

CONTROLLED TRANSMISSION LINES AS INTERSYSTEM CONNECTIONS FOR MAINTENANCE OF ENERGY SECURITY OF REGION

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The abstract: positions and methodical aspects of the problem of energy security are considered, advantages and opportunities of use of controlled transmission lines are described as intersystem connections that will improve the level of energy security of the country and region.

Key words: energy security, indicators, controlled transmission lines (CFACTS).

Statement of the problem

The problem of energy security has arisen in Republic Moldova, also as well as in other countries, from the moment of an establishment of independence of the state. Before the country there was a whole complex of the problems, including political, economic, military, ecological, information, social and other parties {sides} of a life of the state and a society which can be united in concept "security" [1-2]. Stable functioning of the power system during the previous period, presence of the competent personnel, the adjusted delivery of fuel, redundancy of the installed generating capacities promoted confidence that such position in power system PM will be kept and in the further.

But last years the situation has changed. The means in updating, modernization of the equipment that leads to its ageing, breakdown susceptibility and decrease in operational readiness are not put in the energy branch. Reorganization of structure of power has led to occurrence of some the independent organizations, but with loss of uniform coordination of energy complex management as a whole.

The purpose of present article is consideration of positions both methodical aspects and the analysis of a problem of energy security, the description of the indicators reflecting intersystem connections, and estimations of their role on increase of a level of energy security of the country and in the region.

General provisions and definitions.

The concept of energy security of Republic Moldova, as well as other countries, is multi-sided and mentions the phenomena and processes not only in the power system, but also in economy [3-6.] For the present moment development of economy has reached the level at which the influence of energy sphere on other economy making plays a key role.

Energy security is a condition of security of the country (region), its citizens, a society, the state and economy from threat of deficiency in maintenance of needs for energy economically accessible fuel and energy resources comprehensible quality in normal conditions and at force majored, and also from threat of infringement of stability fuel and power supply [1-2].

Methodical issues.

In the methodical plan of research of energy security contain a number of defining stages, namely:

- Carrying out of the general analysis of a energy branch;
- The analysis of changes in it under influence of various internal and external factors can reflect formation of system of the basic parameters (indicators) which characterize branch with greatest degree;

- Revealing, the analysis and ordering to defining attributes and degrees of weight of threats of energy security;
- Definition of limiting (threshold) sizes of indicators, which excess leads to occurrence of the negative, destructive phenomena in examined area;
- Calculation of actual values of indicators of energy security and their comparison to threshold sizes;
- Definition of values of integrated parameters of energy security;
- Formation of recommendations and actions on anticipation of threats and improvement of parameters of energy security.

The demanded level of safety is reached provided that all complex of parameters (indicators) is within the limits of admissible borders of the threshold values.

The researches in the field of energy security are spent to last years in Moldova with help of Russian scientists. The collective of authors have prepared the monograph « The Analysis of a condition of the power complex of Republic Moldova and the way of maintenance of energy security » [3] (in Moldova in 2001) in which the qualitative analysis of energy security is executed.

During the subsequent period a number of researches [4-6] in which theoretical results are received has been executed, methodology are developed and practical calculations of quantity indicators (indicators) of energy security for Moldova (the monograph «Methods of calculation and the analysis of parameters of energy security », 2005) are carried out.

For neutralization of arising threats to stable power supply and as the main purpose of the analysis of energy security development of a complex of the actions directed on maintenance of energy security, including on each indicator separately is provided.

There are the indicators reflecting a condition and the level of a reserve of intersystem connections, values of streams of the capacity proceeding on intersystem electric lines in the system of indicators.

The power system of Moldova includes distributive electric systems a voltage up to 110 kV, intersystem high-voltage lines 110, 330 kV and intersystem electrical transmissions 330, 400 kV. The power system synchronously works with the power system of Ukraine on lines 110, 330 kV, and has connections by a voltage 110 kV with the power system of Romania, and on transmission line-400 kV - with power systems of Romania and Bulgaria .

Problems of the power system of Moldova consist in insufficient throughput of intersystem and intersystem high-voltage connections with the Odessa and Vinnitsa power systems of Ukraine, and also weak connections with the western countries.

Bigthreat of energy security of Moldova arises in connection with absence of own balance of electric capacities in the Right bank though it is enough the installed capacities of sources of the electric power of Moldova at present. The basic source of the electric power the Moldavian state district power station is used unsatisfactorily. Work of station is limited to 1-2 power units (from 12), and only for electro supply of the Left bank.

Role of the Moldavian state district power station as basic unit of the Moldavian and Odessa power systems, it is exclusively great in maintenance of balance of capacity, and also static and dynamic stability of an electric power pool of the South. The Moldavian state district power station has great value for maintenance of opportunities of development and functioning of an electric power pool of the countries of the Black Sea region.

Taken place emergency repayments of power systems of Moldova and the Odessa area recently occurred{happened} that in work there were only 1-2 power units MGRES with generation 250-350 MW, During same time on one-chain transmission line -330 kV Dnestrovsciaia HYDROELECTRIC POWER STATION - Beltsy - Strasheni - Kishinev took place limiting on size overflows of capacity (300-400 MW) from a power system of Ukraine and at an adverse condition of networks 330 kV adjoining to Moldova from Ukraine.

The executed researches and calculations, and also modelling of emergencies have revealed a number of "narrow" places of a power system. They have given the basis to bring a number of offers on development of intersystem and intrasystem electric mains by a voltage 330, 400 kV, including in view of prospects of synchronous work of power systems of Moldova - Ukraine (in structure of an electric power pool of the CIS countries) - Romania and other countries, and also at creation incorporated, synchronously working, an electropower system "East-West".

On fig. 2 the scheme{plan} main by a voltage 330 kV and above existing and offered new (are shown by a dotted line) is shown.

For strengthening{amplification} connections of power systems and increase in a limit of capacities{powers} of sections of power systems Moldova - Ukraine and Moldova - Romania expediently construction of following BJI:

- transmission line 330 kV Beltsy (Moldova) - Dnestrovscia HYDROELECTRIC POWER STATION (Ukraine);

- transmission line 330 kV Beltsy - Strasheni - Kishinev (Moldova);

- transmission line 330 kV Beltsy - Ribnitsa (Moldova);

- transmission line 330 kV Strasheni - Ribnitsa (Moldova);

- transmission line 330 kV Ribnitsa - the Moldavian Thermal Power Electrical Station (MTPES);

- transmission line 330 kV Usatovo - Adjalik (Ukraine);

- transmission line 330 kV Strasheni (Moldova) - Iasi (Romania);

- transmission line 400 kV Beltsy (Moldova) - Suceava (Romania).

For development of connections of power systems of Moldova, Ukraine, Romania, Bulgaria, the countries of the Balkan and Black Sea regions rather important introduction in work transmission line 750 kV S (Ukraine) - Isakcea (Romania) - Varna (Bulgaria) and construction of its new site up to Istanbul (Turkey).

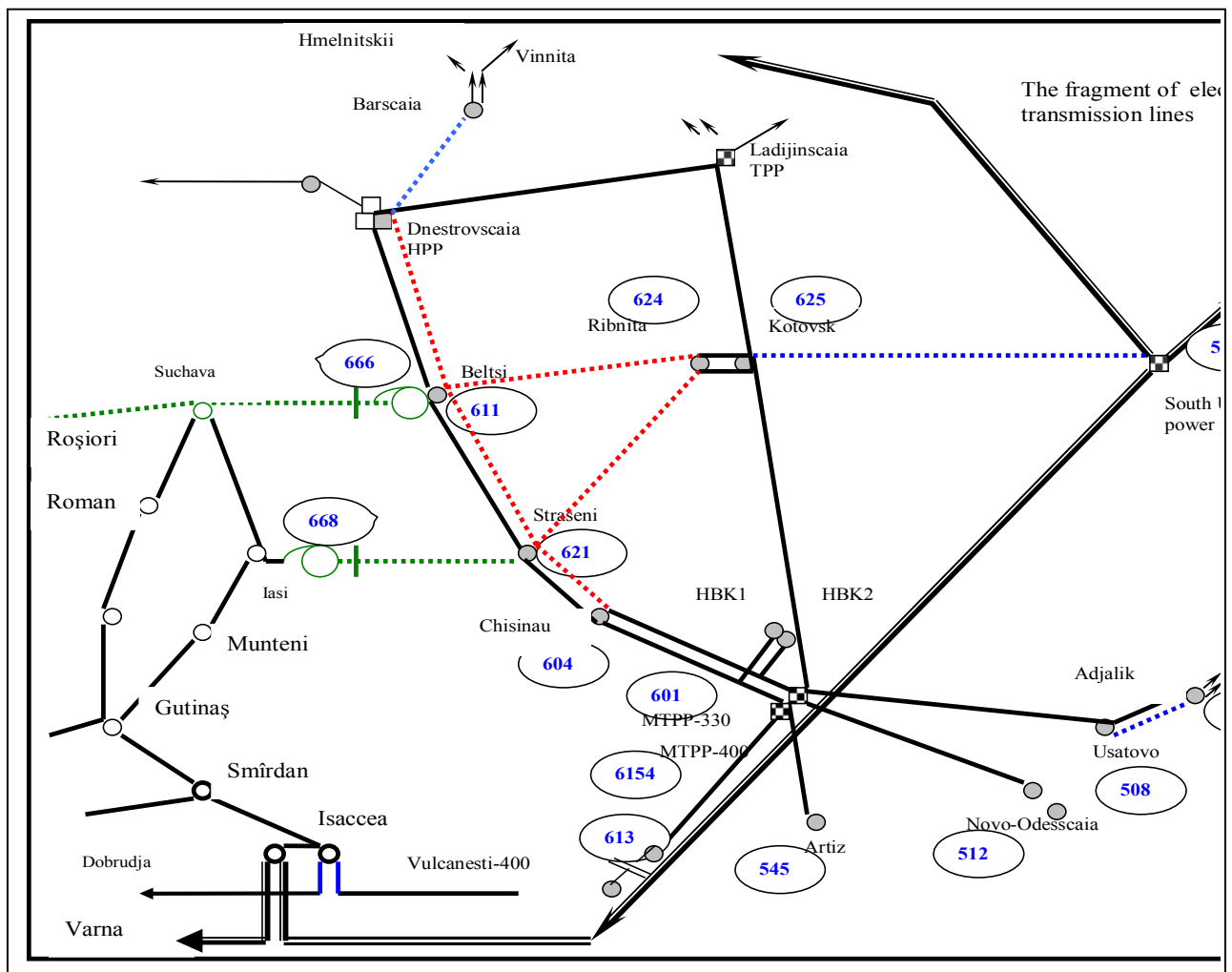
The important role in transit of the electric power can play transmission line 400 kV - the MTPES - Vulkanesti (Moldova) - Isakcea (Romania) - Dobrudja (Bulgaria) and loading on full capacity of the MTPES.

To provide the best values of the indicators reflecting a condition of intersystem connections, and, hence, to increase energy security, it is possible at use of operated self-compensated controlled alternative transmission lines (CFACTS) on the basis of development of Institute of Power Engineering of Academy of Sciences of Moldova in the field of electricity transmissions of the raised throughput and means of phase regulation which in a complex with application of usual means allow to receive the set parameters of modes of power systems.

Main advantages CFACTS consist that in comparison with usual transmission lines they have higher throughput and allow to regulate parameters of modes according to changes of size of transmitted capacity that allows to reach thus a minimum of losses of the capacity, the set distribution of a level of a voltage, restriction of size of through currents of short circuit and high reliability.

Two-chain CFACTS-110 kV, possessing in comparison with usual transmission lines - 110 kV the increased throughput, it is constructed and successfully works in the Moldavian power system within 20 years. On the parameters and throughput it comes nearer to characteristics one-chain transmission lines a class of the voltage 330 kV.

The researches and development CFACTS and on higher classes of a voltage, including on 220, 330, 500, 750 and 1150 kV are executed in the Institute of Power Engineering Institute. Elements of designs and isolation two-chain CFACTS-220, 500 kV are tested on ranges in a Khotkovo (the Moscow region) and on high-voltage test polygon of Institute of Power Engineering ASM. It is executed by the FEASIBILITY REPORT of some electricity transmissions of the specified type a voltage 220-1150 kV.



The fragment of electrical scheme with new transmission lines

Data of researches and development show that CFACTS in comparison with usual transmission lines being equal provide on 20-40 % the greater size of throughput, create new opportunities of management of streams of capacity, improvement of parameters of modes of power systems, decrease in losses and reduction of electromagnetic influence in surrounding space.

On the basis of CFACTS can be successfully solved problems of forming big systems and the appreciable economy of capital investments and current expenses for transport and distribution of the electric power is reached.

The specified advantages are reached due to change of a design of the lines realizing rapprochement of phases of a line - in case of three-phase one-chain lines and rapprochement of circuits - in variants of multichain lines, applications of means of regulation of jet capacity and phase regulation devices.

For CFACTS change of a configuration of an arrangement of conductors leads to change of size of capacity. In earlier spent researches various variants of designs were considered{examined} at rapprochement of phases up to 1,1 m. the Further researches have shown, that rapprochement can be carried out on the even greater{big} size, in particular, up to 0,4 m at application of the isolated wires, [3,4,5]. The covering of wires a layer of isolation allows to strengthen even more advantages CFACTS in comparison with usual lines. From all advantages of the isolated wires it is possible to note the following:

- Reduction of a right-of-way;

- A smaller degree of formation of ice on wires;
- Simplification of a lining of a line;
- Uninterrupted electro supply in case of failure of wires from support;
- It is completely excluded crossing wires.

The specified advantages allow to make CFACTS with the isolated wires in the form of multichain net designs (it is worked for a class of voltage up to 110 kV).

CFACTS and increase of energy security

Apparently from the lead analysis, CFACTS and CFACTS with isolated wires possess the best characteristics, than usual transmission lines.

Due to the raised throughput, CFACTS allow to improve indicators of the block of distribution and transport of the electric power. Application CFACTS provides an opportunity to transmit the increased volumes of import of the electric power that is especially actual in critical modes. At modernization of networks by replacement of existing lines on CFACTS the increase in a reserve of networks on throughput on 10-30 % that allows to improve the indicator of an intersystem reserve is possible{probable} and if necessary to solve questions of transit of capacity and energy. CFACTS, owing to their improved parameters, facilitate the decision of problems of big systems formations .

CFACTS allow to improve indicators of the ecological block. The given lines create smaller values of intensity of an electric field in surrounding space (on 15-40 %), including at the surface of the ground and demand for construction of a smaller right-of-way ground counting upon a power unit (on 40-35%).

Also improvement of parameters of the mode of electric systems, in particular, smaller losses of a voltage, an opportunity of regulation of overflows of capacity is provided; reduction of quantity of refusals and others. It promotes more stable electro supply of consumers that finds the reflection in the corresponding indicator of the block of consumers.

Performance CFACTS with the isolated wires essentially increases reliability of distributive networks. In particular, it is expressed in smaller ice and, accordingly, leads to reduction of breakdown susceptibility; in increase of mechanical stability due to reduction of dancing and crossing wires; in decrease in dynamic mechanical influences on wires. Besides performance CFACTS with the isolated wires promotes reduction of an electric traumatism and reduction in commercial losses.

Considering, that CFACTS demand smaller capital investments (on 10-30 %) and on 10-20 % of decrease in the resulted expenses for unit of transmitted capacity, as a whole on a power system it can create significant economy of financial assets that is reflected in financial indicators.

Last years transmission lines considered and from other point of view- as sources of receipt of the electric power . In the Right-bank part of Republic Moldova just there is such situation, and a role of intersystem lines, their quantity and throughput get essentially more great value for maintenance of steady electro supply of the country and maintenance of energy security. The similar situation is available and for other countries.

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