Chernobyl NPS caused grave consequences for the health of the liquidators. The results of the exposure to β-radiation were "nuclear sunburn" e-skin blackening of faces and hands of the first liquidators, and nuclear quinsy e-continuous hoarse cough due to throat and bronchia burn.

STRUCTURE OF SOFTWA RE AND HARDWARE COMPLEX FOR MONITORING AND CONTROL OF PARAMETERS AND MODES OF SOLAR COLLECTORS

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Some characteristics and features of structure of software and hardware complex for monitoring and control of parameters and modes of solar collectors are considered, that will allow realizing remote automated operation with this equipment that is difficult to maintain, as well as located in hard-to-reach places, and make prerequisites for rather effective and optimal solutions of its using.

Keywords: structure, software and hardware complex, monitoring and control, solar collectors.

Currently, due to the large demand of the automated management of various devices and the measurement of various media parameters, there have been proliferated different software and hardware complexes for monitoring and control of large amount of parameters and modes and special embedded systems – microprocessor (microcontroller) hardware and software management systems that are intended, as a rule, for functioning in the devices that are controlled directly by them. Such devices can be applied to automated or automatic adjustment and manufacturing control equipment, telecommunications equipment, machines with computer numerical control, automated teller machines, payment terminals, etc. It is also advisable to use similar systems in the field of renewable energy in order to optimize the operating modes of the corresponding equipment.

One of the software development platforms for such systems are Microsoft .NET Micro Framework or Arduino. They allow in environments Microsoft Visual Studio or Arduino IDE using the C# or C++ programming language to create applications for different embedded devices, which are characterized by the minimum weight, size and power consumption as they are placed within more complex equipment. These platforms are rather popular because the code (managed for C# language) is created using a high-level language and it simplifies the process and reduces the time of software development for hardware platforms. In this, during stand-alone functioning of the debugging board it is not required to use a computer with an operating system and development environment later.

Some of the application areas of mentioned above systems in the environmental problems:

- collecting and processing of data from sensors located in different equipment, for example, such as used in the renewable energy sector;
- remote monitoring and control of equipment parameters of the industrial and infrastructure facilities;
- building of geographically distributed systems of data collection and processing for monitoring of environmental parameters, and the like.

To test the effectiveness of using microcontroller embedded systems for solving environmental problems it is planned to develop an automated system for monitoring and control the status and operation of solar collectors. Key features of this system and its developed functional structure:

- data collection for the building of various dependencies of temperature and its differences from time in specific places of equipment;
- calculation of energy performance for a predetermined periods and formation of data for charting characterizing energy efficiency of equipment;
- monitoring of the current values of equipment's parameters;
- control of different equipment's operating modes.

In solving of presented problems for software implementation, deployment and debugging of software directly on the physical device can be used the following:

- debugging board with the microcontroller of ARM Cortex M or AVR architecture;
- sensors, actuating devices and shields (expansion cards);
- computer to which the debugging board is connected;
- installed integrated development environment and software framework and development tools (kit).

Thus, developed functional structure of software and hardware complex for monitoring and control of parameters and modes of solar collectors will allow to create a mentioned above system that can realize remote automated operation with solar collectors that are difficult to maintain, as well as located in hard-to-reach places, and make prerequisites for rather effective and optimal solutions of its' using.

SPATIAL-TEMPORAL CHANGES OF EMISSIONS OF POLLUTING SUBSTANCES IN ATMOSPHERIC AIR OF BELARUS

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Atmospheric air is one of the vital elements of the environment, a favorable condition which is the natural basis of sustainable socio-economic development of the state. In the work of the basic indicators characterizing state of atmospheric air of the Republic of Belarus for the period from 2010 to 2016.

Keywords: atmospheric air, quality, pollution, greenhouse gas, assessment.

Air condition is largely predetermined volumes of pollutant emissions from stationary and mobile sources. During the 2005–2016 there is a general tendency to reduce them. Since 2010 total emissions of pollutants into the atmosphere has stabilized, while there was a slight increase from their stationary sources and the reduction from mobile sources. In 2015 it noted a significant reduction in pollutant emissions of mobile sources in comparison with the previous two years (from 881–928 to 801 thousand tons) and an increase of 22,8 % compared to 2010 emissions from stationary sources (from 377 to 463 thousand tons) [1].

The highest emissions are typical for industrial centers (Navapolack, Mazyr, Minsk – more than 30 thousand tons), as well as the values of emissions per unit of area (more than 15 tons / km2 for the listed cities) and 1 person. (Mazyr, Navapolack, Kasciukovičy, Novalukomĺ – to more than 250 kg per person).

The structure of emissions from stationary sources by economic activity is characterized by an increase in the share of agricultural organizations (from 13,2 % in 2010 to 33,7 % in 2016) and a decrease in the share of manufacturing companies (with 49,6 % to 40,2 %). Share of organizations of other types of economic activity compared with 2010 has not changed significantly.

A significant impact on climate change, greenhouse gas emissions have. The main greenhouse gas in Belarus is carbon dioxide (CO2), whose share in the greenhouse gas emissions of CO2 equivalent of about 65,0 %, followed by methane (CH4) and nitrous oxide (N2O), each more than 17,0 %, respectively, the proportion of HFC, and SF6 is practically zero, and thousandths of a percent. During the period 1990–2015 carbon dioxide emissions have decreased by 41,7 %, nitrous oxide at 29,0 %, methane emissions increased by 8,3 % [2]. Sources of greenhouse gas emissions in Belarus are primarily the "Energy", "Agriculture" and "Waste".

According to the results of observations of air quality in the framework of the National Environmental Monitoring System found that during the 2005–2016 the content of pollutants in the air most of the cities controlled by the Republic of Belarus was below the maximum permissible concentration (TVL). The proportion of samples with concentrations of pollutants from 0.5 MAC or less accounted for 93,0 %, and the number of samples exceeding the maximum single TVL, in 2014 amounted to 0,9 %.

Air condition industrial centers of the country quite well. For a long period, the average annual concentrations of most of the regulated pollutants below the MRL and the number of days with average daily concentrations of particulate matter PM-10 in the air above the TVL in most monitored cities (Mahilioŭ, Žlobin, Hrodna, Salihorsk, Polack, Navapolack, residential areas of the city of Homieĺ, Viciebsk and Minsk) is significantly lower than the EU countries to target. Only occasionally average daily concentration of nitrogen dioxide and sulfur dioxide exceeded the TVL in certain cities [3].

BIBLIOGRAPHY

1. National Statistical Committee of the Republic of Belarus [Electronic resource]. – Access mode: http://www.belstat.gov.by.

2. National report on the greenhouse gas inventory of the Republic of Belarus [Electronic resource]. – Access mode: https://unfccc.int.

3. National Environmental Monitoring System of the Republic of Belarus: the results of observations, 2005–2016 [Electronic resource]. – Access mode: http://www.nsmos.by.