

ДИАЛОГ КУЛЬТУР

МАТЕРИАЛЫ XV МЕЖДУНАРОДНОЙ НАУЧНО-ПРАКТИЧЕСКОЙ КОНФЕРЕНЦИИ НА АНГЛИЙСКОМ ЯЗЫКЕ

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*Под общей редакцией заведующего кафедрой иностранных языков,
кандидата филологических наук, доцента
В. В. Кирилловой*

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V. V. Kirillova*

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PROBLEMS AND SOLUTIONS FOR THE ELIMINATION OF EMERGENCY SITUATIONS AT THERMAL POWER PLANTS

Student **Gaffanova Angelina Ramisovna**,
Student **Ishalin Alexandr Veniaminovich**,
PhD in Technology, Associate Professor
Nizamiev Marat Firdenatovich,
Kazan State Power Engineering University,
Kazan, Russian Federation

Abstract. The analysis of emergencies in the main buildings of thermal power plants, their causes and consequences. Possible causes of fires and the course of emergencies are analyzed on the example of thermal power plants.

Keywords: accident, fire, power plant, electricity, thermal power plant, TPP.

ПРОБЛЕМЫ И РЕШЕНИЯ ПО ЛИКВИДАЦИИ АВАРИЙНЫХ СИТУАЦИЙ НА ТЕПЛОВЫХ ЭЛЕКТРОСТАНЦИЯХ

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Казанский государственный энергетический университет,
г. Казань, Российская Федерация

Аннотация. В работе проведен анализ аварийных ситуаций в главных зданиях тепловых электростанций, их причины и последствия. На примере тепловых электростанций анализируются возможные причины возникновения пожаров и ход аварийных ситуаций.

Ключевые слова: авария, пожар, электростанция, электроэнергия, тепловая электростанция, ТЭС.

A thermal power plant (TPP) is considered to be one of several major types of electricity generation. In the total volume of installed capacity, its share is 70 %.

The problem of combating fire safety at a power plant is very relevant today. At TPPs, power units are placed in one building as a convenience (polyblock layout solution). In terms of fire safety, this solution has a negative side - in case of an accident, the risk of fire spreading increases, which may eventually lead to equipment breakdown and failure of several TPP units.

The category of the premises according to the explosion and fire hazard of the TPP enclosure refers to buildings of the 1-2nd degree of fire resistance (SP

12.13130.2009 Determination of categories of premises, buildings and outdoor installations according to the explosion and fire hazard) [1]. The main building is a building that houses the main equipment of the TPP (gas turbine with air compressor, electric generator of the gas turbine, HRSG, steam turbine, main transformer), which ensures production of electric and thermal energy, auxiliary equipment (various installations for normal operation of the TPP – heat exchangers, slag removal systems, pumps, condensers, etc.), as well as service rooms. Figure 1 shows the structural diagram of the main building of the TPP.

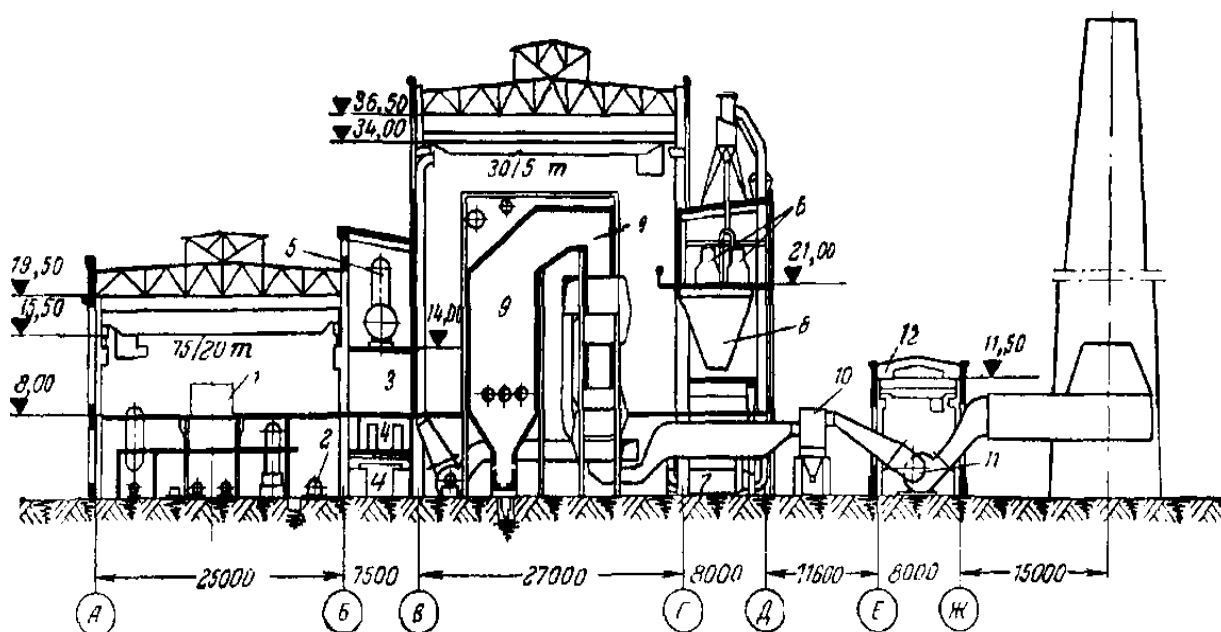


Figure 1. Scheme of the main building of the TPP

Over the last 20 years, combined cycle power plants (CCPPs) have been actively developed due to their high efficiency (up to 60 %) and low NO₂ and CO emissions, but for the time being, steam power plants have more advantages in production at thermal power plants [2].

A modern steam power plant includes the following facilities:

- production purpose;
- auxiliary production purposes;
- auxiliary facilities.

All objects are connected by engineering and transport communications.

In many domestic and foreign thermal power plants, all power units are located in one building - in the main building. This type of layout is called a poly unit layout. Such layout has Konakovskaya GRES (8x300 MW), Zainskaya GRES (12x200 MW), Shoaiba TPP in Saudi Arabia (5x400 MW), etc. Figure 2 shows views of the main building from the side of the engine room of Zainskaya TPP (a) and the engine room inside Zainskaya TPP (b) [2].



Figure 2. View of the main building from the side of the engine room of Zainskaya SDPP (a), view of the engine room inside Zainskaya SDPP (b)

The advantages of such placement in the main building compared to the monoblock housing are:

- Specific consumption of building structures and materials is reduced;
- The size of the industrial site on which the plant is located is reduced;
- Maintenance costs are reduced and reliability of equipment is increased;
- The amount of work in general on the improvement of the territory is reduced.

But there are also disadvantages, which are the reasons for the increased risk of fire spreading in some accidents, which can result in several TPP units being out of operation. Installation of fire partitions between the power units in the main building is not possible, so the fire can spread to the neighboring power units, resulting in the failure of all electrical equipment [2].

Over the last 5 years, about 8 major accidents with failure of several power units occurred at power plants [3].

Table 1 – Accident statistics for the last 5 years

<i>Date of accident</i>	<i>Name of power plant</i>
March 2, 2016	Ohinskaya CHPP
January 26, 2017	Penza CHPP-1
October 1, 2017	Yakutskaya GRES-1
February 3, 2018	Pervomayskaya CHPP-14
March 3, 2018	Smolenskaya CHPP-2
January 13, 2020.	Khabarovskaya CHPP-1
December 11, 2020	Lipetsk CHPP-2
December 23, 2021	Ulan-Ude CHPP-1

On December 23, 2021, an accident at Ulan-Ude CHPP-1 occurred as a result of a short circuit in the basement of the turbine house, a fire in the cable

compartment, interruption of fuel and fuel oil supply to the CHP unit, resulting in 6, 7, 8, 9 boilers and 6 and 7 turbine generators being shut down. In connection with this, heat and hot water supply to 70 % of homes and apartments was stopped. The elimination of the accident was successful, the emergency services and engineers and workers of CHPP-1 eliminated the consequences of the emergency [4].

According to statistics, 90 % of major accidents are caused by equipment failures and accompanied by fire; the remaining 10 % are a consequence of damage to building structures. Figure 3 shows the main places of fire emergence at the TPP.

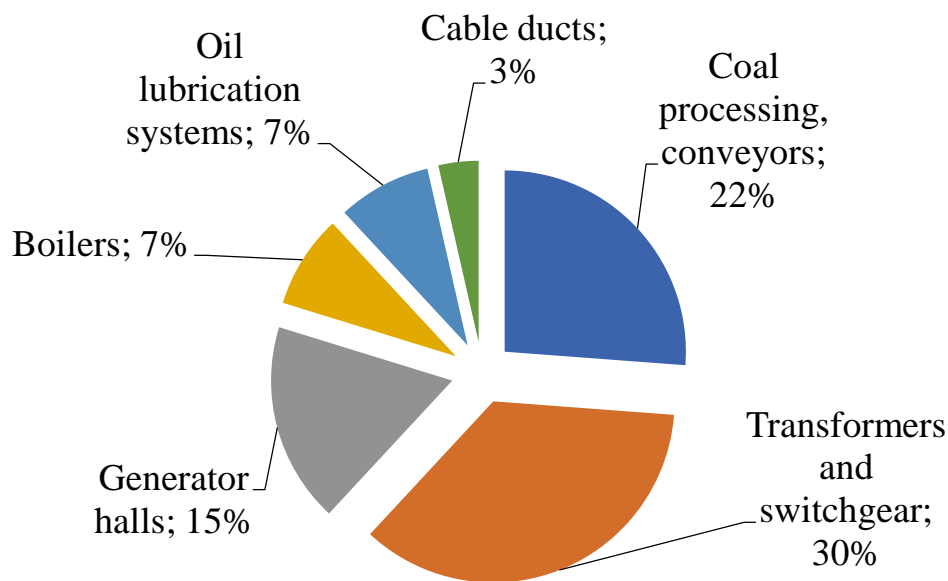


Figure 3. Common locations of fires at TPPs

The main causes of major accidents in the main buildings of TPPs:

1. Errors of operating personnel;
2. Mistakes in design and installation of building structures and facilities;
3. Faulty repair of main and auxiliary equipment;
4. Mistakes of ODU;
5. External factors.

At the initial stage of design of fire protection at TPPs, it is important to consider possibilities:

- Signal control of the fire-extinguishing system
- Operative recording of the system state on the ES control panels
- Reception of a signal from manual call points on the territory and on the premises of the power plant

- Training of all personnel to manage the evacuation of people in case of fire.

It is important to consider that fire safety should be carried out by highly qualified specialists, who must have all the skills and abilities, as well as understand all the features of work in the energy sector [5].

Today, the main building of the TPP is a hazardous production facility and is subject to compulsory insurance. The issue of accident insurance is still not considered necessary due to its unlikelihood, but it can contribute to the rapid recovery of damage. The problems that are associated with explosion and fire safety are still relevant to this day for the electric power industry in Russia.

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