World Economics & Finance Bulletin (WEFB)
Available Online at: https://www.scholarexpress.net
Vol. 1 June-July 2021,
ISSN: 2749-3628

ELEMENTS OF POWER GRID DESIGN

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Article history:

Received: May 11th 2021
Accepted: June, 11th 2021
Published: July, 8th 2021

Abstract:
Designing a new power grid is a complex task that requires solving many technical and economic issues. At the technical issues that given for designing, piece of consumer loads with reliability of energy supply is provided . It also provides opportunities for further development of the network, such as daily schedules of loads, operating time per year with maximum load, secondary voltage of substations, relative position to each other, and availability of supply sources.

Keywords: Rated voltage, economic current density, overhead line, substation, transformer

In the terms of reference for the design, the composition of consumers according to the reliability category of the power supply with load capacity is given. It also provides opportunities for further development of the network, such as daily schedules of loads, operating time per year with maximum load, secondary voltage of substations, relative position to each other, and availability of supply sources.[4]

During the design process, the nominal voltage, the rational scheme of the network, the cross-section of the conductor and cable lines are selected on the basis of the initial data in the available terms of reference; the number and capacity of transformers or autotransformers in substations are determined; their electrical wiring diagrams are developed; the need to install reactive power sources at substations will be assessed; the means of adjusting the voltage are determined. [1, p 180]

Currently, in practice, the method of mutual comparison of costs is used in the design of power grids. The proposed options differ in the rated voltage of the installed network, the configuration of the circuit, the reliability of the power supply to consumers. But all of these options must meet the required requirements. Exactly such options of the power grid are then carried out by economic analysis and selection of the most rational. If the cost of the compared variants is based on the initial data in the task, then the final choice is selected according to the additional characteristics of the options, ie network operating conditions, its subsequent expansion, high rated voltage, the possibility of easily adding additional automation tools.

The cross-sectional area of line wires of power lines with a nominal voltage higher than 220 kV is selected from the economically normalized current density.

A section of conductor that is economically feasible

$$F_{эк} = \frac{I_{N.b}}{I_{эк}},$$

where, $I_{N.b}$ – is the current flowing through the line wires in the normal mode with the largest load, A.

The next step in determining the cross-section of the conductor wires is to determine the whole value close to the standard values, to check the conditions of general coagulation and heating of the conductors in the post-accident mode, as well as to change the selected sections if the conditions are not met.

In power transmission above 330 kV, the economic current density is not normalized, and the determination of the economic cross-section is carried out by the method of economic intervals.

The cross-section of the conductors of local networks is determined by the allowable voltage loss under additional conditions. If, as an additional condition, the equality of the cross-sections of the conductors in all parts of the line is taken, then,

$$F = \frac{\rho}{\Delta U_{\alpha\, add.} U_{N.Ohm}} \sum_{i=1}^{n} P_i l_i,$$

where, ρ is the specific resistance of the conductor, Ohm·мм^2/km; $\Delta U_{\alpha\, add.}$ i- allowable voltage drop across the active resistance of the line; $P_i l_i$ - active power and the length of the -th part of the line [1, p.182]

If the voltage drop in the line is within the $\Delta U_{add.}$ allowable magnitude,

$$\Delta U_{\alpha\, add.} = \Delta U_{add.} - \Delta U_r(F);$$

$$\Delta U_r(F) = \frac{x_{03}}{U_{N.Ohm}} \sum_{i=1}^{n} Q_i l_i,$$

where, x_{03} –is the inductive resistance along the length of the line, set the same for each part of the line; Q_i- reactive power of the i-th part of the line .

If the equality of the current density in all parts of the line meets the additional conditional requirements, it is calculate from the following formula

$$j = \frac{\Delta U_{\alpha\, add.}}{\sqrt{3}\rho \sum_{i=1}^{n} l_i cos\varphi_i}$$

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where, $l_i, cos\varphi_i$ is the length of the network and the power factor of the *i*-th part , respectively .

To eliminate the uncertainty in determining the cross section of the conductors, one of the additional conditions is to achieve the minimum material consumption during the line installation process. In this case, the cross section of the last section of the line is from the following formula

$$F_n = \frac{\rho\sqrt{P_n}}{\Delta U_{\alpha\ add.} U_{N.Ohm}} \sum_{i=1}^{n} l_i\sqrt{P_i}$$

The cross section of the remaining parts is determined from the following relation

$$\frac{F_1^2}{P_i} = \frac{F_2^2}{P_2} = \dots = \frac{F_i^2}{P_i} = \dots = \frac{F_n^2}{P_n}$$

In the considered cases, the determined quantities are rounded up to the nearest standard values and the compliance of the actual and allowable values of the voltage loss is checked. Inductive resistance $x_0 = 0$, cable-sectional direct line voltage loss $\Delta U_{add.}$ is selected magnitude. Power lines are designed to be tested for heat, as are conductors. Under such test conditions, the maximum operating currents of the $I_{max.p}$ lines $I_д$ are compared with the allowable heating currents to the conductors, in terms of previously abandoned cost-effectiveness or allowable voltage loss . If the $I_{max.p} \le I_д$condition is met, then the selected cut is considered to satisfy the heating conditions in the set mode. In this case, the allowable heating current for cables is determined by making a correction to the number of cables operating close to the ground, the temperature of the ground and the overload at the time of emergency response.

The operating and starting currents of the line, which are characterized by a n-load, m coefficient of uniformity, are determined from the following formula

$$I_{max.p} = m\sum_{i=1}^{n} I_{max.p}\,(i)$$

$$I_{пуск} = I_{пуск(n)} + m\sum_{i=1}^{n-1} I_{max.p}\,(i)$$

As can be seen from the last equation, with a maximum starting current, one motor is started, while the rest of the loads operate in the set mode. The rated operating current of motors, their nominal power $P_{N.Ohm}$, ф.и.к η, power factor cosh and load factor $k_з$ are determined: [5]

$$I_p = \frac{P_{N.Ohm}k_3}{\sqrt{3}U_{N.Ohm}\eta cos\varphi}$$

If the $I_{max.p} < I_{N.Ohm}$ condition is met, the $I_{N.Ohm}$ fusible inserts of the rated current savers ensure the normal uninterrupted operation of the line being protected.

The second criterion for selecting soluble inserts for storage is the engine start condition, which corresponds to the following inequality:

run under normal conditions

$$I_{N.Ohm} \ge \frac{I_{пуск}}{2{,}5}$$

In severe start-up conditions $I_{N.Ohm} \ge \frac{I_{пуск}}{1{,}6\div2{,}0}$

Mechanical accounting of overhead lines is an integral part of network design. There are issues with the choice of the capacity of the step-down transformer with or without a moving reserve in the system. In accordance with these recommendations, the total power of the additional reactive power sources $Q_{к\Sigma}$ is equal to the value of the reactive power imbalance in the network.[2]

If reactive power sources are connected at n-substations, then $Q_{к\Sigma} = m\sum_{i=1}^{n} Q_{кi}$

where, is a m-time coefficient.

In order to determine the cost-effective placement of reactive power sources of substations in the network, it is necessary to determine the minimum costs associated with the connection of these sources to the network.

When applied to radial networks with a single load at the end of each line, the minimum cost specified shall meet the following condition

$$\frac{\partial З_1}{\partial Q_{к1}} = \frac{\partial З_2}{\partial Q_{к2}} = \dots = \frac{\partial З_i}{\partial Q_{кi}} = \dots = \frac{\partial З_j}{\partial Q_{кj}} = \dots = \frac{\partial З_n}{\partial Q_{кn}}$$

In this case, the economically feasible size of the *j*- substation reactive power sources is as follows [2, p.288]

where, r_i - i is the active resistance of the supply line of the substation; Q_i, τ_i - the reactive power of the substation and the time of maximum losses , respectively ; r_j, Q_j, τ_j - similar to the above quantities, only a *j*-for the substation

REFERENCES

1. Веников В.А. Расчеты и анализ режимов с.180-185
2. Лыкин, Анатолий Владимирович. Электрические системы и сети (Электронный ресурс): (учеb. пособ. по направ. «Электроэнергетика») / А.В. Лыкин.
3. Idelchik V.I. Elektricheskie seti i sistemo'. M.: Atomizdat. 1999.
4. Karimov X.G., Rasulov A.N. Elektr tarmoqlari va tizimlari. Toshkent . 1998

5. Эралиев Abдинаби Хакимович, Хамиджонов Зухриддин Маръуфжон Угли, Рахимов Миркамол Фархотжон Угли, and Абдуллаев Абдувохид
6. Абдугаппар Угли. "Повышение эффективности турбогенераторов в теплоэлектрических центрах" European science, No. 6 (48), 2019, pp. 37-40.