

ON MERGING POWER SYSTEM OF AZERBAIJAN WITH IRAN'S AND TURKEY'S

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ABSTRACT

The paper intends to consider possibility of uniting power system of Azerbaijan with those in Turkey and Iran within the framework of future project aimed at establishing united power system of the Black Sea and Caspian states. The paper emphasizes importance of such the united system for the Eurasian energy system. A number of expected problems in addition to issues related to preparation of the systems to become united are outlined in the paper.

Keywords: power system, intersystem, superunion, merging, power consumer

I. INTRODUCTION

Development of the power engineering proceeds along the path of establishing interstate, transnational and transcontinental system. A number of large-scale systems are already in operation, e.g. the North American and Canadian power systems, UCTE in the Western Europe, CENTREL in the Central Europe, Nordel in the Northern Europe, United Power System of Russia. The systems are being united in the Central and Southern America, Africa, Asia and others. Advantages of such the united systems are well known. One can mention the frequency, power flow, operating modes, structural, commercial and environmental contributors [1], which are the main components defining efficiency of the united power system operation.

Rise in prices and limitation of the fuel recourses, demand growth for electrical energy raised a world-wide energy saving problem followed by a process of monopoly system take-over in power industry and transition towards market system. Mentioned processes have become known as globalization and liberalization. It is not that easy to distinguish between both processes from standpoint of achieved results – cost-performance is the dominating factor. However, more and more frequently requirement for cost-effectiveness contradicts with reliability of power supply which results in serious power supply interruptions. Statistical data on such the power interruptions has been collected since 1965 (North America and Canada – 19, West Europe – 5, North Europe – 2) [2]. Many reasons contribute to power

interruptions caused by conflict of cost-performance vs. system reliability.

The globalization and liberalization processes normally results in dialectical conflict between dynamic features of the power systems and lagging behind methods and technical controlling means and protecting systems.

II. BODY OF THE TEXT

Dynamic features of the power system define its behaviour during emergency situations (transients). As a rule, merging of power system is fulfilled using “weak” links, a mutual effect of transients in connected power systems on systems working in parallel is strengthened. Most commonly the transients represent misbalance of power flows followed by sudden shutdown of power generating unit. The “weak” links contribute to presence of weakly-damping irregular fluctuations which threaten “slipping down” to violating direct component of static stability. Thus, there are “technical risks” embedded within present united system which shall be corrected through implementation of new principles and modern controlling means.

In the run of the market economy the globalization and liberalization process are also accompanied by segregation and diversity. At the same time, it is currently the stage where despite declaring segregation, the World practice demonstrates that development of the Automatic Power Management Systems (APMS) shall head towards improving centralized power control system along with expanding economic market functions. New structure of power management system shall be based on actions on independent system operator who would not only control its technical features associated with power generation, transmission and consumption, but also commercial components of the associated processes such as cost of production, transit, regulation, operating expenditures, etc. New structures shall be capable of utilising a whole range of IT techniques based on hierarchical model similar to other APMS. At the present conditions it is impossible to provide reliable power supply to consumers without properly developed power system control system, Automatic Voltage and Reactive Power Regulation (AVRPR) using reactive power compensation and

FACTS, static thyristor converter, controlled padding reactors, upgrade of Automatic Frequency and Power Flow Regulation (AFPFR) system and protection systems. Diversity consists in utilisation of different fuel recourses to generate electricity, distributed generation located close to consumers who are, in turn, remote to central power supply systems. Above introduces ambiguity to operation and stability of the power system. A dynamic stability of power system is adversely affected by provision of independence of power consumers from the central power system, improvement of power supply reliability, reduction of losses in the system, improvement of voltage levels and quality at remote nodes and growth in static stability reserve [3].

Moreover, it is worth to mention that at the present time power supply companies do not fully realise technical necessity of investing to support required power reserve, development of power networks and protection systems, etc.

Above stated provides necessary grounds for comprehensive (legislative, organisational, technical, economic) preparation of the power system to merge to reduce adverse impact of mentioned processes.

Future projects for establishment of Eurasian United System consisting of European PS, United PS of Russia, Eastern Siberia, the Far East, the North-East Asia and others [4] are currently under discussion and consideration. A project on connecting power systems of UCTE-CENTREL with the European South-East (TESIS) is also under consideration. The power system of the Black Sea – Caspian region is also mentioned: this is the subject of the present paper.

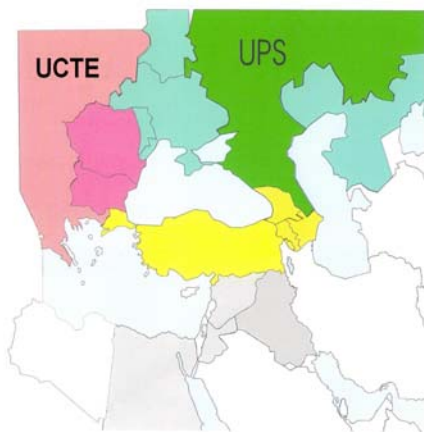


Figure 1 – The Caucasus countries and the surrounding electricity grids

Figure 1 shows geographical location of the countries of the Black Sea – Caspian basin (Azerbaijan, Armenia, Bulgaria, Georgia, Iran, Moldavia, Russia, Romania and Turkey).

As it can be seen the power supply system of the South-Caucasian region takes a strategically importance place and may become a linking chain between power system North – South.

In the North – The Power System of Russia that forms own electrical connections in the West (UCTE +CENTREL, Nordel, Baltiya) and in the East.

In the South – the power system of Iran possessing electrical connection with the power systems of Turkmenistan, Turkey, Pakistan and, in future, with Afghanistan; in addition, the power system of Turkey bordering with PS of Bulgaria, Iraq, with prospects of connecting with UCTE and the Near East’s PS.

It can therefore be concluded that under appropriate conditions the power system of the South-Caucasian region can become a part of a closed loop formed by the extensive united power system.

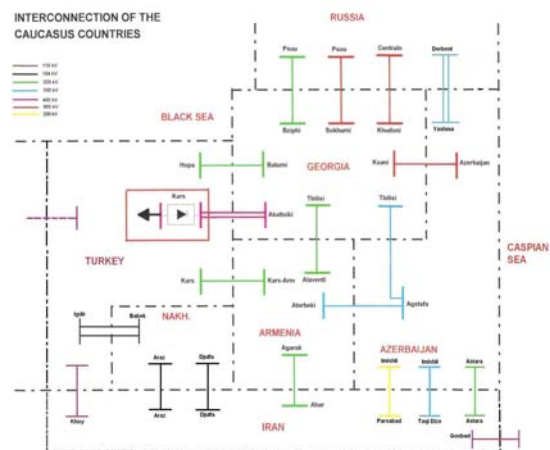


Figure 2 – Interconnection of the Caucasus countries

Figure 2 shows a schematic representation of inter-system links (ISL) in the South-Caucasian regions which are already in operation. Let us review a few of them which are of defining value.

An analysis of present ISLs in the South-Caucasian region reveals the following:

Azerbaijan PS – no ISLs with the Turkish PS. An IL with the Georgian PS is formed by two HV lines: 330kV and 500kV. It should be mentioned that the 500kV overhead line needs some refurbishment work to be done.

An inter-system link the Russian PS is via single-circuit 330kV line rated at 350MW – which is not sufficient. Development and design of the second circuit is ongoing.

An inter-system link with the Iranian PS is via 230kV overhead transmission line. Construction of the second circuit (330kV) is close to completion.

Thus, at the moment the Azerbaijani PS has respective links with the power systems of Russia, Iran and Georgia and can fulfil appropriate transit functions.

The Georgian PS has powerful inter-system links with the Russian PS (500kV).

Interconnection between the Georgian and Turkish power system is represented by a single 220kV transmission line through which the Georgia PS will not be able to fulfil transit functions.

The connection of the Russian and Azerbaijani power systems with that of Georgia can be implemented by

means of strengthening power transmission capacity of the Georgian PS, in particular, through 500kV lines.

As it can be seen, the Black Sea – Caspian regional loop with links to UCTE and power systems of the Central and South-East Asia can be formed by means of merging the PS of the South-Caucasian region: the Azerbaijani and Georgian PS with those of Turkey and Iran.

The technical and economic conditions for merging the power systems of Azerbaijan and Georgia to the Turkish PS has already been reviewed in 1997 within the framework of TACIS project. The grounds have been given for possibility of such the merge by the means of putting in operation an HVDC unit (600MW, 400kV) at Kars substation and strengthening the 500kV electrical power transmission system of Georgia (500kV HV overhead transmission line Zestafoni – Ahaltsihe and Ksani – Ahaltsihe).

Since then essential changes have been taking place in the Azerbaijan PS, which, in turn, now prepare it to merge.

660MW of new installed generating capacity have been introduced from 2000. Newly installed gas-turbine (110MW) and cogeneration plants (400MW) are equipped with modern automatic frequency and power flow regulators. A number of units at Mingyachaur hydroelectric power station have been refurbished, so a proportion of obsolete units came down to 20%.

A construction of 5-unit power station with total generating capacity of 450-460MW is ongoing. They will allow unload the main transmission lines, enhance voltage quality and power supply reliability in the regions. The inter-system links between the power systems of Azerbaijan, Russia and Iran are also being strengthened.

Introduction of inner loops and new 330kV substations within the Azerbaijani PS also contribute to strengthening of power transmission capacities inside the country.

The upgrade of the second and third stages of the protection system will be kicked off in 2006.

New hierarchical structure of the National Power System Dispatching is being developed.

A necessity for establishment of a two-stage structure for the National Power System Dispatching Centre (NPSDC) with five Regional Power System Dispatching Centres (RPSDC) at lower levels has been justified. The structure satisfies integrity and segregation standards. As applied to the structure, a 2-level SCADA-based IT system is being created.

Above mentioned constitutes content of the State Program on Development of the Power Industry for 2005-2015.

In accordance with the program the power capacity of the Azerbaijani PS will total more than 600MW. The power system has always been dominating, and in the future its potential opportunities as an energy exporter and transit state will be even greater. It should be noted that the interchange will take place in the following directions (Figure 3).

- United Power System of Russia – Azerbaijan – Georgia – Turkey – UCTE
- United Power System of Russia – Azerbaijan – Iran – Central Asia and further.

Joint implementation of the both directions is possible after strengthening of the present inter-system link between the power systems of Iran and Turkey which was built to the voltage of 400kV, but used at 132kV.

Figure 3 represents possible future scheme of the Eurasian System and roles of the Azerbaijani, Georgian, Iranian and Turkish power systems in it.

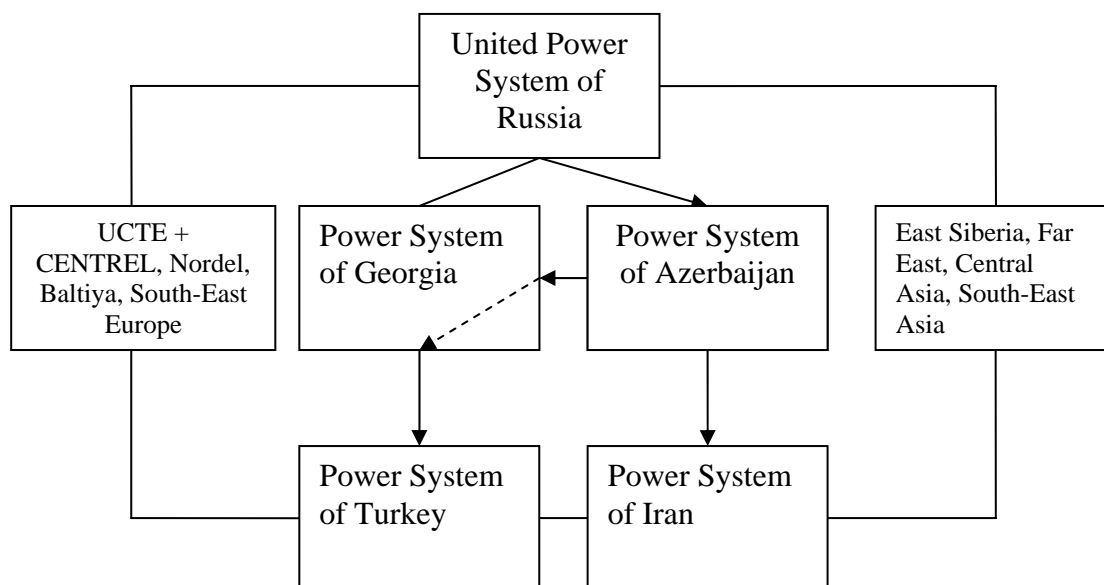


Figure 3 – Block diagram of the inter-system links

III. CONCLUSION

1. There is a real opportunity to establish the Eurasian power system superunion that would consist of UCTE, CENTREL, United Power System of Russia, Turkey and Iran, as well as, energy systems of the South-East Europe, Central and Eastern Asia.
2. Important roles in establishing such the union (North – South) belongs to the power system of the South-Caucasian regions. The present intersystem links lay conceptual grounds for the union and necessity of reinforcing them.
3. Improvement of the inner-system transmission lines in Georgia (500kV) and introduction of the 600MW HVDC facility that would enable connection with the Turkish power system at 400kV play the very important roles in provision of parallel operation of the power system of the South-Caucasian region.
4. The merging of the power system is connected with a number of reliability-related problems and therefore necessitates greater efforts when preparing them to the parallel operation.
5. Within the frameworks of the development program in the power system of Azerbaijan, a number of measures are being implemented in order to get ready very soon to the parallel

operation as both a transit country and electrical energy exporter. The inter-system links with the power system of Islamic Republic of Iran are considerable strengthen; strengthening of the power system links with United PS of Russia is upcoming. The refurbishment of the protection system as well as development of the hierarchical national power dispatching centre equipped to high standards is ongoing.

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