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REVIEW AND PURPOSE OF WEB APPLICATION – LOCAL REGISTRY OF POLLUTION SOURCES

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Abstract. *Web Application "Local Register of Pollution Sources" - (LRPS) is the result of research on the project "Improvement of the monitoring and evaluation of long-term exposure of the population pollutants in the environment by using neural networks". The structure and the content of the application are made in accordance with the Regulations on the methodology for the development of national and local register of pollution sources ("Official Gazette of RS", No. 91/2010), made in Joomla! Framework, using the programming language PHP/MySQL. For the management and review of electronic forms used is a software component Fabrik Joomla! Application Builder.*

Key words: *local register of pollution sources, web application, databases, pollutants.*

1. INTRODUCTION

There is no doubt that, as a result of increasing world population and modernization of cities, global system of environment is under increasing pressure. Air, water and land are under constant "attacks" caused mainly by the industries, which produce bigger pollution.

Industrial diversity and the different activities of the company in Serbia discharge various pollutants that emerge as a consequence of outdated technology, without the use of equipment for pollution reduction. The largest recorded polluters are energy sector, chemical industry, oil refineries, landfills, etc. [1]. On the territory of the Republic of Serbia there are a few black spots in terms of air and water pollution that significantly exceed established standards. Measuring changes in the global state of the environment and monitoring of these changes is an important step in raising and resolving questions about the state of environmental pollution.

Taking into account that the environment is exposed to various pollutants, the main problem arises when it is necessary to determine the sources of pollution and find the best solution in order to prevent further environmental pollution. Identification of individual

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pollutants and their quantities and concentration is the key to solving this problem. Determination of the effects of pollutants on the environment has three main objectives:

1. Determining the starting points of negative impacts;
2. Determining the relationship between the concentration of pollutants and the consequences that are manifested by the presence of pollutants;
3. Measuring the concentration of pollutants which the population and the local community is exposed to in a certain time period.

To identify the problems of environmental pollution, several methods that can help to determine potential contaminants have been developed. There are different checklists, GIS maps, matrices, internet applications, online networks and computer models.

For that purpose, since 2011, the researchers from the Faculty of Occupational Safety in Niš have been implementing the project "Improving the system of monitoring and evaluation of long-term human exposure to pollutants in the environment using neural networks", funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia. The project is divided into three sub-projects, including the sub-project titled "Creating an application for the establishment of the register release and transfer of pollutants into the environment." One of the results was created and established a Web application - Local Register of Pollution Sources (LRPS), with the proper data base for the City of Niš.

This application represents one of the segments of information systems on environmental protection at the city level. LRPS contains systematized information about pollution sources, types, amounts, manner and place of discharge of pollutants into the air, water and land, as well as the quantity, type, composition and method of waste treatment and disposal.

LRPS is designed for all taxpayers, local bodies, those institutions whose activities lead to environmental pollution in the form of emissions of pollutants in air, water and soil, as well as generation and waste management.

This paper presents the structure of Web application, content and manner of functioning. Web application enables the efficient provision of information and data that are consistent with international and European methodology. Based on the database, it is possible to monitor all waste flows and waste management, emissions of pollutants in air and water.

1.1. Previous research

Taking into consideration the well-known problems of environmental pollution and lack of citizens' awareness in this area, there is a need to develop adequate information systems that will report on the state of environmental pollution at the global level. This is how a unique Pollutant Release and Transfer Registers - PRTR [3] has been developed.

Pollutant Release and Transfer Registers (PRTR) is a database that includes the countries and organizations that collect data and report in the form of PRTR (Australia, Austria, Belgium, Canada, Chile, Cyprus, Croatia, Mexico, Norway, United Kingdom, Germany, etc., as well as international agencies and organizations: European Pollutant Release and Transfer Register E-PRTR, the North American Commission for Environmental Cooperation CEC, the United Nations Environment programme UNEP, the World Health Organization WHO, etc.). PRTR provides information about the sources of environmental pollution, the list of potentially hazardous chemicals and pollutants emitted into the air, water, land and the method of management and waste generation. Key elements of the PRTR system are:

- A list of chemical substances, the group of chemical compounds and other major pollutants that are emitted into the environment;
- Integrated multi-media reporting about a broadcast pollutants and waste into the environment;

- Reporting periodically (annually);
- Ensuring public access to the database.

This register provides information about the activities of industries and companies from around the world. It aims to help developing countries, how to apply and improve PRTR program. It was developed and is maintained by the Working Group of the Organization for Economic Co-operation and Development - OECD, in cooperation with the United Nations Economic Commission for Europe - UNECE and the United Nations Environment Programme [4]. The aim is to consolidate data on the sources of environmental pollution from several countries. Database represents the data collected at the national and regional level. It does not contain information about individual objects. The website PRTR can compile a report depending on the year, country, region, industry sector, type of source, type of release and transport of pollutants.

2. OBJECTIVE

The objective of implementating Web application LRPS is a response to the need for quality and accurate information about environmental pollution, requested by the companies that discharge pollutants into the environment. Identifying the sources of pollutant emissions, reducing pollution from power and industrial plants and other sources of raising awareness about the risk of environmental pollution, informing decision-makers about interventions towards pollution reduction and its harmful effects, are just some of the goals.. Registers of this type represent adequate and reliable information systems that contain information about a broadcast, and the movement of pollutants and waste through the environment.

3. METHODS AND MATERIALS

According to the defined objectives, the main research method is the analysis of documents, i.e. analysis of the legislative framework of LRPS application. To create a LRPS, the analysis of national legislation related to this type of registry has been conducted. For that purpose, the analysis involved the following documents:

- Regulation about the methodology for the development of national and local register of pollution sources, as well as the methodology for the types, methods and deadlines for data collection ("Official Gazette of RS", No. 91/2010) [5];
- Systematic list of settlements of the Republic of Serbia by districts and municipalities, Statistical Office of the Republic of Serbia;
- List of municipalities by districts with social security numbers of municipalities and county codes, Statistical Office of the Republic of Serbia;
- Classification of activity, Republic Institute for Statistics.

To achieve more efficient and simpler reporting on LRPS, the Regulation about the methodology for the development of national and local registers of pollution sources, as well as the methodology for the types, methods and deadlines for data collection ("Official Gazette of RS", No. 91/2010), included the following attachments:

- List of activities and minimal limit values for reporting to the National Register of pollution sources;
- List of activities and minimal limit values for reporting to the Local register of pollution sources;
- List of pollutants;

- List of pollutants emitted into the air depending on activity of the company;
- List of pollutants emitted in the water depending on activity of the company.

In addition to the above attachments, for the purposes of reporting LRPS the Regulation on waste categories, testing and classification ("Official Gazette of RS" No. 56/2010) included the following attachments [6]:

- Index number of waste;
- List of waste category (Q list);
- List of hazardous waste characteristics (H list);
- List of hazardous waste categories according to their nature or activities (Y list);
- A list of procedures and methods of waste disposal and recovery (D and R list).

Web application is created in Joomla! CMS (Content Management System)/ framework, which means that is not necessary to possess programming skills to manipulate of content of web application. For developing application, knowledge in programming is necessary, but after the completion of the development manipulating comes down to administration of the application by the client. Platform that Joomla! used is a PHP / MySQL. The recommended version for the "Local Register of Pollution Sources" is PHP 5.3.x MySQL 5.0.4+. Server used during the development and testing of applications is Apache 2.2.22. The entire software that is used is the Open Source Software family.

4. RESULTS

By entering application's web address in the web browser, there is the home page of application, which is shown in Figure 1. Instantly after entering the address, the user gets an insight into the structure and content of applications:

- General information about the database LRPS
- Who is obliged to report to register and fill in the required information
- How to log in and create an account for use of the application
- Video instructions for using the application
- Two drop down boxes to fill in and view the forms

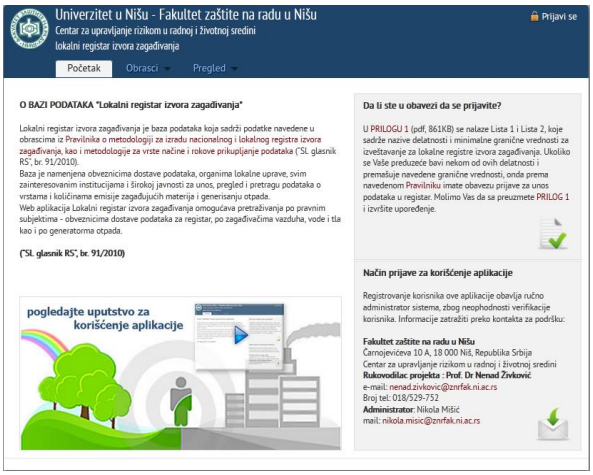

Fig. 1 Home page of Web applications LRPS

Accessing application is free for individuals and private entities. The system itself is organized so that it is possible to limit the role of site visitors. It is set on three levels:

- Public visitor (has the ability to just review the completed forms);
- Registered users of the application, i.e. subjects who fill in the forms about pollution (have the option of filling and changing the input data, as well as the views of all forms);
- An administrator who manages the users and entered data (has full control of the application).

LRPS consists of two drop-down menus where it is possible to fill a new and review already completed forms and they are related to the general data about the source of pollution, and information about the plant.

Depending on their activities, the users are given the option of filling the following form: emissions into the air; emissions into the water; emissions in the soil; waste management.
Input fields can be: basic fields - from the basic control input (text fields) and fields with declining menu.

The above forms, except for form 1.1, are finished with the standard form, with the fields for notes and memos.

Completed forms can be reviewed by anyone who accesses application in the "Overview", which is the same content as the "Forms".

After entering the data into the database LRPS perform an assessment of the completeness, consistency and credibility of the submitted data.

4.1. General information about the source of pollution

This form represents the users ID card, i.e. pollutants. It also provides: (1) basic information about the company - operator (name and location); (2) information about the responsible person of the company, and (3) information about the person who will cooperate with the administrator.

Filling in general data is a priority and continues to bring other data. All subsequent completed forms apply to a company or an operator. The general form is not necessary to be filled for each year, unless there are changes in the data.

4.2. Information about the plant

In this form, it is necessary to provide the data for plants that are located within the company. An important element of this form is entering the total number of discharges in air, the water, soil, and the number of types of waste that plant in its production process generates. In addition to basic information about the plant (plant name, address) of the required data needs to provide: (1) operation time of the plant during the year (the beginning of the season, the end of the season, the number of working days per week and per year); (2) The fuel used in the production process with daily consumption, mode of storage and the amount of stock; (3) The final products of the plant (name and description of the product, the annual production) and (4) the raw materials used in the production process.

4.3. Emissions into the air

At the beginning of this form one shall enter: (1) general information about the source (type of source, geographic coordinates, altitude sources, sources inside diameter at the

top, the mean annual temperature and velocity of the gases at the measuring point, the average annual output flow at the measuring point, the way of work sources - continuous or discontinuous); (2) The source activity during the year (the number of hours and days per year, the distribution of emissions by seasons - winter, spring, summer, autumn) and (3) the types of fuel used (total annual consumption, lower heating value of the fuel and fuel composition).

Depending on the activity in which they are engaged, the operators are required to provide data about pollutants emitted into the air. The operator that emits pollutants into the air is necessary to specify the substance on the basis of determining the balance sheet or emission measurements. Concentrations are entered for the annual average value measured in the flue gas at normal operation of the plant, as well as the emitted amount of concentration in accident situations.

The overview of the pollutants depending on the activities of the company is given in the form of contributions application - Appendix 3 - pollutants emitted into the air.

4.4. Emissions into the water

This form, which is the greatest according to its structure, consists of four parts:

I. Data on outlet effluent discharge to the environment: (1) Type of effluent discharged (sanitary, industrial, refrigeration, atmospheric); (2) The geographical coordinates of release; (3) The mode of release - continuous or discontinuous; (4) The projected capacity of the outlet; (5) The period for discharge; (6) Total amount of effluent per year; (7) Type sewer (river, lake, stream, soil, channel, city sewer, septic tank); (8) Name of the recipient; (9) Watershed.

The effluent treatment plants - if there is a plant for effluent treatment in the company, it is necessary to specify the devices that are used (mechanical treatment, chemical treatment, biological treatment, devices for heat exchange).

II. Data about the balance of emissions pollutants: (1) Name of pollutants discharged into the water (Appendix 4 - Pollutants emitted into the water); (2) The average annual value measured pollutants in effluent during the regular operation of the plant and in accident situations.

Recipient of effluent: (1) Name of pollutants; (2) The concentration of pollutants before discharge effluent; (3) The concentration of pollutants after discharge effluent.

III. Recipient of wastewater: (1) Name of pollutants; (2) The concentration of pollutants before discharge waste water; (3) The concentration of pollutants after wastewater discharge.

IV. General information about water systems (applies only to public utility companies): (1) The total surface area; (2) Percentage of total population connected to the water supply; (3) The amount of produced water; (4) The total amount of water supplied to households and all other consumers (industry and other institutions in the municipality); (5) The main industrial consumers - the name and business industries and quantity of water supplied.

General information on sewer systems: (1) Percentage of total population connected to sewers; (2) Determination of the method for measuring the amount of wastewater to the sewer system (volumetric or measuring equipment).

4.5. Emissions into the soil

Data for this form are the following: (1) Information about the location of waste disposal (geographic location coordinates); (2) The type of waste that is disposed of; (3) The amount of waste disposed during the year; (4) the total quantity of waste; (5)

Determining the method of waste disposal - waste disposal on the ground or deep injection; (6) Data on the balance of polluting substances (name of polluting substances in Annex 2 - List of pollutants, the concentration pollutants in the waste disposed).

4.6. Waste management

Waste management form comprises the following data:

I. Types and classification of this waste: (1) The geographic coordinates for the location of waste disposal; (2) The type and description of the waste; (3) Category waste (waste category list - Q list); (4) The index number of waste; (5) Character waste (inert, non-hazardous, dangerous); (6) Labels of hazardous waste characteristics (Hazardous waste characteristics - H list); (7) Category of hazardous waste according to the origin and composition (list of hazardous waste categories according to their nature or activities which creates - Y list); (8) Physical state of waste (solid - powder or chunks, viscous paste, liquid substance, residue); (9) The components that make up hazardous wastes: (a) The chemical name of the substance, (b) The amount of hazardous substances and (c) The amount of waste.

II. The second part presents a method of waste management. It is characterized by mode of waste transportation– who is the carrier and where the waste is disposed. Waste treatment and disposal operations are characterized by utilization of waste operations, which are detailed in the of D and R list (List of procedures and methods of disposal and reuse).

4.7. Who reports to LRPS?

Those companies - operators engaged in any of the activities listed in Annex 1 of the Regulation about the methodology for the development of national and local register of pollution sources, as well as the methodology for the types, methods and deadlines for data collection ("Official Gazette of RS", No. 91/2010), and whose capacity exceeds the set limit values are required to apply to register and enter the required information. In order to fill in the forms, the user needs to have an open account with an administrator. Sending a request via e-mail to the administrator, the users receive username and password which they can successfully log in to the registry and can fill patterns (see Fig. 2).

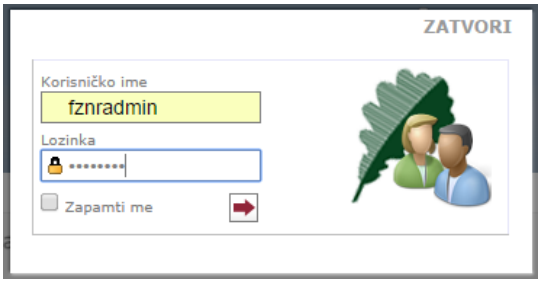

Fig. 2 Logging to register with the received user name and password

The information about whether the operator is obliged to report to the registry can be seen in the following scheme (see Fig. 3).

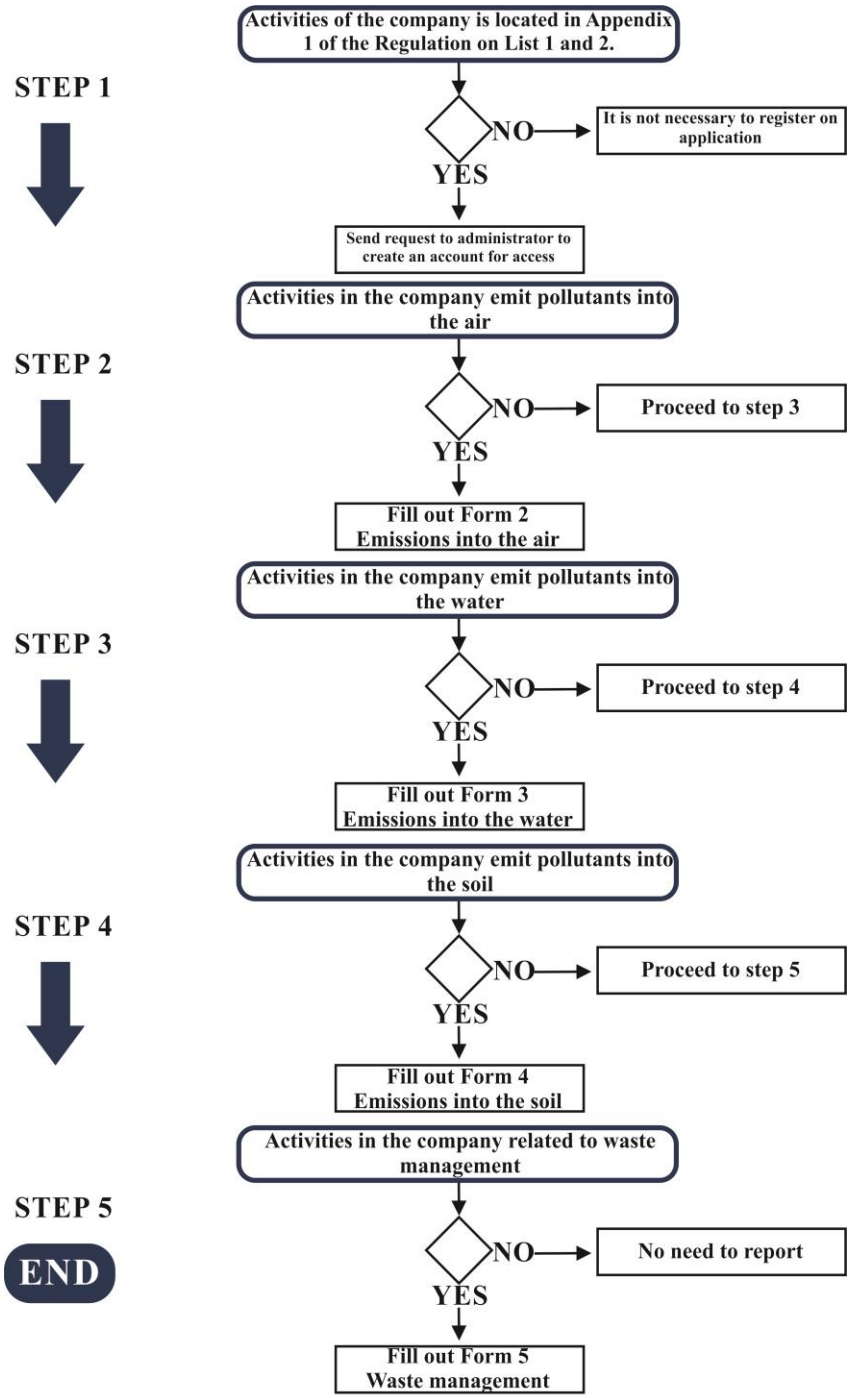

Fig. 3 Proceedings of registration and fill out forms for LRPS

5. DISCUSSION

The structure and content LRPS will follow modern trends in the provision of basic information about the state of environmental pollutants. The establishment of such a registry has certain advantages:

- Establishment of a database about potential pollutants whose activities may jeopardize the state of the environment;
- The list of pollutants emitted into the air, water and soil,
- Monitoring the flow of waste disposal and management;
- Monitoring the amount of emitted pollutants for a certain period of time.

Based on a database, local governments may follow the flows of pollutants' discharge. In this way it can be determined whether the company - operator, i.e. polluter contributes to environmental pollution, and whether he can set the priorities for preventive action in order to reduce or even eliminate pollutants.

LRPS represents a specific decision support system, whose data can be used in process multiple organizations. Increased concentrations of environmental pollutants can be correlated with the occurrence of respiratory disease in humans. Using these data can have a key contribution to the assessment of health risks. In addition, the database LRPS can have a major contribution to urban planning and design, in terms of determining the spatial distribution of pollutants.

LRSP needs to have a developed GIS mapping which is used to show the locations of the recorded emitted pollutants.

It is expected that LRPS system encourages operators at local level to reduce the level of emitted pollutants. The result of such a system can be a major instrument for the introduction of technologies for cleaner production. In this way costs and environmental degradation are reduced and efficiency is increased.

6. CONCLUSION

LRPS will establish a database of operators and polluters within the local community according to the activities they perform, as well as the information on pollutant activities that deteriorate the environmental quality in the local community.

This application provides information to the public about environmental contaminants, and it is a significant step in solving the problems environmental pollution and its negative impact on in the local community.

LRPS can be an important tool in the total environmental policy. Reporting to the media can encourage public authorities to take the necessary steps in pollution prevention and reduction. The development and constant improvement of LRPS can serve as the main motive for reducing pollution in many sectors of the economy.

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REFERENCES

1. The North American Mosaic: An Overview of Key Environmental Issues, Industrial Pollution and Waste.
2. Regional Association of Oil and Natural Gas Companies in Latin America and the Caribbean, Environmental Impact Assessment Process.
3. http://www.prtr.net/
4. http://www2.env.go.jp/chemi/prtr/prtrdata/prtr/localstart.php
5. Pravilnik o metodologiji za izradu nacionalnog i lokalnog registra izvora zagađivanja, kao i metodologiji za vrste, načine i rokove prikupljanja podataka ("Sl. glasnik RS" br. 91/2010).
6. Pravilnik o kategorijama, ispitivanju i klasifikaciji otpada ("Sl.glasnik RS" br. 56/2010).
7. Redžić N., Đorđević Lj., Dukić I., Misajlovski N., Mihailović L., Uputstvo registra izvora zagađivanja, Agencija za zaštitu životne sredine, Beograd, 2010.
8. Sara Mills-Knapp, Kira Traore, Bret Ericson, John Keith, David Hanrahan, Jack Caravanos, BLACKSMITH Institute, The World's Worst Pollution Problems: Assessing Health Risks at Hazardous Waste Sites, Zuirich, Switzerland.
9. Ministry for the Environment, A Guide to Preparing a Basic Assessment of Environmental Effects, ISBN: 0-478-30102-2, Wellington, New Zealand.

PRIKAZ I NAMENA WEB APLIKACIJE – LOKALNI REGISTAR IZVORA ZAGAĐIVANJA

Web aplikacija „Lokalni registar izvora zagađivanja"- (LRIZ) predstavlja rezultat istraživanja na projektu „Unapređenje sistema monitoringa i procene dugotrajne izloženosti stanovništva zagađujućim supstancama u životnoj sredini primenom neuronskih mreža". Struktura i sadržaj aplikacije je urađena u skladu sa Pravilnikom o metodologiji za izradu nacionalnog i lokalnog registra izvora zagađivanja („Sl. glasnik RS", br. 91/2010). Izrađena je u Joomla! framework-u, pomoću programskog jezika PHP/MySQL. Za upravljanje i pregled elektronskih obrazaca korišćena je softverska komponenta Fabrik Joomla! Application Builder.

Registar sadrži podatke o lokaciji – postrojenjima izvora zagađivanja, obimu i vrsti emisija u ambijentalni vazduh, vode i tlo, generisanju i upravljanju otpadom. Namenjena je operaterima i javnosti kao baza podataka o zagađivačima i emisiji zagađujućih materija u vazduh, vode i tlo na teritoriji razmatrane lokalne zajednice.

Ključne reči: *lokalni registar izvora zagađivanja, web aplikacija, baza podataka, zagađujuće materije*