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## The economic part of the design of the electrical part of IES and the relay protection of the turbogenerator Tomsk Polytechnic University

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### Abstract

Evaluation of the economic value of the project is an important condition for searching financial sources for carrying out scientific research. This evaluation is an important factor for developers who must rely on existing perspectives of ongoing research. Thanks to this assessment, the engineer can find a partner for a qualitative and rapid scientific research, as well as the approval and commercialization of the results in this paper a comparative evaluation of the relay protection characteristics of different firms (EKRA, ABB, GE) was carried out. The main criteria for evaluating relay protection in the global market are identified: noise immunity, reliability, functional capacity, the quality of the intelligent interface, etc. The relationship of all identified criteria is established. As a result, the most favorable version of the relay protection of the turbogenerator was obtained. The obtained criteria can be used to evaluate the relay protection of other power plants (transformers, autotransformers, powerful turbo-generators).

*Keywords:* Relay protection, design, financial management, resource efficiency.

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### 1. Introduction

The specificity of the electrical part of IES (condensation power plant) is determined by the location of the power plant far from the centers of electrical loads [1]. Under these conditions, all the power is delivered to the network at an increased voltage. The peculiarity of IES is the low power of the thermal equipment, in contrast to the CHP (Combined Heat and Power), which complicates the protection of the environment from the adverse effects of the power plant. To reduce emissions, it is advisable to use primarily high-quality coal, as well as other fuels. The use of low-grade fuels leads to the development of various environmental problems.

During the design and operation of such a system, it is necessary to take into account the possibility of damage and abnormal operation modes [2, 3]. Short circuits are the most common and dangerous types of damage.

The economy of our country, where energy plays an important role, requires uninterrupted power supply to consumers [4]. Therefore, we should strive for trouble-free operations. To prevent the occurrence and development of accidents, to reduce damage, it is necessary to disconnect the damaged element quickly.

The on-site staff is unable to determine the occurrence of a fault, to find its location and to give a signal to turn off the breakers of the damaged element in such a short period [5]. Therefore, these actions are performed automatically, with the help of relay protection, providing protection against damage and some abnormal operating modes.

It is interesting to examine a promising scientific study that deals with the economic part of the design of the electrical part of the IES and the relay protection of the turbogenerator. Evaluation of the economic value of the project is an important condition for searching financial sources for carrying out scientific research and commercialization of the results. This evaluation is an important factor for developers who must rely on existing perspectives of ongoing research. Thanks to this assessment, the engineer can find a partner for a qualitative and rapid scientific research, as well as the approval and commercialization of the results.

## 2. Evaluation of the characteristics

The efficiency determination of a type of relay protection occurs on the basis of the calculation of the integral indicator of efficiency. It is connected with the calculation of two weighted averages: financial efficiency and resource efficiency. In our project, the main parameter is the resource efficiency (Table 1).

Table 1. Comparative evaluation of the characteristics of project implementation options

Criterion	The weighting coefficient of the parameter	Object of study		
		EKRA	ABB	GE
Error-rate performance	0.111	5	4	5
Margin of safety	0.111	5	4	4
Functional capacity (provided capabilities)	0.139	5	4	3
Intelligent interface quality	0.111	4	4	3
Ability to connect to a computer network	0.139	5	5	3
Level of penetration to the market	0.139	5	4	3
Time to market	0.111	4	3	3
Availability of development certification	0.111	4	3	3
TOTAL	1	4.62	3.87	3.375

The most favorable option for the relay protection of the turbogenerator in our project is the relay company EKRA.

## 3. Conclusion

During the study a comparative evaluation of the relay protection of the turbogenerator of various firms has been carried out and variants of relay protection with regard to resource efficiency have been offered. The most resource-efficient variant is considered to be the relay company EKRA.

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