IMBALANCE OF REACTIVE POWER AND ANALYSIS OF TRANSIENT PROCESSES

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Probability limits of active power shortage in power receiving system with regard to the imported power taking into the consideration admitted inflow of the reactive power into this very system in emergency shutdown of the intersystem line are analyzed.

Respective curves for particular cases are drafted. It is shown that in running analysis in a wider spectrum, it is possible to develop adequate activities for timely and effective elimination of emergency situation.

Key words: *reactive power, imbalance, transient process, idling mode, frequency.*

Further development of power transmission network of the country's power system takes place in Georgia at quite a large scale. 220 kW as well as 500 kW power transmission lines of the internal system are being constructed and are planned to be constructed in future too. High voltage intersystem power transmission lines to connect to the neighboring power systems are being constructed as well.

Emergency shutdown of one of such lines (especially the long line) will cause the deficit of the reactive power in both connected power systems which, at some point, makes the problem relating to the active power deficit in the active power receiving system easier, and the problem relating to the excess active power in the active power delivering system harder [1].

These circumstances should be considered when analyzing transient processes occurring in the power system and respectively, complex of adequate activities in order to timely and effectively eliminated the emergency situation should be developed by means of system automatics.

The analysis of misbalance impact of the reactive power on the course of the transient processes in Georgian power system was run on the example of the emergency shutdown of 550 kW international line (Mukhrani) connecting Georgian and Azerbaijanian power systems. Cases when active power running within this line is unchanged and the value and direction of the reactive power changes were reviewed. Three different options according to the active power flow were reviewed:

- **flow to Mukhrani P=0;**
- **flow to Mukhrani P=63 MW to Azerbaijan;**
- **flow to Mukhrani P=75 MW to Georgia.**

Picture of the course of the transient processes is shown on figures 1-3 in form of frequency changes within the system. As it is seen from these pictures, the value of the reactive power running within the line before it is shut affects the frequency deviation.

Mukhrani line is approximately 280 km long and the reactive power generated by it is also about 280 Mwar. ≈140 Mwar reactive power flows from the line to Georgian power system in idling mode (P=0). Given this, in the emergency shutdown of this line, as it is shown on figure 1, the frequency in Georgian power system increases to approximately 50,75 Hz. When 63 MW active power flows to Azerbaijan (about 140 Mwar reactive power still flows

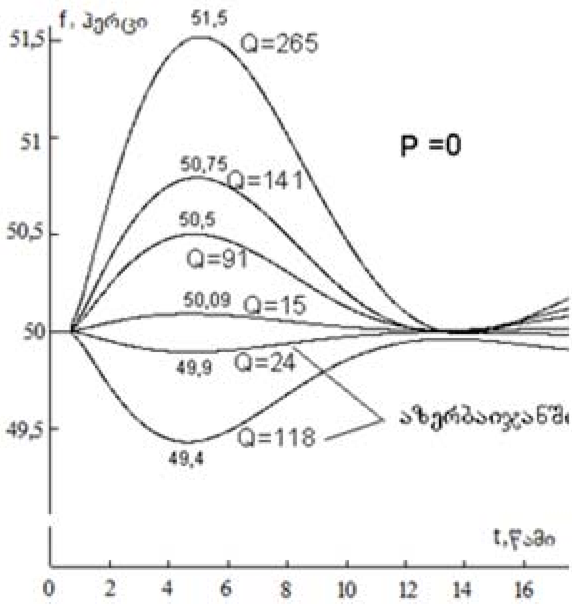

Figure. 1.

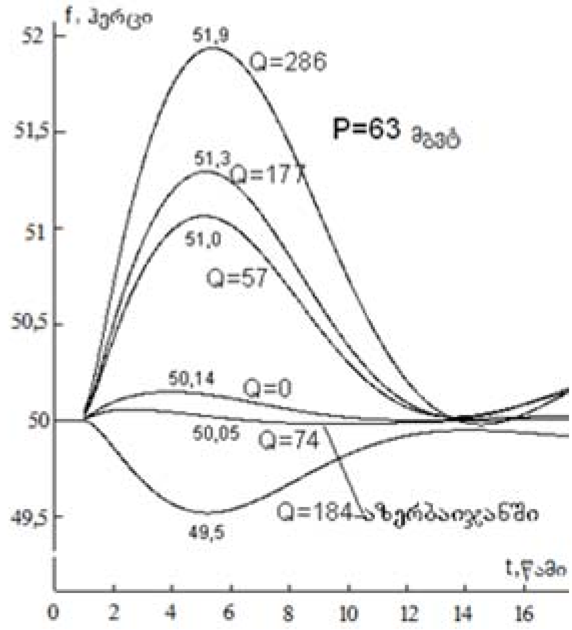

Figure. 2.

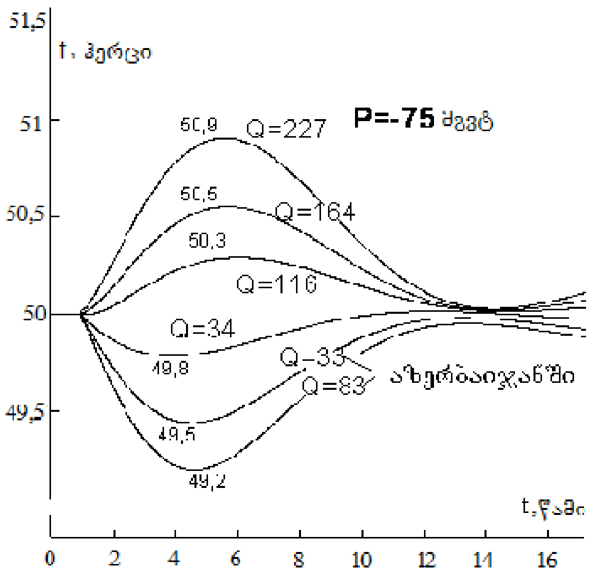

Figure. 3.

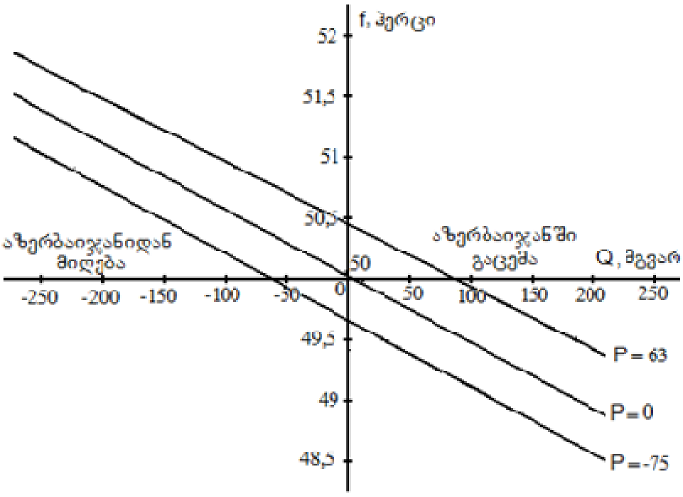

Figure. 4.

to Georgia at this moment), the emergency shutdown of the line leads to the frequency increase to approximately 51,21 Hz in Georgian power system (fig. 2), and when 75 MW active power flows from Azerbaijan to Georgia (140 Mwar reactive power still flows from the line to Georgia at this moment), the emergency shutdown of the line leads to the frequency increase to approximately 50,4 Hz in Georgian power system (fig. 3).

Figure 4 shows the relation of the frequency deviation with the value and direction of the reactive power running within the line during the flow of the given amount of the active

power. It is seen from this figure that in case the flow of the given amount of the active power is followed by uniquely determined flow of the reactive power, there is no frequency change observed in power receiving system. In particular, there will be no frequency deviation in Georgian power system if 63 MW active power flows when flowing 79 Mwar reactive power or in flowing 75 MW active power, there is the flow of 61 Mwar reactive power observed.

By the condition of the frequency stability, the above shown proportion of the active and reactive powers running within the line is conditioned by load regulation effect. In particular, uniquely determined excess and deficit of the reactive power changes the voltage level by such a value that the active power deficit is almost completely compensated.

Provision of such a desired proportion of the active and reactive powers flowing within the line is actually impossible because in case of providing the admitted working voltage at the top and bottom of the line, the given value of the active power running within the line uniquely determines the value of the reactive power running at the top and bottom of this line. In particular, for the reviewed line, when P=0 it makes 140 Mwar.

Consideration of this issue to the above direction will allow to determine the expected deficit value of the active power arisen within the power system in advance according to the active power flowing within the intersystem line as well as to develop the adequate activities for timely and effective elimination of the emergency situation in advance.

R E F E R E N C E S

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