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Regularity Of Localization Of Fires At Energy Facilities In Uzbekistan

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ABSTRACT

In the article, the author analyzes emergencies at power plants in Uzbekistan, including research by scientists who conducted their research on extinguishing and localizing fires with the use of appropriate technical means at energy facilities, taking into account the observance of safety measures for energy facilities that have the property of electric shock to firefighters. In addition, the author provides a mathematical analysis of a fire event using the multi-interval method and formulates the appropriate conclusions. At the same time, the author proposes the use of the latest information technologies in extinguishing fires of this kind.

KEYWORDS

Fire, fire safety, hydroelectric power plant, thermal power plant, power engineering facility, fire extinguishing, automatic fire extinguishing, fire equipment, forces and means of fire rescuers.

INTRODUCTION

In the Republic of Uzbekistan, special attention is paid to energy facilities, since the fires that occur at these facilities negatively

affect the entire economic infrastructure of society,

including both the production and housing sectors.

In the energy sector alone, work has begun on the construction of six new power plants on the basis of public-private partnership with foreign investors.

They have a total value of \$ 2 billion and a capacity of 2,700 megawatts¹.

In addition, new power plants with a total capacity of 760 megawatts will be commissioned in Tashkent, Navoi, Samarkand and Surkhandarya regions.

According to the research of Doctor of Technical Sciences A.D.Ishchenko "One of the most important aspects preventing the further development of a fire that has arisen is the organization of continuous fire extinguishing from the moment the fire extinguishing agents are supplied to localization.

METHODS OF RESEARCH

To fight fires in these premises, various technical solutions are used, for example, fire safety systems in buildings and structures. The effectiveness of these solutions is considered in a relatively short period of time (10-15 minutes), although it is obvious that these solutions can sufficiently improve the working conditions of fire departments when carrying out work related to extinguishing a fire that arrived in the shortest possible time. But, as a rule, dense smoke complicates the work of the links of the gas and smoke protection service (GSPS), thereby making it possible for a fire to develop according to its own scenario.

As you know, for work in an environment unsuitable for breathing, firefighters use breathing apparatus with compressed air and compressed oxygen.

¹ Appeal of the President of the Republic of Uzbekistan Shavkat Mirziyoyev to the Oliy Majlis in the 2020 year 29 December // President.gov.uz.

Energy facilities have their own specifics: design features (horizontally developed rooms with large volumes), the presence of a significant amount of a combustible load with increased smoke-generating ability, etc. For example, the cable tunnels within the computer room consist of several cable corridors, divided into compartments (each corridor is divided into compartments) with a length of no more than 100 m. The total length of the cable tunnels is about 1000 m. In cross-section, each cable tunnel is 220x260 cm. fire localization cable tunnels are divided into several compartments by fire partitions with fireproof doors. In some places, the length of the compartments reaches more than 100 meters. The fire hazard of cable structures depends on the material used for braiding and insulating wires and cables, so for insulation and protective covers, combustible materials are used: polyethylene, PVC cable plastic, rubber, paper, bitumen, oil. Ignitions in cable tunnels are accompanied by high temperatures, scattering of molten metal sparks during a short circuit, and a high speed of combustion and smoke propagation. The linear speed of propagation of combustion in cable tunnels is 0.8 ... 1.1 m / min.

Do not forget that when the GSPS link moves in conditions of dense smoke, the link speed decreases several times. Such a variant of events is possible when the GSPS link does not have time to reach the fire source. This is facilitated not only by dense smoke, but also by the insufficient time of the protective action of the DASV, which does not allow to overcome the tunnels, in view of their complex layout and length. As a result, the GSPS link was forced to leave the VAT to change the compressed air cylinders, without starting to localize the fire source. Also, with a large number of unit changes, the load on the personnel increases"².

² Ищенко А.Д. Теория локализации пожаров в зданиях объектов энергетики: Диссер. на

The modern development of technical means of fire extinguishing undoubtedly requires the development of appropriate vehicles for delivering firefighters to the fire site. In this regard, the approach of the researcher M.V.Aleshkov, who offers fire fighting equipment for eliminating fires and accidents at energy facilities, is of certain interest³.

In addition, the fire extinguishing system at the power plant also requires improvement. So, when nuclear weapons explode at an altitude of more than 30 km, an electromagnetic pulse with a field gradient of up to 50 kV/m appears near the earth's surface. Due to the wide and increasing use of low-voltage highly sensitive microelectronic and microprocessor equipment in the power industry, an electromagnetic pulse of a high-altitude nuclear explosion (HEMP) is perceived by many world armies as a promising weapon for destroying the foundations of the infrastructure of any country, i.e. electric power industry. For example, many countries have recently begun to develop protective equipment to protect electrical power equipment from HEMP. However, in addition to electronic and electrical equipment that is directly involved in the production, transmission and distribution of electricity, there is another type of highly sensitive electronic equipment that is not directly involved in these processes, but can interfere with them. These are fire extinguishing systems installed at any power plant and electrical substation⁴. If, for example, we take

the accident at the Talimarjan TPP that occurred on January 5, 2021, then according to the primary data, due to the triggered technological protection, an unscheduled shutdown of the Talimarjan TPP's combined-cycle plants took place. As a result, there was a surge in capacity on transit lines connecting the Unified Energy System of Central Asia with the Unified Energy System of Russia and Kazakhstan, which led to the disruption of the stability of parallel operation⁵. All this testifies to the use of automatic protection for the functioning of energy facilities.

In this regard, it is necessary to turn to the large fires that occurred in the Republic of Uzbekistan at energy facilities. For example, in 1981 at the Syrdarya SDPP, 30 working blades of the low-pressure cylinder stages broke off at power unit No. 4, which caused a fire, which led to the failure of 10 power units of the station with a capacity of 300 MW⁶. The arithmetic downtime after the accident was: for power units No. 1,2,4-1382 hours, No. 3-927 hours, No. 5-564 hours, No. 6-658 hours, No. 7-290 hours, No. 8-80 hours, No. 9 –108 hours, No. 10–27 hours. The total downtime of the power units of the Syrdarya SDPP was 4036 hours. Which corresponds to 168 working days. The reason for this fire was insufficient technical monitoring of the operation of the low-pressure turbine unit. Unfortunately, this sad fact was repeated 9 years later, namely in 1990 at the same Syrdarya SDPP there was a fire in the working blades of the last stage of the low-pressure cylinder of turbine unit No. 7, which led to a fire. Three power units of the station with a capacity of 300 MW were shut down. Turbine unit 7 was completely destroyed, and the roof of the engine room from 33 to 36 axles was also rendered

соиск. уч. степени док-ратехн. наук.-М., 2020 г.-С. 122-123.

³ См.: Алешков, М. В. Пожарная техника для ликвидации пожаров и аварий на объектах энергетики / М. В. Алешков, О. В. Двоенко, И. А. Ольховский // Энергосбережение и водоподготовка. – 2012. – № 2(76). – С. 69-72.

⁴ Vladimir Gurevich Improvement of HEMP Resilience of Automatic Fire Suppression System//International Journal of Research and Innovation in Applied Science (IJRIAS) |

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⁵ Источник: Podrobno.uz 8.01.2021.

⁶ It is regrettable that it was in this year (1981) that this station had just begun its work.- authors' note.

unusable, including damage to the turbine generator and auxiliary equipment. The damage amounted to about 73 million rubles (in 1990 prices), downtime for power unit No. 1–7005 hours, No. 2–3806 hours. The total amount of time lost due to the fire accident was 10,811 hours, which corresponds to over 450 days. It follows from this that the fire accidents at the Syrdarya SDPP tended to increase material harm and loss of working time compared to the incident in 1981, by almost 62.66 percent, which actualizes the issue of ensuring fire safety at energy facilities in Uzbekistan.

Analysis of fires at energy facilities in the Russian Federation has shown that the direction of development of fire fighting equipment is also determined by the situation that develops during the elimination of fires and the consequences of emergencies. So, during the elimination of the consequences of an emergency at the Sayano-Shushenskaya HPP, it was necessary to use all the forces and means to pump water, and during the protection in 2010. from forest fires of the federal nuclear center in Sarov, it was required to supply a large amount of water to extinguish fires⁷.

Such a need determined new tasks for manufacturers of fire fighting equipment; it was necessary to develop and create pump-and-hose complexes of increased productivity. New fire-fighting vehicles produced by Velmash-service have appeared⁸:

- Universal pump and hose car "Potok";
- Universal pumping and hose complex of high performance "Shkval".

⁷ См.: Акт технического расследования причин аварии, произошедшей 17 августа 2009 года в филиале ОАО "Русгидро" "Саяно-Шушенская ГЭС имени П.С. Непорожного". Федеральная служба по экологическому, техническому и атомному надзору; Природные пожары в России в 2010 году. https://ru.wikipedia.org/wiki/Природные_пожары_в_России_в_2010_году.

⁸ Алешков М.В., Ольховский И.А. и др. Пожарная техника для ликвидации пожаров

и аварий на объектах энергетики // Энергосбережение и водоподготовка. 2012. № 2 (76). С. 69-72.



Fig.1.Shkval, a universal pump and hose complex of high performance

In addition, it has been established that the main danger in extinguishing fires of electrical equipment under voltage is the high probability of electric shock to persons involved in fire extinguishing work. In this regard, various options for the injury of people by electric shock and its consequences are considered, scientific works on electrical safety and the effect of electric current on a person are analyzed.

According to the studies carried out by A.A. Kolbasin, little attention was paid to the issues of extinguishing fires of electrical equipment under voltage. At the same time, fire fighting equipment, both in foreign countries and in Russia, has received strong development. New fire extinguishing agents (EA) and means of their delivery have appeared, the previously known EA have received new applications. At the same time, their effectiveness and the possibility of safe use for extinguishing fires of electrical equipment under voltage have not been studied.

It should be especially noted that at the country's critical energy facilities (nuclear power plants) there is a list of rooms in which power outages are unacceptable in

connection with ensuring the safety of the nuclear reactor.

Therefore, fire extinguishing in these rooms should be carried out without removing the voltage from the live parts of the equipment, which is in the range from 0.4 to 6 kV⁹.

In other words, when extinguishing fires at power facilities, you should strictly adhere to this rule: if the disconnection of electrical equipment or cable is not indicated in the extinguishing permit, then they are considered energized.

Fire extinguishing at power facilities can be carried out on disconnected electrical installations that are energized; water is used in the form of compact jets from the HBK-50, HB-50 barrels and sprayed from the barrels with the NRT-5 nozzles, as well as non-combustible gases and powders. It is strictly

⁹ Колбасин А.А. Нормирование требований к средствам тушения электрооборудования под напряжением на объектах энергетики: Автореф. На соискан. Уч. Степени канд. Техн. Наук.- М., 2012.-С. 4.

forbidden to supply any foam by hand when extinguishing live installations. To avoid electric shock, personnel should not go behind the fence where switchgears and high-voltage devices are located.

According to research carried out by Doctor of Technical Sciences A.D. Ishchenko: "Another important component of the fire extinguishing system is the for fire protection of organizations, which are created in accordance with section 6 of SP 232.1311500.2015"Methods for determining the number and technical equipment of the fire protection of an enterprise for organization and implementation of extinguishing fires". In accordance with this technique, the most fire hazardous object on the territory of the enterprise is selected, characterized by the largest possible fire area and the highest flame propagation speed, and the fire development pattern in accordance with the fire load characteristic of the selected object. After that, the speed of the fire trucks to the place of the alleged fire is selected, depending on the type of road surface, and the time of the beginning of effective actions to extinguish the fire (the time interval from the moment of the outbreak of the fire to the moment the fire engine is fed to the fire) is calculated according to the formula:

$$t_{\text{нач}} = t_{06} + t_c + t_{c6} + t_{c1} + t_p, \quad (1).$$

where t_{06} is the time from the moment of fire occurrence to the moment of its detection, min;

t_c - time from the moment a fire was detected until the moment it was reported to the fire brigade, min;

t_{c6} - is the time it takes for the fire department to travel from the place of receipt of the fire message (from the fire station) to the place of the fire, min;

t_{c1} - is the time from the moment of arrival at the fire until the moment the first barrel is fed

into the fire center (time of deployment of forces and means), min.

t_p - time from the moment of arrival at the fire until the moment the first barrel is fed into the fire center (time of deployment of forces and means), min¹⁰.

Indeed, the proposed formula reflects the regularity of the arrival of fire rescuers at the site of the fire, taking into account the moment of its initial detection and the interval between its detection and the corresponding message about the fire that occurred to the fire and rescue service. In addition, A.D.Ishchenko takes into account such an important point as the supply of fire extinguishing agent from the first barrel and the shorter the time interval between the arrival of firefighters to the fire site and the supply of fire extinguishing agent from the first barrel, the closer the fire extinguishing effect will be to unity. Otherwise, this effect will approach zero. Thus, methodologically, the fire damage will be the least when approaching unity and the highest when approaching zero.

By the way, if we analyze the work of such a researcher as V.I. Levin, then we can be convinced of his approach to the application of a set-theoretic construction associated with the use of a multi-interval method, which consists in a paradigm reflecting that the set of all possible values of an incompletely defined quantity \tilde{a} set only by its lower (a_1) and upper (a_2) boundaries. Accordingly, the value \tilde{a} is written in the form of a limited uncertainty interval of the form:

$$\tilde{a} = [a_1, a_2] = \{a \mid a_1 \leq a \leq a_2\}. \quad (2)$$

¹⁰ Ищенко А.Д. Теория локализации пожаров в зданиях объектов энергетики: Диссер. на соиск. уч. степени док-ра.техн. наук.-М., 2020 г.-С. 124.

It is assumed here that the unknown "true" value of the undefined quantity \tilde{a} reliably lies within the interval $[a_1, a_2]$, without going beyond its boundaries (a_1) and (a_2). Moreover, all values within this interval are considered "equally possible" in the sense that there is no reason to prefer one value to another. Note that in this case, the concept of equal to a possibility does not mean setting a uniform probability or any other distribution of possible values within the specified interval. Algebraic operations are introduced over intervals of the form (2), similar to the

corresponding operations over numbers. For this, a set-theoretic construction is used:

$$\tilde{a} \circ \tilde{b} = \{a \bullet b \mid a \in \tilde{a}, b \in \tilde{b}\},$$

$$\circ \tilde{a} = \{ \bullet a \mid a \in \tilde{a} \}, \quad (3)$$

That is, any operation on the intervals \tilde{a} is determined on the basis of the corresponding operation on exact values \bullet , provided that the specific values of these values acquire all possible values from the corresponding intervals. Simple rules for performing operations on intervals follow from this definition:

$$[a_1, a_2] + [b_1, b_2] = [a_1 + a_2, b_1 + b_2]; [a_1, a_2] - [b_1, b_2] = [a_1 - a_2, b_1 - b_2];$$

$$k \cdot [a_1, a_2] = \begin{cases} [ka_1, ka_2], k > 0, \\ [ka_1, ka_2], k < 0; \end{cases} [a_1, a_2] \cdot [b_1, b_2] = [\min_{i,j}(a_i \cdot b_j), \max_{i,j}(a_i \cdot b_j)];$$

$$(4)$$

$$[a_1, a_2] / [b_1, b_2] = [a_1, a_2] / [1/b_2, 1/b_1], \text{ when, } 0 \notin [b_1, b_2].$$

In, further development of interval mathematics is proposed, the concept of a polyinterval is introduced as a sequence of several single intervals of uncertainty:

$$\tilde{M} = \{\tilde{a}_1, \tilde{a}_2, \dots, \tilde{a}_n\}, \quad (5)$$

Where $\tilde{a}_1, \tilde{a}_2, \dots, \tilde{a}_n$ is an interval of the form presented in formula (5).

CONCLUSION

Thus, when extinguishing fires at energy facilities, you should:

- To supply fire extinguishing substances to electrical installations only after removing the voltage, grounding fire trucks and barrels, appropriate instruction by the elders, from among the technical personnel of the facility or the operational field team and obtaining a written permit;
- Not to allow independent actions of the personnel of fire brigade units to turn off electricity and supply fire extinguishing agents;
- To organize the shutdown of turbine generators in the event of a fire threat to

the turbine room, cut off the hydrogen supply for cooling and displace it with an inert gas from the cooling system, drain oil from the oil system and oil tanks (up to 20 cubic meters each);

- Carry out the supply of powder, low expansion foam or sprayed water inside transformers and other oil-filled equipment through the busbar openings, avoiding emergency drainage of oil from the transformers;
- Quenching the liquid metal coolant with special-purpose powders;
- Constantly monitor the condition of the supporting structures and coatings, ensure their cooling;

- To prevent the accumulation of personnel of fire protection units in rooms with electrical installations;
- Carry out video monitoring of fire extinguishing using automatically controlled drones covering the entire territory where the fire occurs, including direct communication of the head of the RTP with the corresponding duty unit of the Ministry of Emergency Situations of the Republic of Uzbekistan;
- Comply with labor protection and safety regulations when performing assigned tasks.

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