoring team, searches for the best routes on site and to find points that make a maximum contribution to the collective dose.

When a facility implements any new software, the operator's efficiency must increase, while working time stay constant or reduces. This statement applies for input data into the database, mathematical analysis that presents the results in a report drawn up in accordance with the rules of the company. In this paper on example of Northwest Center for Radioactive Waste Management SevRAO is shown that the installation of information-analytical system (IAS) helped reduce the time for entering and processing data on the radiation measurements. IAS also has an opportunity to automate the creation of reports.

To be most effective, the regulator should control about 250 parameters of the radiation situation. Basically, these are the control points and the reference values of dose rate at these points for the technical area, buildings and structures located at the industrial site. For each point there are two control values - the dose rate at rest and during work. It is more important for regulator to compare the radiation situation with control levels, but not only to see radiation situation itself. So we have developed software that graphically presents information as areas on the map. With a glance at the screen, the regulator can see where levels have been exceeded.

INTRODUCTION

The goal of our project (DOSEMAP-3) is improvement of radiation safety during the Sites of Temporary Storage (STS) remediation by optimizing information and analytical system on radiation safety of workers (IAS RBP) of the SevRAO-1 Andreeva Bay Facility up to the level supporting actual application of IAS RBP for the purpose of regulatory supervision of radiation safety of workers. One of goals was to improve the software to create a user friendly interface that could be used by operator and regulator.

DISCUSSION OF NEED

Radiation Safety Standards (NRB-99) require the normal exploitation of sources of radiation to be guided, by the principle of optimization, i.e. keep individual doses and the number of exposed persons as low as possible and reasonably achievable[1] in works with any sources of radiation, taking into account economic and social factors.

The principle of optimization is an integral part of the general culture of enterprise safety, which is understood as a qualifying and psychological preparedness of all personnel. Safety is a priority goal and an internal need, which leads to self-awareness of responsibility and self-control during all activities affecting safety.

The principle of optimization must be applied at all stages of the organization of the work process and operation of the radiation facility, starting from the stage of designing, during the operation and until the completion of the object out of the operation and disposal of radioactive waste.

Objects for optimization:

- radiation exposure of personnel (individual and collective doses) with the priority of individual doses;

- activity of emissions and discharges;

- specific activity and the total amount of generated radioactive waste.

The System for stimulation of work must be developed by enterprise managers. This system should minimize dose rates in combination with a demanding and coercion (the presence of the leaders in the performance of radiation-hazardous work, periodic and unscheduled detours control by the Department of radiation safety).

In fact, nowadays in Russia the implementation of the optimization principle has been neglected, in contrast of Western countries. There is various reasons for this, but one of them is the lack of strict regulation of the principle of optimization in NRB-99, in contrast, for example, the principle of limitation of individual radiation dose.

PROJECT HISTORY

“SevRAO” facility, in particular, the Branch №1 located in the Andreeva Bay, has a special situation. It is located close to the territories of neighbor countries (the distance from the industrial site of the branch №1 to the border with Norway is 59 km).

Therefore, Norway and some other countries are involved in financing the work on the industrial site in Andreeva Bay and scientific support of these activities, including field of radiation safety of “SevRAO” personnel and people living in the surrounding areas. For this reason, the principle of optimization is most likely to be implemented on this object.

In order to realize the ALARA principle in the Branch №1 State Research Center Burnasyan FMBC of FMBA of Russia issued guidelines in 2008 [1]. These guidelines are intended for use by regional federal executive authority (Regional Management №120 of FMBA of

[1] The principle of optimization is also known as the ALARA principle (As Low As Reasonable Achievable). ALARA - is the concept of dose limitation, based on the principles of minimization of exposure levels, taking into account the economic and social feasibility.

Russia). RM-120 authorized to carry out sanitary and epidemiological control, radiation safety service of the enterprise in the planning of radiation-hazardous work with sources of ionizing radiation.

The next step after the development of the Guidelines for SevRAO in the Andreeva bay [1], was the Russian-Norwegian project DOSEMAP to create the information and analytical system on radiation safety of workers (IAS RSW) of the SevRAO, one function of which was making optimization realization decision support in the current plant.

The first stage was carried out in 2008-2010 and has been associated with the creation of a specialized software based on the famous program RADRUE [2], which is widely used and is currently using in a number of international epidemiological projects of the Chernobyl liquidators dose reconstruction.

The second stage of the project was devoted to IAS RSW deployment and was performed in 2010-2012. As a result of the second stage of the project it became clear that for all the informative and useful service for “SevRAO” Radiation Safety department the program requires too much time for “SevRAO” personnel adaptation and use.

RECENT WORK

This conclusion is updated the third stage of the project, which implementation is scheduled for 2012-2014. At this stage, work with IAS RSW must be repeatedly simplified, and its informative value and performance significantly improved based on the project second stage accumulated experience of IAS RSW exploitation.

In 2010 NRPA drew attention Burnasyan FMBC on activities of the Norwegian Institute for Energy Technology (IFE) in Halden, which is engaged in the development of dynamic radiation environment 3D visualization tools with radiation work. IFE and FMBC expert meeting showed that the approaches developed in these institutions, not duplicate, but addition each other. As example, IFE visualization tools, radiation grid calculated as a function of activity and other characteristics of the source and the radiation grid of FMBC application is the result of radiation measurement values interpolation.

It is the reason why during the DOSEMAP-3 project in 2011-2013 IFE with FMBC performed the DRIVE project. Compare of those projects shown in table 1. As we can see, this projects addition each other.

Table 1.Comparison of properties of DRIVE and DOSMAP-3

Property	DRIVE	DOSEMAP-3
Modeling the radiation from radioactive sources	Yes	No
Analytical part	No	Yes
Entering data on radiation environment	No	Yes

Interpolation of measurements of dose rate	No	Yes
3D visualization	Yes	No

So, the original measurement radiation data are made in the computer's memory with the help of software developed in the DOSEMAP-3 project and then transferred to the software tools developed in the DRIVE project, and are also used in software developed in the project DOSEMAP-3 as shown in Fig. 1. At the same time, the 3D visualization are developed only in the project DRIVE and reasonable to use of these funds also for visualize the results of the analytical solution of the tasks of the DOSEMAP-3 project. Thus, it is apparent that the maximum efficiency of projects DRIVE and DESEMAP-3 the possible to only in the case of joint use of these software projects.

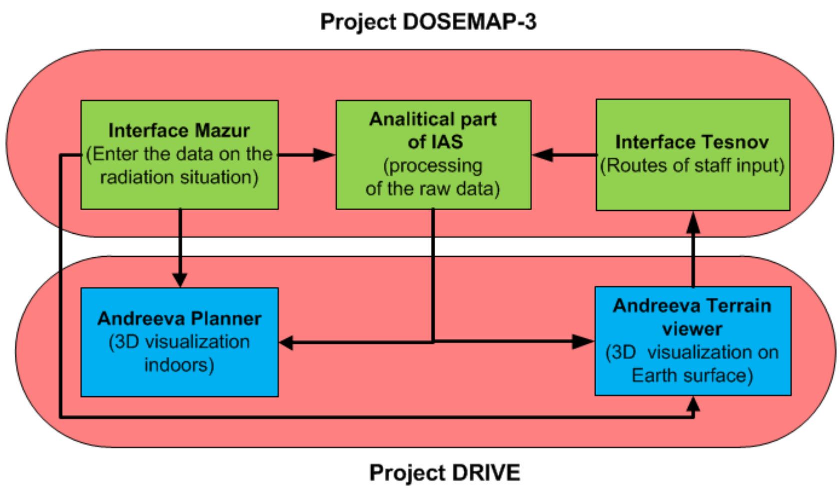

Fig. 1. Interaction scheme of software tools developed in DOSEMAP-3 and DRIVE projects

Let us briefly consider how to interact software of DRIVE and DOSEMAP-3 projects. Every software primary operates with original data, which include maps: industrial site, facilities and buildings, data of radiation measurements at the industrial site, in buildings, as well as staff routes. The last include a graphic image of the route: the trajectory zone or a set of stay, as well as the attributes of the route: start time, duration and number of repeating of the route and the type of shielding device that is used on this route.

The input of new topographic maps and radiation data was implemented in “Mazur Interface” software. All topographic bases are integrated into a single map in «Andreeva Terrain Viewer» software. Entering the graphical image of route is done in «ATV» software, the entered route is saved as a kml-file and transferred to the "Tesnov Interface" software, where it is the route attributes added to the kml-file. All routes per employee are stored in a kml-file. Thus, number of employees is equal to number of kml-files. All routes from one employee can be represented on a map, see Fig. 2.

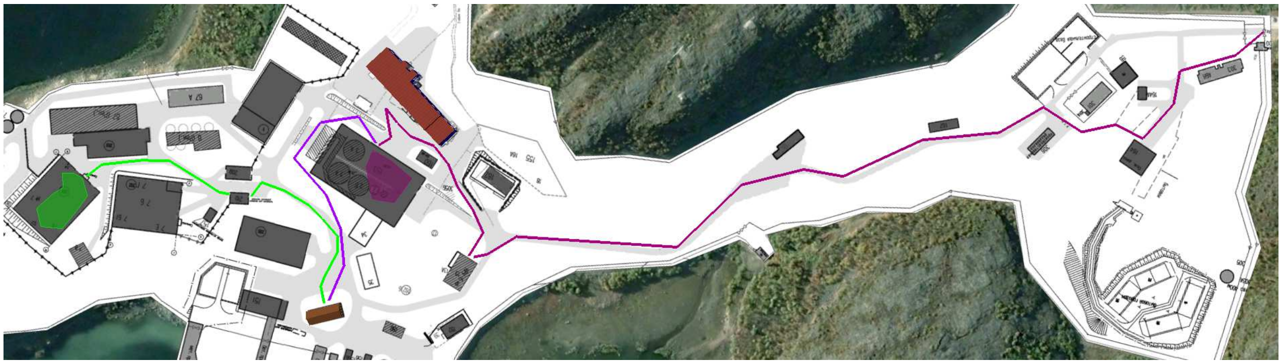

Fig. 2. Example of work with routes. There are 7 routes (included 5 paths and 2 polygons) painted on presented map. The first episode routes are painted with a purple color, the second episode routes – with a green color.

Further, all the initial data (the new topographic base map, measurement data files and kml-files) transmit to the «Analytical part of the IAS» to produce a five-layer map as shown in Fig. 3.

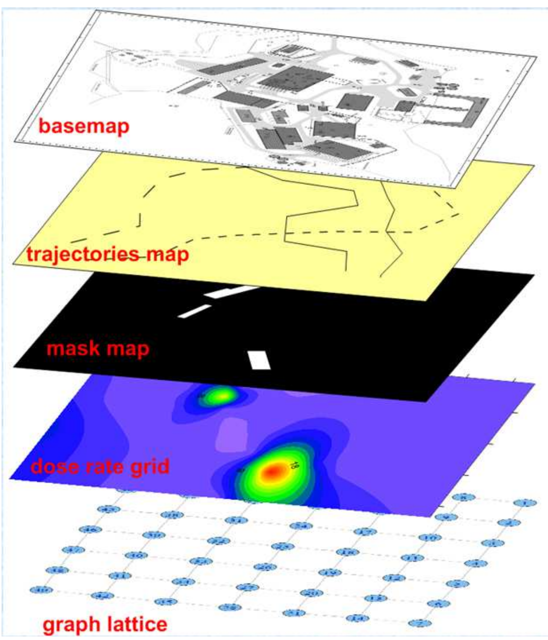

Fig. 3. Five-layer map, used in «Analytical part IAS» software.

This software tool calculated the so-called radiation grids using radiation initial data files with Ordinary Kriging interpolation method [3]. We calculate the dose for individual routes for each person from the staff, and the cumulative dose on all routes. Various analytical tasks are solved, including the optimization tasks. Grids with the radiation situation are transmitted to the «AP» and «ATV» software.

In «AP» software radiation grids are used (visualized) in different scenarios, see Fig. 4. In «ATV» software radiation grids are also visualized together with the routes and initial measurement data, see Fig. 5. «AP» and «ATV» software allow not just the visualization of the radiation situation in the 3D, but an, additional support through use of the time-slider, for displaying the object change over time. In our case, this means that we can insert a variety of models of buildings and structures and other facilities, including radiation situation, in accordance with the period of their existence in the technical site of “SevRAO” at Andreeva Bay.

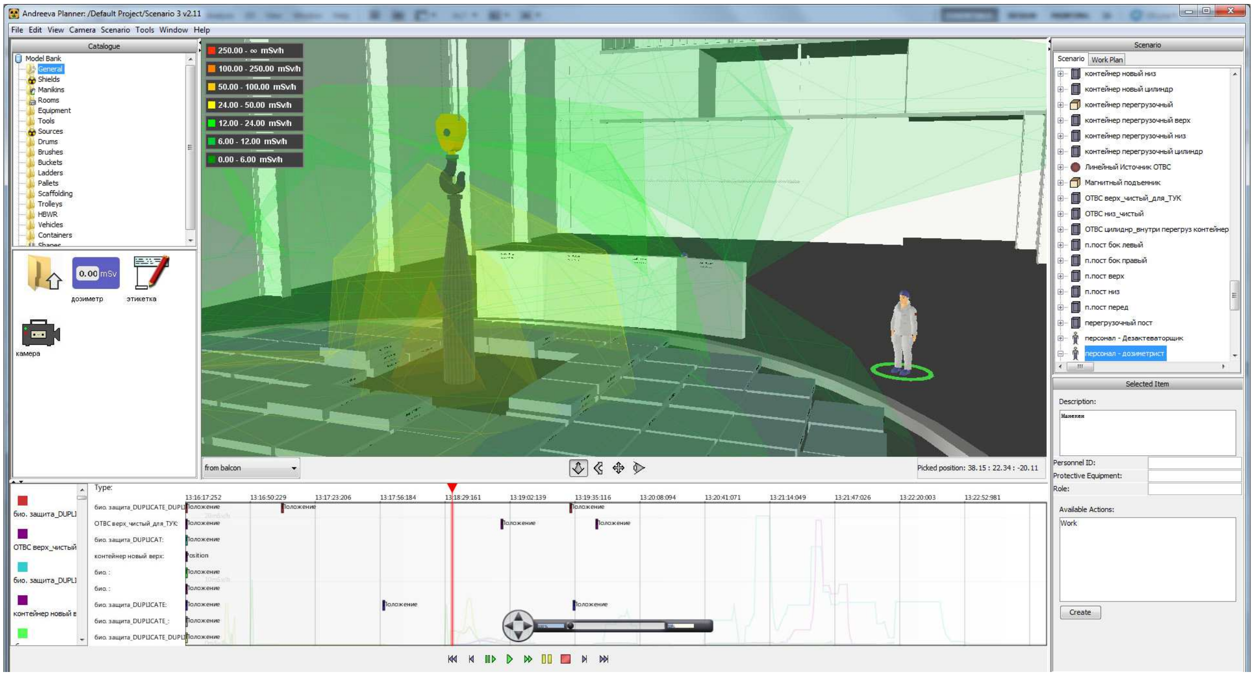

Fig. 4. Screenshot of «AP» software

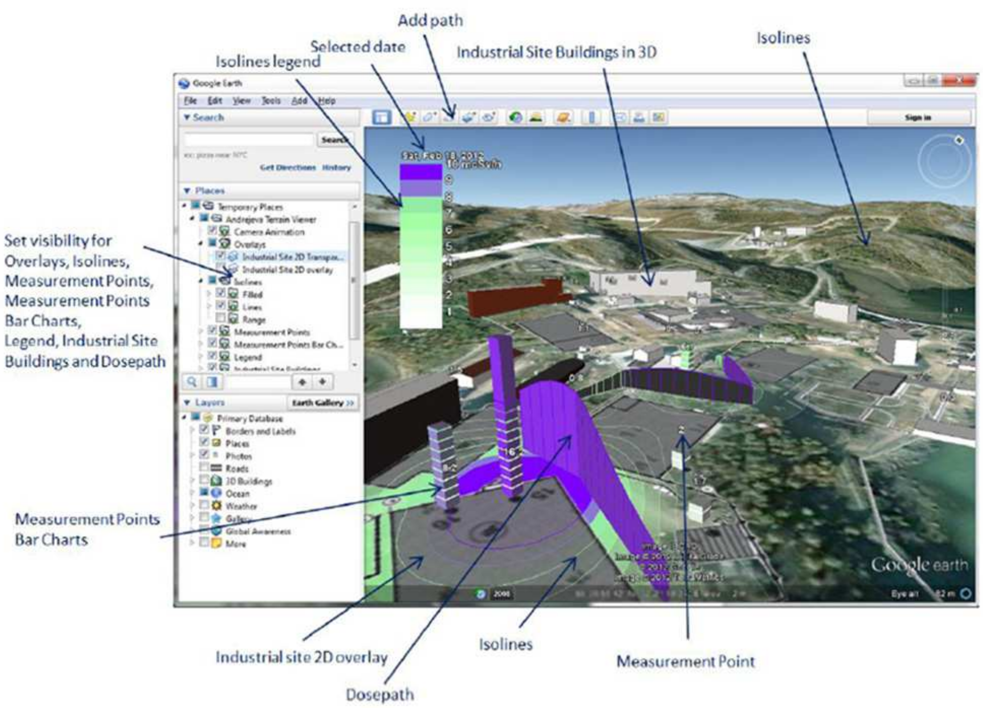

Fig. 5. Screenshot of «ATV» software

CONCLUSIONS

The examples above show how the IAS helps to solve problems of monitoring of the parameters of radiation situation.

For the operator and the regulator, in addition to informative, easy use of the program is important. This factor has received considerable attention in the design. The first version was introduced to SevRAO, but the operator had problems with using it, because of the cumbersome interface. Issues were a great time to enter the route and a large number of extra clicks when moving from one scheme to another. Then, through consultations with the operators and testing directly on the site, the software was further developed by our specialists. As a result, the time to enter the data into the program was significantly reduced and user interface was simplified. Most importantly, the operator realized that the use of this program will not increase, but rather will reduce operating time and thus help him.

Various types of imaging information can be used at all stages of scheduling as well as for training and dose assessment. Also, sharing of scenario files bring the exchange of data between the operator and the regulator to a new level. The System does not text documents, but 3d-interactive models and multilayered maps. This allows users and regulators better planning of future works.

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ACKNOWLEDGEMENTS

We would like to thank the Norwegian Radiation Protection Authority for financial support of this work, and Northwest Center for Radioactive Waste Management "SevRAO" - a branch of the Federal State Unitary Enterprise "Enterprise for Radioactive Waste Management" RosRAO" for providing data on the radiation situation and on the organization protective actions on site.