COMPUTER–AIDED SAFETY SYSTEMS OF INDUSTRIAL HIGH ENERGY OBJECTS

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ABSTRACT

The addressing of fire safety problems of large–scale industrial objects by means of Computer–Aided Fire Safety Systems (CAFSS) are considered in this paper.

Modern objects of fuel and energy, chemical industries are characterized: by high power consumption; by presence of large quantities of combustible and explosive substances used in technological processes; by advanced communications of submission systems of initial liquid and gasiform reagents, lubricants and coolants, the products of processing, and wastes of production; by advanced ventilation and pneumatic transport; and by complex control systems of energy, material and information flows. Such objects have advanced infrastructures, including a significant quantity of engineering buildings intended for storage, transportation, and processing of combustible liquids, gasiform fuels and materials, and firm materials. Examples of similar objects are nuclear and thermal power stations, chemical plants, machine–building factories, iron and steel industry enterprises, etc.

Failures at such enterprises are classified as "heavy." They are dangerous not only for staff of these enterprises, but sometimes for the whole region. Such failures are characterised by high material and social damage. According to research conducted by the Higher Engineering Fire Service Technical School (HEFSTS), the reason for heavy failures at the mentioned objects is fire or explosion.

Many tasks and functions characterising the problem of fire safety of these objects can be accomplished only upon the development of special Computer–Aided Fire Safety Systems (CAFSS). The principles of construction and functioning of CAFSS have been developed by the Special Electrical Engineering, Computer–Aided Systems and Communication Department of HEFSTS, jointly with other academic and trade scientific research institutes and design offices of Russia.

The CAFSS for these objects are intended to reduce the hazard of disastrous accidents both causing fires and caused by them. The tasks of fire prevention and rescue work of large–scale industrial objects are analysed within the bounds of the recomended conception. A functional structure of CAFSS with a list of the main subsystems forming a part of its composition has been proposed.

According to the recommended conception, CAFSS should be designed as a single complex, organizing technical and software components, which has a multilevel hierarchical structure.

A great deal of attention in this conception is devoted to the problem of providing the object with fire safety while it is still in the design stage. The Computer–Aided Designing Fire Safety System (CADFSS) is a part of the CAFSS. The purposes of CADFSS are to work out constructive planning solutions to reduce the probability of fire breaking out and spreading. Among other purposes of CADFSS are the choice and combination of active and passive methods of fire protection, choosing and placing the systems of fire protection equipment, etc.

A data base of fire–prone outages of equipment elements must be created for storing and further processing in the framework of the Computer–Aided Fire Safety Informative System (CAFSIS). This data base can be processed by the method of probability analysis for defining the work to capacity of different equipment elements. Based on this analysis, recommendations can be formulated for a period of conducting preventive repairs, replacing equipment by new equipment, or changing its work regimen.

Reducing the hazard of disastrous accidents and decreasing their negative effect on environment and people is closely connected with the creating of systems simulating and forecasting fire–prone situations which may occur. These systems are a powerful tool for monitoring technological control objects by means of generating control commands which may correct a technological process or completely stop it in urgent situations. Consequently CAFSS should be either integrated into the Computer–Aided System of Control Technological Processes (CASCTP) or made as an independent system (Topolsky 1994). Both systems should be made on the same computer hardware components, with an organizing information–control interface.

An increase in functioning reliability of all levels of CAFSS is ensured by the complex integrating and duplicating of the most important items of information, and also by using different hardware and software decisions.

The quality evaluation of CAFSS application efficiency is shown by an essential increase in discovery and effective localization of fire–prone situations by means of automatic fire equipment and fire brigades. Consequently, the level of object fire safety increases. The application of computer–aided systems creates the prerequisites for the improvement of fire brigades and actions to organize industrial object personnel for fire–fighting.

The possibility of acceptance of well–founded solutions to liquidate critical situations is ensured by the automatic analysis of information received from fire alarm sensors and from an object's technological equipment, with the consideration of computer–aided forecasting. The continuous control of automatic fire equipment's capacity for work makes it possible to increase the reliability of its work, and to reduce the equipment stoppage time connected with the search for equipment outages. The CAFSS makes it possible to realize continuous control for carrying out of the object's fire safety measures.

The social efficiency constituent of CAFSS quality evaluation includes the following socially significant components:

- first, personnel's confidence that their life and health are reliably protected from the influence of fire dangerous factors;
- second, an essential reduction of personnel fluctuation and population migration from regions where large–scale industrial objects are placed;
- third, an increase in the efficiency of work productivity and social productivity by means of the combined action of the first two factors; and,
- fourth, an essential reduction of the probability of fire sacrifices and injuries to people during the action of fire dangerous factors.

The recommended approach was used for working out fire safety systems for the new generation of nuclear power plants, industrial enterprises with high power available per worker, and other objects.

REFERENCES

Topolsky, N.G. 1994. *Automatization of Nuclear Power Stations Fire Service Safety Systems*. Higher Engineering Fire Service Technical School, Moscow, Russia.