GENERAL CONTROL CHARACTERISTICS OF ANTI-EMERGENCY SYSTEMS

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It is shown that the asynchronous modes appears at improbable severe emergencies. These modes are characterized by dangerous reasons, consequences of parallel operation stability or probability of emergency sequential development. That's why the elimination of asynchronous modes becomes the important task.

Note that the control of power system in diferent modes is diferent.

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INTRODUCTION

The redamage of the network first circuit or the failure of the control system causes the series of emergencies. In these cases the resulting asynchronous mode can be cancelled by two methods:

1) the increase of the generation power and the opening of low-frequency power systems, resynchronization method caused by the difference of high-frequency power system;

2) the disconnection of the nonsynchronous working part of power system by the means of automatics. The restoration of synchronous and parallel operation by the way of collection of generation power reserves after the disconnection of power-deficient part by the means of frequency automatic disconnection.

In order to choose the right decisions in such cases, it is necessary to find the solution of the task:

-is the stability of this connection or the responsible and powerful power transmission in the neighborhood maintained during asynchronous operation?

- which parts of consumers are open and how long they are without energy for this or another chosen solutions?

Many air electic power transmission lines (AEPT) work with minimal stability resources. That's the probability of stability loss in neighbour lines increases in one line at synchronous operation. By these reasons it is profitable to use the separate network than the synchronized one [3] at appearance of asynchronous mode.

The emphasizing of nonsynchronous part of power system is rational one in the following cases [1]:

- in case of disposition of important reliable operators near vibration center and possibility of their breaking in asynchtonous mode;

- in comparison with separation of the power systems it is easy to disconnect the loading of big power in asynchronous mode;

- when asynchronous mode causes the instability in other lines.

The discriminative automatics is applied in power system for the elimination of asynchronous mode. The automatization of departments is based on other principles and influences on departments in first or following cycles of asynchronous carrying out. Consequently, the parallel lines should have at least two sets of splitters, by the one set in the end of each line. Besides, the automatics of asynchronous stop is applied in interconnection lines. Mainly, this takes place at appearance of incomplete phase mode in lines and as a rule, at periodic oscillations of residual currents.

EXPERIMENT TECHNIQUE

Asynchronous modes or deep synchronous vibrations lead to significant decrease of strength on consumer power rails [4,5]. As a result, the serios interferences in power supply appears and in this case the breaking of power system receiving center with the operation of the frequency automatic breaking prevents the frequency decrease. In such cases it is necessary to apply the fast non-selective automatics. In such cases the automatics should be selective one both for the synchronous vibrations and symmetric short circuits. The energy receiving system should be divided on operation of automatic opening and frequency. The power system divides on necessary parts for the selectivity increase after 2-3 cycles of asynchronous mode or waiting period. In short term asynchronous modes the divisor automatization should work only in the case if the resynchronization is imposible by any reasons. Moreover, the necessary asynchronous mode is necessary to resynchronize after 3 -5 steps but not later than 15 – 30 seconds, i.e. the division takes place with delay. The analysis of asynchronous modes at the choice of parameters of dividing automatic alignment and definition of resynchronization conditions, is carried out. The influences of diferent factors on resynchronization square, loading part at the opening and times of synchronous operation restoration. The theory of impulse system is applied in automatization of technological processes [2]. For this purpose, the sequence of unmodulated amplitudes $u(t')$ in the form of $s(t')$ is supplied on controlled boiler-turbine agregates. As a rule, the control object presents itself

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continuous or impulse system with non-linear characteristics. It is supposed that $u(t')$ impulse consistences are obtained from ideal impulse element and the forming impulse characteristics $s(t')$ is calculated from inner parameters of boiler-turbine and generators. Therefore, the equivalent controlling impulse exposure $u[n,0]$ becomes the discrete function. At such exposure the reaction process $z[n,0]$ takes place in object. In order to evaluate the process character, it is compared with standard process. The standard sine frequencies, strengths and currents obtained by boiler-generator set on rated power modes are accepted as standard process.

The simple reports of asynchronous modes, their duration, resynchronization possibility by principle of divided automatics and choice of alignment parameters are carried out with following approximations:

- E' is stability of power line (PL) switcher, $x'd$ is reactive reactance of generators;
- generator rotors have electric and magnetic symmetries;
- taking under consideration the loads with constants resistances.

The equation of rotor motion is written by following way:

$$T_q \frac{ds}{dt} + P_{as}(s) + P_{11} + P_{12} \cdot \sin(\delta_{12} - \alpha_{12}) = P_\tau(s) \qquad (1)$$

if the installation works to powerful receiving power system in asynchronous mode for schemes of electric power plants consisting in equivalent generators.

As the mutual strength in asynchronous mode practically doesn't influence on average slipping, we can write the following expression:

$$\int_0^{2\pi} P_{12} \cdot \sin(\delta_{12} - \alpha_{12}) d\delta = 0 \qquad (2)$$

That's why the equation of average value change as a result of the analysis has the following form:

$$T_q \frac{ds}{dt} + P_{as}(s) + P_{11} = P_\tau(s) \qquad (3)$$

At $ds/dt = 0$ the average displacement $s_{or}q_{\partial r}$ in stationary mode is obtained by the way of solving of equation (3). Usually the power system has $s_{or}q_{\partial r} < 0$ at power exceed and $s_{or}q_{\partial r} < 0$ at power shortage [2].

If in transient process the average shift curve s_{or} monotonously approximates to solution value not crossing the abscissa axis, so the resynchronization takes place only because influence of mutual strength and inclination of instantaneous value of average shift. In this case the resynchronization criterion is defined from the integral of the equation (2) in asynchronous chain:

$$T_q \frac{ds}{dt} = -P_{12} \cdot \sin(\delta_{12} - \alpha_{12}) \qquad (4)$$

The equation (4) expresses the rotor vibrational motion in asynchronous mode under influence of mutual stregths. For the determination of minimal value of the average shift causing the asynchronous mode, let's consider the solution of (4) equation with coordinates on phase plane $\delta = \delta_{12} - \alpha_{12}$:

$$\frac{ds}{dt} = \frac{ds}{d\delta} \cdot \frac{d\delta}{dt} = S \frac{ds}{d\delta} \quad \text{or} \quad S \frac{ds}{d\delta} = -P_{12} \cdot \sin\delta / T_j \qquad (5)$$

Integrating the equation (5) from initial values δ_0 and S_0 up to current values of alternatives δ and S we obtain the following equation:

$$S = \pm \sqrt{\frac{2 \cdot P_{12}}{T_j}(\cos\delta - \cos\delta_0) + s_0^2} \qquad (6)$$

The equation (6) corresponds to trajectory family shown in phase plane. As it is shown the separatrixes divide the plane in two parts:

- resynchronization region (closed mechanical trajectory) and region of asynchronous motion (open mechanical trajectory). The maximal shifts are obtained at S_{max}, $\delta = 0$ and the minimal ones are obtained at $\delta = \pm\pi$. When $s_{or} = (s_{max} + s_{min})/2$, $s_{min} = 0$ is accepted for the separation and emitted average slipping becomes $s_{or\,bur} = s_{max\,bur}/2$.

The inclination of any of these values in output of pulse block circuit becomes the mistake or mistake signal:

$$e[n,0] = z_0[n,0] - z[n,0] \qquad (7)$$

The mistake $e[n,0]$ correspondingly depends on impulses of $u[n,0]$ control signal impulses. The necessary character can be made to $e[n,0]$ process, changing it. These changes are the qualitative index J and its value shows on the fact how successful the control exposure is chosen. In our case this is the control optimal method by the important system lines of anti-emergency automatics.

The criteria of optimal control are expressed in following modes [2]:

- normal optimal mode; at this all mode parameters (strength, fluxes of current and power, frequency) are in norm limits during long time; the conditions of quality and reliability are carried out; the distribution and loading levels become the economically profitable ones;

- normal nonoptimal one; in this case the normal mode takes place, but the distribution of loading differs from optimal one and strength level is economically unprofitable one;

- hard mode (degradation); at this the values of separate parameters differ from the long-time permissible limits and are saved during several minutes up to appearance of normal value because of the circuit difference on normal state decreases its reliability;

- emergency mode; in this mode several parameters (current, strength, frequency and etc) are exceed the bounds in very short time periods, causing the stability and breaking the equipment. The short circuits, asynchronous operation and occasional decreases of strength and frequency are related to emergency modes;

- mode after defects; it is caused by the parameter values which are diferent from the parameter values of emergency mode as a result of sudden breaking of scheme or network mode;

- mode after emergency; parameter values are close to ones caused in emergency.

The postemergency mode can be as normal or assisted one, supplying the quality, economic efficiency and reliability.

The control of power system is diferent one in diferent modes.

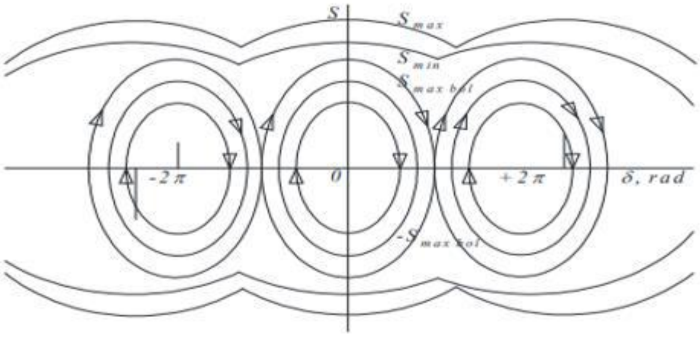

Fig.1. Reserve norm of stability trajectory family.

CONCLUSION

1. The right establishment of the defences in emergency modes in industrial technological equipment and networks has the primary importance.
2. The mutual power and average slipping in asynchronous mode is paid the essential attention.
3. The resynchronization at approximation of transient process to decisive importance takes place only because of influence of mutual strength and inclination of immediative value of average shift.
4. The optimal method of control by important line system of anti-emergency automatics is also considered in the article.
5. It is important to avoid transition on hard modes leading to such situations as the power flux, voltage jumps and etc.

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