MATEC Web of Conferences 37, 01014 (2015)

THE DEVELOPMENT OF COMPUTER-AIDED DESIGN FOR ELECTRICAL EQUIPMENT SELECTION AND ARRANGEMENT OF 10 KV SWITCHGEAR

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Abstract. The paper intends to give an overview of a computer-aided design program application. The research includes two main parts: the development of a computer-aided design for an appropriate switchgear selection and its arrangement in an indoor switchgear layout. Matlab program was used to develop a computer-aided design system. The use of this program considerably simplifies the selection and arrangement of 10 kV switchgear.

1 Introduction

Computer-aided design (CAD) is the use of computer programs to create two- or three-dimensional (2D or 3D) graphical representations of physical objects. CAD software may be specialized for specific applications. CAD is widely used for computer animation and special effects in movies, advertising, and other applications where the graphic design itself is the finished product. CAD is also used to design physical products in a wide range of industries, where the software performs calculations for determining an optimum shape and size for a variety of product and industrial design applications.

In product and industrial design, CAD is used mainly for the creation of detailed 3D solid or surface models, or 2D vector-based drawings of physical components. However, CAD is also used throughout the engineering process from conceptual design and layout of products, through strength and dynamic analysis of assemblies, to the definition of manufacturing methods. This allows the engineers both interactively and automatically to analyze the design variants, to find the optimal design for manufacturing while minimizing the use of physical prototypes [1].

In this scientific research as a CAD system is used MatLab program. This programming environment is the main source for development selection and arrangement of 10 kV switchgear CAD.

2 The main switchgear components

Switchgear and control panels are found in power generating stations, transformer stations, distribution substations, commercial and institutional buildings, industrial plants and factories, refineries, paper mills, metal smelters and any other place where electric energy is utilized or electric power is distributed to any number of zones [2].

There are a few common types of assemblies that cover almost any application. A broad classification according to the location of the switchgear assemblies is whether the gear is installed indoor or outdoor.

We will deal with indoor switchgear which differs from each other by their construction and equipment. The main components are:

- draw-out circuit breakers (oil, air, SF_6, vacuum);
- switching device;
- instrument transformers;
- relays;
- meters and instruments;
- main bus;
- control and indicating devices, jumpers, cable lugs, cable supports and potheads;
- instrument compartments;
- test switches and breaker accessories [3].

This program was designed based on MatLab program in the Guide environment by using “SVEL group” company switchgear catalogue [4].

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Article available at http://www.matec-conferences.org or http://dx.doi.org/10.1051/matecconf/20153701014

3 The algorithm of switchgear cabinet selection

The program simplifies considerably the selection of switchgear cabinets since it takes into account the main parameters of switchgear cabinets: appointment, design, additional equipment and rated current of switchgear cabinets.

The algorithm includes some stages. At the first stage the user is offered to choose the cabinet function (bushing, outgoing line, bus sectionalization, voltage transformer cabinet). Then depending on switchgear cabinet function the user selects its design (for example, for bushing cabinet – cable or bus bushing). The next stage involves the indication of rated current and the choice of optional equipment.

Figure 1 shows the cabinet selection of the outgoing line (L1). The selection is carried out according to the above described algorithm.

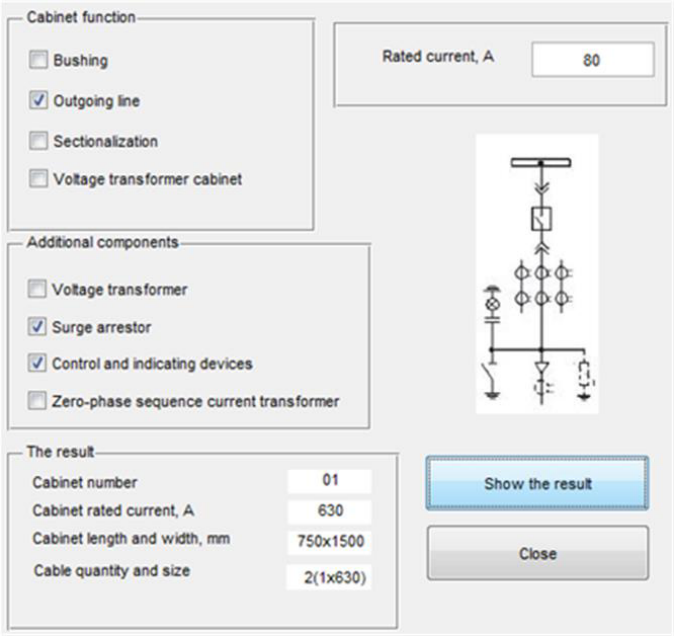

Figure 1. Cabinet selection of the outgoing line

As Figure 1 shows by the selection of the desired parameters the program selects automatically the required switchgear cabinet from the specified and downloaded catalog. Moreover, it offers data about overall dimensions of switchgear cabinet which would be essential for indoor switchgear arrangement.

4 The algorithm of switchgear cabinet arrangement

The next step of our research is the arrangement of selected switchgear cabinet which takes into account the minimal building standard and indoor switchgear size.

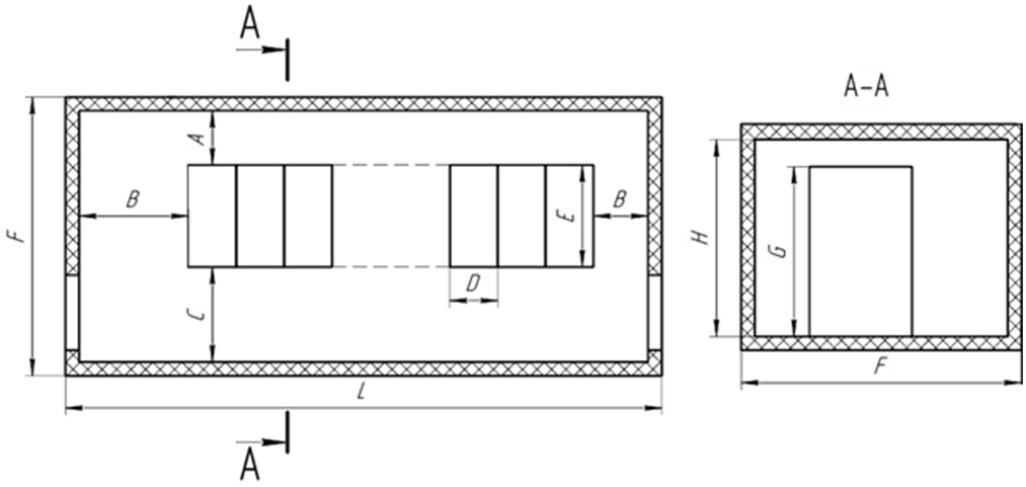

Figure 2. Single-row switchgear cabinet arrangement

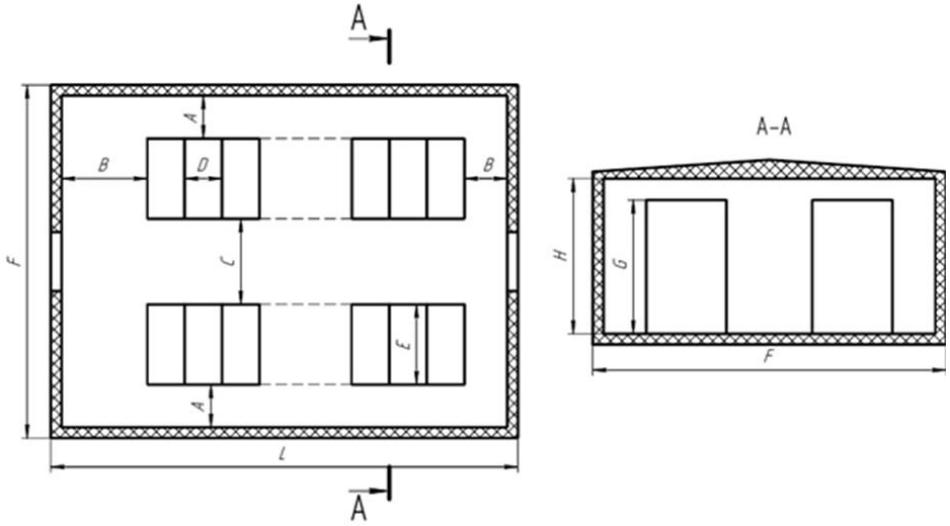

Figure 3. Double-row switchgear cabinet arrangement

It is necessary to know the size of an indoor switchgear and quantity of outgoing lines for switchgear cabinet arrangement. There is a single-row and double-row switchgear cabinet arrangement. Depending on the equipment arrangement the minimal building standard is normalized. Figures 2 and 3 show the single-row and double-row switchgear cabinet arrangement in the indoor switchgear [5]. Moreover, these figures show the minimal building dimensions. According to these parameters the program offers the indoor switchgear arrangement.

According to Electric Installation Code [5] the program calculates the number of outgoing lines, then compares it with the actual number. If the condition is satisfied then the offered arrangement is accepted. Otherwise, the total adjustment of indoor switchgear dimensions is required.

5 Conclusion

To sum up, the developed program allows firstly to automatize the selection of switchgear cabinet. Secondly, it allows the development of the equipment arrangement of the indoor switchgear according to the required building standards.

Thus, the designed computer-aided algorithm is of great importance for the selection and arrangement of the cabinets of an indoor switchgear.

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