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Information Technology in the Field of Nuclear and Radiation Safety

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(Dated:)

Here we discuss information technology and free software, which realizes different sides of business process in the field of nuclear and radiation safety. Such software should ensure the implementation of the control functions for the radiation safety of ionizing radiation sources, supervision for safety in the construction and commissioning of the Belarusian nuclear power plant etc. It is given a description of framework eLab that is the basis of software for nuclear and radiation safety including review of educational and research portal of nuclear knowledge BelNET and system eLab-Atom for control of ionizing radiation sources.

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1. Introduction

Information technology based on free software in the field of nuclear and radiation safety should include the implementation of the control functions for the radiation safety of ionizing radiation sources, supervision for safety in the construction and commissioning of the Belarusian nuclear power plant etc.

Free Software is a wide range of software solutions, protected by licenses, which provide the user the right to unlimited installation, as well as the study, free use, modification and transfer of programs.

In connection with the global trend (including Belarus and Russia) of active transition to free software and restrictions on use of Microsoft and other multinational companies products, it is obvious need for development of software systems, working not only on the Windows operating system, but also under various versions of Linux.

In 2010 the Russian Federal Government approved the plan for the transition of federal executive authorities and federal budget agencies to use free software. In 2014–2020 it is planned transfer of technology services of the Russian e-government, developed using licensed commercial software (Oracle, IBM and Microsoft) to free software and trusted (devoid of undeclared capabilities) hardware and system software. In connection with the entry of Russia, Belarus and Kazakhstan in the Customs Union and the process of unification of legislation in all areas of life, the transition to free software becomes relevant for Belarus too.

In addition, the Republic of Belarus pays great attention to the safety of information systems. Free software with open source has several advantages over proprietary software. Using the free software makes it easier to ensure the security and verification processes of developed software and allows complete certification procedure, as the source code of such software, and technical documentation that describes the product architecture, protocols and standards of interaction are in the public domain. Thus, formal technical barriers to certification of open source software are removed.

Here we describe Belarusian free software that is used for information technology in the field of nuclear and radiation safety and in other areas of the economy.

2. Framewok eLab

The framework eLab is a skeleton of software system that carries sockets in which plug-in modules (or extension points) are placed. This system has a client-server architecture based on free software: Debian GNU/Linux, Web-server Apache, the Firebird database server using PHP application server. The system runs under Windows and Linux operating systems. The work is carried out through the Internet in multiplayer mode, with the division of access rights by way of widespread browsers: Internet Explorer, Mozilla Firefox, Google Chrome, Opera etc.

eLab distinctive features are the next: division of databases on the system database and user database, maintaining the current state of the user interface, work in real-time with opening data pages in less than half a second when using the internal (corporate) network. eLab is completely secure from unauthorized access. It has a fast response to user requests, providing visibility and accessibility of information through a single interface for a wide range of integrated applications for users with different rights of access. It proved to be a system easily upgradable to conditions of the project.

Distinctive characteristics of the system eLab are the following:

1) ability to extend the functionality of the system;

2) customizable user interface and the preservation of its current state;

3) fast convenient system of sorting, filtering and retrieval of data;

4) automatic update and display the current status of the sampling, simple insertion mechanism, editing, deleting records, editing multiple records simultaneously;

5) validation of input data, the abolition of common mistakes;

6) exclusion of input data duplication;

7) automatic generation of output documents for reports in prescribed form;

8) possibility for user to make changes to the templates of the final documents;

9) separation of user credentials;

10) exclusion of the human factor and related shaping errors in records and output documents.

In 2012, the system eLab-Fuel (electronic document management system of the testing laboratory) put on combat duty in 202 Chemmotology Center of the Fuel for quality monitoring and management of specimens, measurements and passports of fuels and lubricants of the Belarusian Armed Forces [1].

eLab is implemented in the educational process of leading Belarusian universities: Belarusian State University, Belarusian State Technological University, Belarusian National Technical University. It is introduced in the Chemical-toxicological laboratory of the Minsk Drug Treatment Clinic. eLab is been a basis of management of fuels of Belarusian branch of Russian company GazPromNeft since 2013.

3. Portal of nuclear knowledge BelNET

Creating specialized educational and research portal of nuclear knowledge BelNET (Belarusian Nuclear Education and Training) is an important step at the stage of the Belarusian nuclear power plant construction, since by the International Atomic Energy Agency (IAEA) recommendations, each country that forms its own nuclear industry must

have an original national portal of nuclear knowledge, integrated into the global nuclear knowledge management system.

Formation of the Belarusian nuclear power industry requires the immediate development of modern computer technology and the creation of various information systems, providing a stable, secure and efficient development of the country's nuclear power industry. The IAEA pays big attention to the problems of nuclear knowledge management. Nowadays, numerous national and international portals of nuclear knowledge were created in Europe, Asia, Africa and America under the patronage of the IAEA. It is planned to develop an international network of information resources on nuclear knowledge. This means that a unified information space in the field of nuclear knowledge is being formed in the world.

Every developed country with its own nuclear industry has to create and maintain a national portal of nuclear knowledge, integrated into a global system of nuclear knowledge management. In the light of creation of Belarusian nuclear industry and construction of Belarusian nuclear power plant, development of electronic portal of nuclear knowledge is an insistent need for Belarus.

The development of computer technology, new requirements for the volume, complexity and speed of information transfer, as well as the rapid growth of mobile applications with specific requirements on the amount and form of presentation of information demand new effective algorithmic, architectural and software solutions. The portal of nuclear knowledge should be a complex programming system based on such modern technologies. Also, in the light of rapid growth of popularity of free software in the world, it would be good if the portal was developed on the Belarusian free software. So, creating such a portal is not just the development of a simple website, like such as millions in the Internet. The portal must meet the requirements of safety, reliability, efficiency, performance and reflect the national features of nuclear knowledge content.

Portal BelNET is developed by the group of scientists and teachers of the Ministry of Education of the Republic of Belarus and is intended for students, teachers and all interested in the subject Internet users.

The mission of BelNET is creation of favorable information, socio-cultural and educational environment for the sustainable development of the country's nuclear power industry. It has the following objectives: acceleration of search and access to necessary data and information, creation of new knowledge, promotion of participation in research, education and training programs in nuclear industry, management of information resources, knowledge and competencies of nuclear industry in Belarus.

Belarusian content management system (CMS) eLab-Science for educational and scientific portal based on the framework eLab was developed and implemented all necessary functions of the portal, including the ability to remotely edit the portal structure and recording documents, various sorting and filtering tools, as well as two level of access to documents depending on the user rights. It provides, inter alia, the ability to enter text, formulas in LaTeX-like form, input of different types of files, photos, images, video, develop lab works and tests etc.

The main principles of BelNET operation in the frame of eLab-Science are the next. Users with different rights of access such as high school and university students as well as university professors and specialists visit on-line BelNET portal from their computers and laptops. Depending on their rights of access they can read documents available in open access, limited access or restricted access areas. With a user name and a password with appropriate rights, one can enter new documents on-line, or edit the existing ones or execute or develop lab works and tests etc.

So, principles of organization of users access in the portal BelNET are the following:

- multiplayer mode;
- data entry by filling in web forms in on-line mode;
- separation of access rights of different categories of users to data and user interface;
- work through the Web-based interface by the widespread browsers: Mozilla Firefox, Google Chrome, Opera and others.

At present a pilot version of BelNET is located in the Internet at this address: http://lar.inpnet.net/el/belnet/(see Fig.1). At the moment, the portal content includes more than 400 different documents. We emphasize that the process of filling the portal by information and development of special materials for distance learning is the process time-consuming and lengthy. In this sense, the work on BelNET is at the beginning [2]–[8].

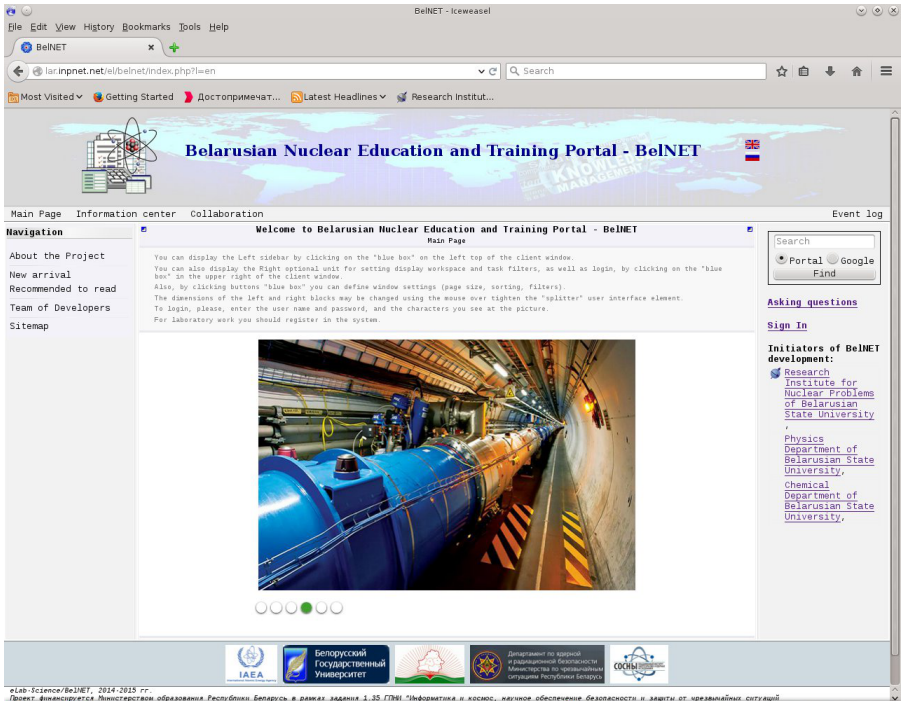

Figure 1: Main page of BelNET

Now moment the following sections of the portal are under work:

- Management of nuclear knowledge,
- Nuclear energy as a factor of sustainable energy development,
- Basic science,
- Applied science,
- Glossary,
- Analytical review of the terms,
- Laboratory works for students,
- Radiochemistry,

- Water-chemical regimes of nuclear power plants,
- Biographies of Belarusian scientists.

So, BelNET content in the area of nuclear knowledge includes a glossary, monographs, textbooks, materials of international scientific conferences, analytical review of terms "Ionizing radiation physics" and "Dosimetry units" with regard to regulating and standardizing documents. Training modules "Management of nuclear knowledge" and "Nuclear energy as a stable energy development factor" are created in the form of podcasts. They include lectures in audio and video format, tests and laboratory works.

A cycle of laboratory works on the passing of ionizing radiation through matter that can be performed using publicly available Internet resources is developed for students, undergraduates, and any Internet users who are interested in this subject.

4. System eLab-Atom

Purpose and main tasks of software of control of ionizing radiation sources in accordance with the current legislation of the Republic of Belarus are registration radioactive sources, account and control their radiation safety status, monitoring and provision of information on the status of radioactive sources, including those in storage and burial of radioactive waste, monitoring treatment of radioactive sources, ensuring the supervision of the radiative safety of ionizing radiation sources, promoting law enforcement authorities in the investigation of cases of illicit trafficking of radioactive sources and radiological emergencies, analysis of security status of sources of ionizing radiation and providing awareness corresponding bodies of the Republic of Belarus, as well as International organizations in accordance with the obligations of the Republic of Belarus.

On the basis of the framework eLab software eLab-Atom for control of ionizing radiation sources was developed [3]. Fig.2 gives a screen copy of the work of program eLab-Atom.

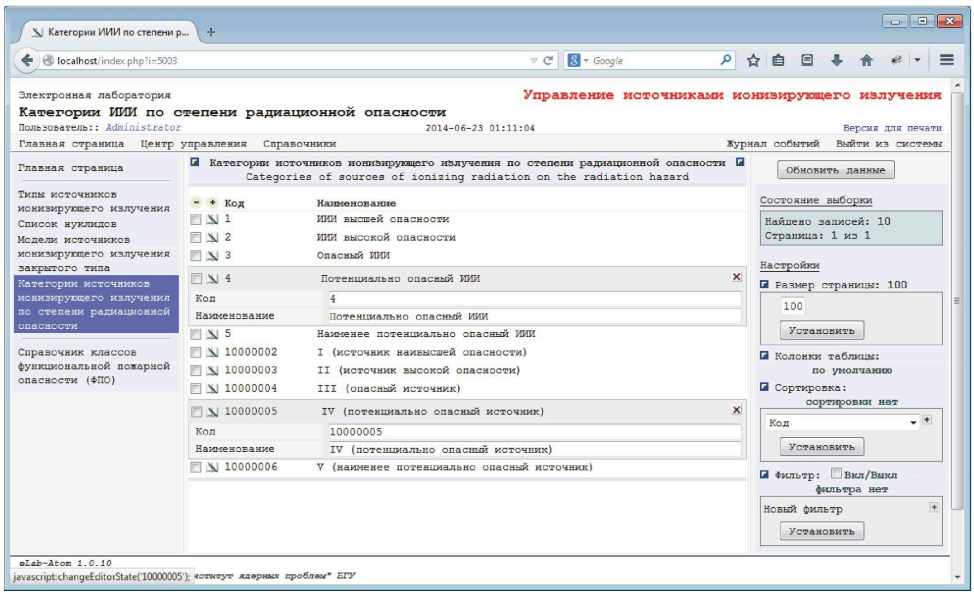

Figure 2: Screen copy of eLab-Atom work

5. eLab applications

Possible applications of software products developed on the basis of framework eLab in the field of nuclear and radiation safety can be the next:

- electronic document management system in the nuclear industry;
- laboratory information system in the nuclear industry;
- system of accounting and control of trafficking in explosives and other hazardous substances.

The two first points can be realized as software for control (supervision) over safety in the construction and commissioning of the Belarusian nuclear power plant, including control (supervision) of equipment, systems and components of generating units No 1, 2 of the Belarusian nuclear power plant and information system with electronic database of records and control of radioactive waste.

Educational and research portal of nuclear knowledge BelNET in the long term should be extended up to specilized electronic portal of nuclear knowledge. On the basis of CMS eLab-Science, there is a possibility of realization of future educational and scientific portals of various profiles.

Software eLab is protected by four Certificates of the National Intellectual Property Center of the Republic of Belarus for registration computer program:

- No 051 "Laboratory information management system" (2008),
- No 677 "Electronic document management system of testing laboratory on control the quality of fuels for heat engines" (2014),
- No 683 "Software of control system of ionizing radiation sources" (2014),
- No 843 "Management system of educational and research portal" (2015).

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