Coordination and Dispatch Center “Energy”

Issues of regional cooperation within the Central Asia Integrated Power System

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A brief description of the CA IPS at a stage of its establishment

A configuration of the Central Asia Integrated Power System (CA IPS) was developed in 1970-s. The CA IPS was designed as a single whole, irrespective of national borders of the Soviet Republics. Like many other power systems it was operated separately from the power grid of the former Soviet Union.

Consisting of 30% of hydropower plants and 70% of thermal power plans, the structure of the IPS is scientifically and operationally optimal in terms of frequency and capacity adjustments and resolving water and energy related problems.

A long-term planning of CA IPS operation modes took into account the composition of power generating sources in each power system constituting an integral part of the IPS as well as issues of centralized fuel supply for thermal power plants of the system.

Such modes were based on both power generation and irrigation needs that are closely interconnected in the Central Asia region. An optimization of regime intended to minimize fuel costs and electric loss in the networks throughout the power grid as a whole rather than a separate power system.

Maintenance schedules were coordinated and spare parts centrally supplied.

The integrity and close interrelation of operation modes of power systems incorporated in the CA IPS was a major precondition to enable control of power system operation modes from a single regional center and to establish an enterprise for integrated dispatch control (IDC) in Central Asia (Integrated Dispatch Center "Energy") and similar units in related sectors (BVO "Syrdarya" and BVO "Amudarya").

The Central Asia IDC enterprise was established in 1960 (April) and was based in Tashkent. Functions assigned to the enterprise were operation and process control of the Central Asia integrated power system (that incorporates the power systems of Uzbekistan, South Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan). Although the CA IPS worked separately, the regional dispatch center was subordinate to the Central Dispatch Administration of the USSR's power grid and financed by the Ministry of Energy and Electrification of the USSR. Operation and dispatch control system had a strict vertical hierarchy that required unconditional subordination of the lower level dispatch control units to the higher ones.

Brief description of the CA IPS following the collapse of the USSR

Following the collapse of the USSR so did the system of centralized supply of energy materials and resources. Each power system urgently undertook measures to ensure its energy independence, that is to reach self sufficiency in terms of power generation and fuel supply. But the countries were at different starting points in this respect. Due to insufficient own energy resources, countries with prevailing hydropower generation started discharging more water from their reservoirs in winter period that had ended up in imbalances between previously established water and power generation modes and caused environmental problems. An objective of getting an optimal operation mode within the IPS was no longer a first priority.

With an understanding that none of the power systems can independently ensure a full scale reliable power supply to its consumers, the senior management of these power systems signed an Agreement on Parallel Operations of the power systems of the Republic of Kazakhstan, Kyrgyz Republic, Republic of Tajikistan, Turkmenistan and Republic of Uzbekistan in Ashgabat on November 19,

1991 in order to maintain parallel operations; constituted an Integrated Dispatch Control of Central Asia's Power Systems; and shared its funding. In the post-Soviet space outside the Russian Federation the Central Asia IDC unit turned to be the only one that was preserved due to sagacity and efficiency of the power systems managers.

The Central Asia IDC Unit was registered with Mirzo-Ulugbek Khokimiat of Tashkent (September 28, 1993) as an enterprise providing operation and processing control of the Central Asia Integrated Power System and assigned a status of a state enterprise of the Republic of Uzbekistan. Since 1994, this enterprise has been functioning under name of IDC (Integrated Dispatch Center) "Energy".

The Board of the Central Asia Integrated Power System consisting of the first managers of the power systems had become a governing body to control and coordinate parallel operations of the Central Asia IPS.

In 2002, as a result of power system restructuring, the Board of the CA IPS made a decision to bring the status of the Board and that of IDC "Energy" in line with new realities, the latter being assigned a status of nongovernmental institution.

On October 27, 2004 the power systems of Central Asia countries entered into an agreement on coordination of their activities in the field of electrical power engineering. Pursuant to Article 1 of this Agreement there was established a Coordination Electrical Power Council of Central Asia (CA CEPC) being a deliberative body for replacement of the existing Board of CA IPS.

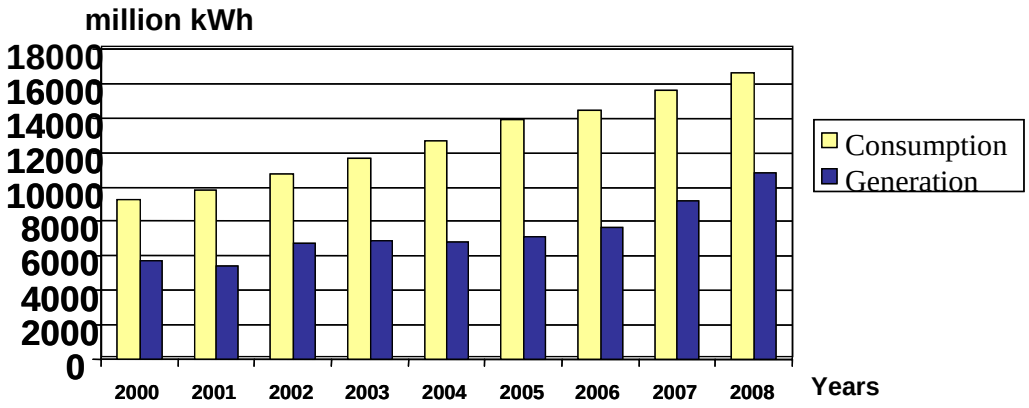
At a meeting of the CA CEPC held on September 29, 2006, its participants endorsed articles of association for establishment and activity of non-governmental non-commercial organization CDC "Energy" whose main functions were provision of parallel work and coordination of operational and dispatch activity of Central Asia power systems. CDC "Energy" is subordinate to CA CEPC, its superior governing body. Pursuant to its articles of association the CDC "Energy" is prohibited to conduct commercial activity.

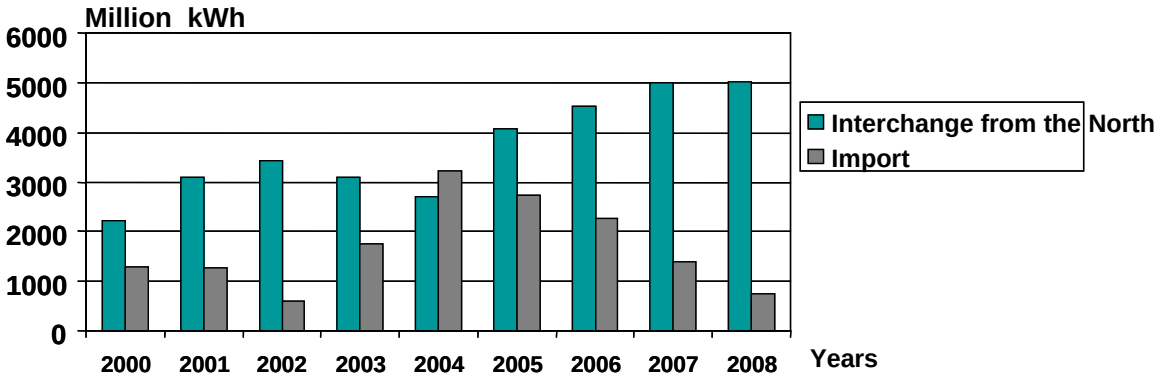
The articles of association of the NNO CDC "Energy" were registered with the Ministry of Justice on May 28, 2007 and CDC "Energy" started functioning as an entity since July 1, 2007.

Brief description of power systems incorporated in the CA IPS

South Kazakhstan's power system

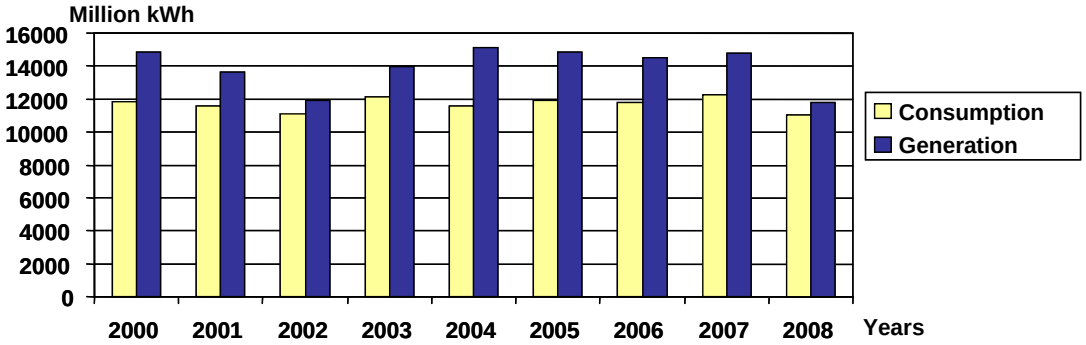
The power system of South Kazakhstan, incorporating power networks of four regions, is deficient for it has insufficient energy resources and is connected to North Kazakhstan's power system incapable of ensuring its reliability and stability.

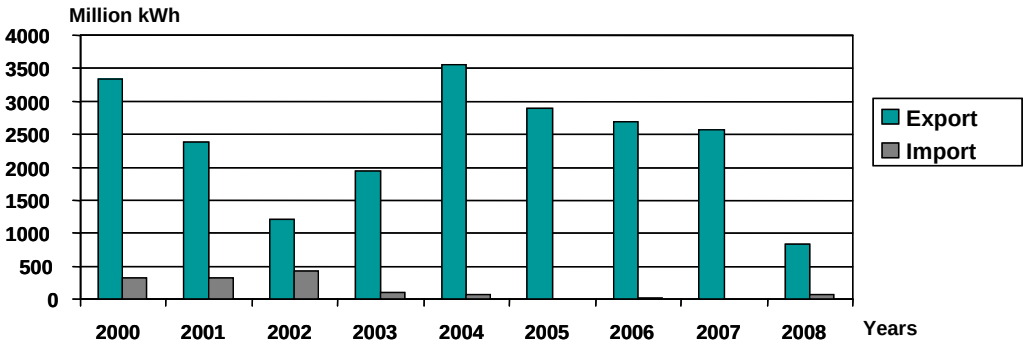




The power system of Kyrgyzstan

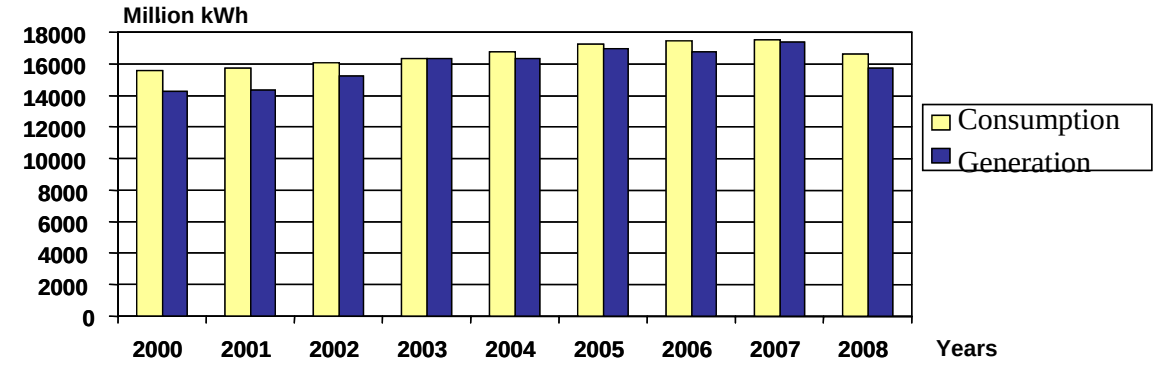
The power system of Kyrgyzstan is excessive and interrelated with all power systems of Central Asia in part of power trade and provision of capacity regulation services.

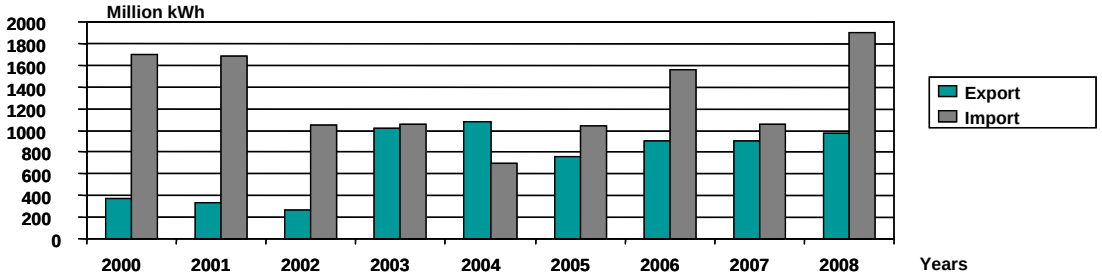




The power system of Tajikistan

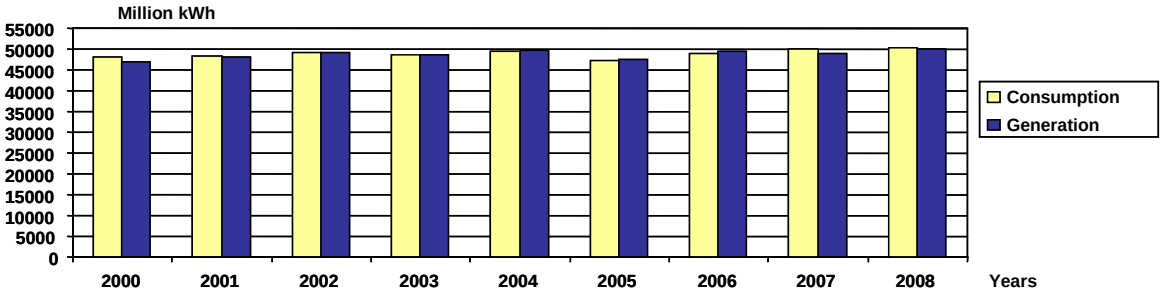
The power system of Tajikistan is excessive in summer and deficient in autumn and winter. This system is interrelated with the power systems of Uzbekistan, Kyrgyzstan and Kazakhstan in part of power trade and provision of capacity regulation services.

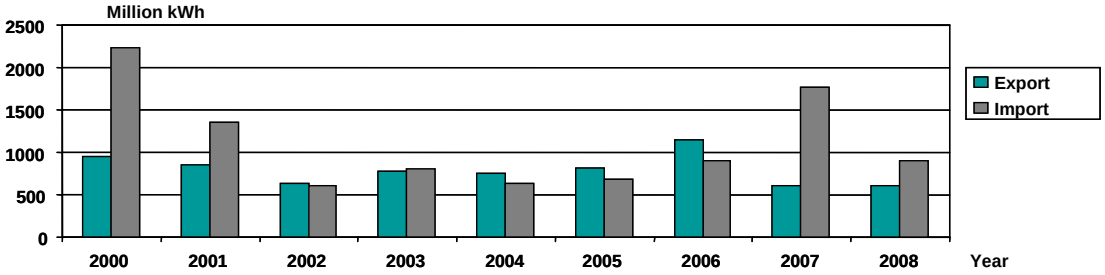




The power system of Uzbekistan

The power system of Uzbekistan is excessive in terms of power generation and capacity but its operation mode is strongly dependant on fuel supply. It is interrelated with the power systems of Tajikistan and Kyrgyzstan in part of electric power trade and provision of transit services. Its interrelation with Tajikistan is based of intergovernmental relations that envisage receiving one and a half times more power in summer against an equal return supply in winter.





To a certain extent all countries of the region have new construction of power networks and generating facilities under way. Yet all the countries are seeking to achieve their power safety and independence.

Whether power systems constituting the CA IPS can sustainably operate separate from one another either nowadays or in near-term outlook (taking into account future construction of power network facilities)?

Major problems of separate operations

Kazakhstan:

- Following an overall completion of the second "North-South" circuit the power system of Kazakhstan would be able to cover its demand (in terms of both power and capacity) except for repair and emergency states.
- However an issue of power interchange control via the North-South link would remain unresolved even under normal conditions due to the absence of mobile hydro-stations in Southern Kazakhstan.
- Voltage control related problems are possible.
- An issue of water supply in southern regions of the country would become irresolvable.

Kyrgyzstan:

- Concentration of power generation sources in the south and of consumption in the north, given a poor connection between them, would not help ensure power safety without power network being strengthened.
- Kyrgyzstan would be deprived of a possibility to export electric power, its major export item, and of revenues from provision of power management/regulation services.
- Enforced transfer of the cascade of Naryn HPPs to solely power generation mode would result in overall disorganization of water modes and worsened relations with downstream countries.
- Poor networking would limit consumption in the north and result in escapages at HPPs in the south of the country.

Tajikistan:

- Following the completion of new construction of the 500 kV "North-South" power transmission line the Tajik power system would be able to supply power to its northern areas using country's own power network, except for a state of emergency or repair.
- A problem of winter time power deficit could not be resolved without power supplied from neighboring power systems.
- Separate operation in summer would entail high power excess and escapages.

Uzbekistan:

- Intended commissioning of electric power facilities would make it possible to ensure independent power supply (in terms of power and capacity) except for repair and emergency states.
- A major problem is acute shortage of regulating capacity and, as a consequence, impossibility of adequate frequency (capacity) control.
- The power system, with thermal power plants constituting 90 % of generating facilities, would not be able to ensure a good quality and reliable power supply due to irregularity of fuel supply under sharp climatic fluctuations.
- Imbalanced water supply all along the Naryn-Syrdarya water-energy way.

In all power systems:

- Separate operation of power systems would increasingly worsen problems related to noncompliance with reliability principle (n-1);
- Impossibility of mode optimization would result in additional power losses and overconsumption of fuel and hydro-resources;
- Violation of adjusted dispatch control system would lead to increased occurrence of breakdown and extended periods required for their elimination;
- Availability of excessive and/or deficient electric power and/or capacity requires mutually beneficial cooperation, that is development of regional trade both within the IPS and with other power systems;
- A main function of power systems – reliable and cost-effective power supply to the customers – would not be maintained adequately.

From the abovementioned and yet far incomplete list of problems it results that:

- Parallel operations of the Central Asia Integrated Power System with the power grids of Kazakhstan and Russia shall be preserved;
- Operational experience of power systems in Western Europe, featuring a better balance and infrastructure, confirms that integration of power systems delivers more advantages in terms of both power supply reliability and market development;
- A CA IPS functioning model that would take into account potential benefits should be developed.

Determination of the countries to ensure their power independence should be welcome. However such independence does not imply separate operations but is a precondition for establishment of a more objective model for regional electric power market where maintaining and strengthening of parallel operations should be a must.

A regional trade of electric power and associated services

During the Soviet period there was a regional model used for exchange (not trade) of electric power and energy resources that took into account advantages of conjoint operations within the integrated power grid as had been designed.

In 1990-s, a model of barter exchange of power and energy resources was used. Following a ban imposed on barter transactions the abovementioned exchange was carried out under intergovernmental agreements – multilateral initially and bilateral later. Procedure for making such agreements is difficult and time consuming for it has to take into account various factors concerning relations between both the entities and the states.

The introduction of market economy mechanisms in trading electric power and, mainly, energy resources has violated the existing models. Models proposed by various international organizations and institutions did not take into account a major feature of the CA IPS, i.e. close interconnection of water and power generation modes.

One of the main obstacles to develop regional power trade is a difference in price level for electric power and energy resources in domestic markets as compared to foreign markets in the countries of the region, though it should be noted that such a situation is not a feature specific to this particular region but quite a common thing throughout the world.

What issues have to be resolved to develop a regional model of energy market?

It is necessary to determine whether the model should consider all components specified below:

- water discharge from reservoirs in excess of own needs during a vegetation period;
- electric power associated with them;
- return supply of hydrocarbon energy resources in autumn and winter period.

Model 1.

A joint consideration of these factors would lead to cross-interests of at least three ministries and therefore its functioning is feasible under intergovernmental agreements only. In this case the model would be administratively driven (with all negative features mentioned above) rather that market oriented.

Model 2.

Country A concerned with obtaining sufficient water from Country B during a vegetation period shall ensure domestic power generation in excess of the country's own needs and supply of equivalent volume of electric power and/or energy resources to Country B in order to prevent evacuation of water from its reservoirs in winter period.

Receiving hydropower during a vegetation period (May – August), Country A:

- saves on organic fuel as it does not have to burn it at its thermal power plants and can create stocks to be used in autumn and winter period;
- implements equivalent return supply of electric power (fuel) to Country B during the autumn and winter period (September - April).

In this respect it should be taken into account that keeping hydro-resources in water reservoirs is akin to keeping fuel oil (mazut) in the tanks since either type of energy resources can be used as needed. This allows return supply of power to Country B in accordance with an uneven schedule minimizing supplied volumes in December – February as Country A may face essential problems related to natural gas supply to its thermal power stations.

In a case that the countries exchange an equivalent volume of energy resources, energy price is assumed to be the same in summer and winter periods, that is its rate would not have principle importance, thus excluding a hard work of contractual price adjustment.

Weaknesses:

- in a case that such exchange is carried out on a barter basis it is necessary to make an intergovernmental agreement that would involve all the abovementioned consequences;
- Country B is unable to secure sufficient amount of fuel for its thermal power plants during an autumn and winter period;
- the scheme is economically non-transparent and may cause delays in making agreements between the entities.

Strengths:

- simple;
- can be implemented with no additional elaborations.

Model 3.

This model suggests considering only water and electric power, that is to take out the fuel component as being directly irrelevant to amount of water discharged and hydro-power generated. A trade of organic energy resources between the countries should be subject to the state of market irrespectively of water – power generation modes.

In this case fuel costs of power generating companies shall be taken into account when calculating a summarized annual price of electric power supplied; that is average annual costs would be used to calculate an amount of electric power to be supplied under this model.

Expenses of other institutions for procurement of fuel, particularly sales to the public, shall not be included in the model (same as in case of gasoline and other petrochemicals).

For example, company's fuel costs for thermal power plants are US$ XXX. This amount will be employed as a component contributing to a summarized price of hydropower supplied during a vegetation period. A precise value of the fuel cost share is to be defined by relevant specialists.

Another component is related to evaluation of water in water reservoir subject to discharge. Upstream countries endeavor to give water a status of a good, which, in turn, is unacceptable for downstream countries. Nobody doubts that bottled water is a consumer good; but can the same approach be extended to water contained in a river or reservoir?

The answer is to be found in economics:
- river water is not considered as a good for it does not contain a labor share required for its production;
- For the same reason water in a reservoir is not a good as well, but a process of its accumulation, storage and evacuation is conjugated with services of river water flow readjustment.

One of reports of one of the countries stated that a major part of a river flow was being formed on its territory but the country made no use of that, while this country had not even a single hydraulic work that would allow **readjusting** river flow.

The services of river flow readjustment are aimed to retain excess water during high-water years and to discharge more water in low-water years, and therefore should be paid for by the users on annual basis irrespectively of volumes of hydro-resources received. Probable, there is a point in introducing the term *"interstate water reserve"* as refers to a reservoir used for provision of long-term water flow adjustment services for which the owner of the reservoir would be paid.

Payment for services of maintaining the interstate water reserve should be made under a multilateral agreement incorporating responsibilities of the parties to such agreement with respect to water accumulation and use.

How much would the service cost? – Assistance of independent international experts is needed to define it.

The term "reservoir maintenance costs" is often improperly used assuming that these costs should be paid for too. From a viewpoint that water reservoir is an integral part of hydraulic works that are designed for power generation, its maintenance costs are already included in electric power price cost, and therefore no extra cost for "maintenance" should be charged.

Therefore, price for electric power generated (by a hydropower plant with a long-term flow adjustment water reservoir) above own consumption needs shall include the following components as minimum:
- hydropower cost price;
- share of fuel cost allowance to ensure operations of company's thermal power plants in cold (autumn and winter) period;
- service fee for establishment of interstate water reserve in the reservoir.

When above hydropower price is defined the task of developing a model for electric power market in Central Asia region can be solved mathematically using well-known methods of nonlinear programming such as simplex-method.