The workshop on the issues of regulation.

The issues of technical regulations in UPS CA

Head of CDC “Energy”

PhD Shamsiev Kh.

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- The purpose of this report is to show to prospective customers of electricity, which technical regulations are in force in UPS CA and should be taken into account while formation of contracts.
- This report includes the technical aspects, which make the UPS CA different from other united power systems, even from those, with which UPS CA operates in parallel mode (i.e. Unified Energy System of Russia (RAO UES) and other post-soviet power systems).
- The specific character of UPS CA is the fact that since establishment and until 2002 this energy union was operating isolated from other parallel operating power systems of former USSR.
- Currently all these power systems (except Armenian) have a direct link with RAO UES and are forced to operate according to the rules formed in Russian energy system.
- Unlike them the UPS CA has indirect connection with RAO UES via power system of Kazakhstan. Due to this fact it was possible to keep in operation that groundwork which was created by force in UPS CA after the collapse of USSR.

- In 1991 when independent states were formed the heads of the power systems in UPS CA were aware that none of the power systems cannot survive alone and:
  - signed an Agreement of parallel operation of the following power systems: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan;
  - formed the Council of UPS of Central Asia;
  - established an organization “Unified Dispatch Control of power systems of Central Asia”, and took its financing assumed on a pro rata basis (present CDC “Energy”).
- The UPS CA was forced to develop urgently and independently the model of joint cooperation of power systems in conditions of parallel operation in UPS CA and isolated operation of UPS CA from UPS of CIS.
- Several methodologies that have no analogues in other energy unions were developed. They are still operating with some modifications and determine the features of UPS CA.

- **The first feature** is conditioned by parallel operation mode.
- Parallel operation mode means a joint functioning of power systems with common frequency and providing the following characteristics in acceptance limits:
  - voltage level in so called nodes of energy systems,
  - power flows on interconnection lines (or set of lines, included in controlled cutset).
- This definition deals with 3 types of technical regulation which are implemented in each power system:

regulation of frequency;

  - regulation of voltage;
  - regulation of power flow in lines.

- The process of frequency regulation in UPS CA has its feature and differs from approach accepted, for example, in UCTE, when all parallel operating power units take part in regulation, and they must satisfy rather severe requirements.

- The UPS CA accepted the system of frequency regulation that was inherited from soviet period. According to this system the regulation of frequency is provided by specially dedicated for this purpose, so called the power stations of primary regulation.
- The primary regulation must respond to any power unbalances, regardless of the place of their occurrence. The main purpose is to hold the frequency error at an acceptable level in case of occurrence of the emergency power flow unbalances in power system.
- Until 2002, when there were no connections of UPS CA with UPS of CIS the functions of primary regulation were vested in Toktogul HPP (Kyrgyzstan) and/or Nurek HPP (Tajikistan) which had to maintain the “hot bank” of power which equals to the power of the largest generating unit in power system (for compensation in case of its disconnection).

- The operation of primary regulation must start as soon as power unbalances appear.
- Depending on the amount of power unbalances, the half (50%) of needful primary reserve must be given out during not more than 15 sec, and the total primary reserve must be given out during not more than 30 sec.
- Then the reserves on specially dedicated power stations, maintaining secondary regulation, must come into play.
- Secondary regulation is implemented either automatically under automatic frequency and power flow control system, or in the absence of such systems, promptly (manually) on command from the dispatcher.

- After commissioning into operation the HVL 500kV in 2002, the Northern and Southern parts of Kazakhstan were connected; hence, the UPS CA began to operate with UPS of CIS via UES of Kazakhstan. Therefore, currently the primary and secondary regulations in UPS of CIS are provided by the power system of Russia.
- The frequency regulation service that consists in compensation of power flow unbalances in various power systems is implemented on a paid basis. Historically it was emerged that the procedure for regulation's payment was put into operation in UPS CA earlier than in UPS of CIS.
- In the UPS of CIS the common methodology of service volume estimate and their price rates are not still developed. However, such methodology appeared in the UPS CA in the mid-nineties. In 2006 it was changed entirely and exists with some modifications up to date.

- Without going into details, it should be noted that estimate of regulation service volume is made by staff of CDC “Energy” for each hour of day on basis of definition of average hourly power deviation from planned value, provided by daily operations schedule of power flow balances.
- In this case the initiators of deviations are customers of regulation service, and those systems which compensate these deviations are sellers.
- Based on hourly readout average daily values are estimated, and by them – average monthly ones.
- Average monthly value of regulation service volume, measured in megawatts, is payable.
- The payment is produced by contract power rate ($/kW), which differs significantly from energy rate (cent/kWh).

- Taking above-mentioned into account, while signing in the future the contracts for supply of electricity, it will be necessary to pay attention to correct preparation of daily delivery schedule and hold it. Any hourly average deviations either in one side or the another side of the adjusted delivery schedule are payable for regulation services.

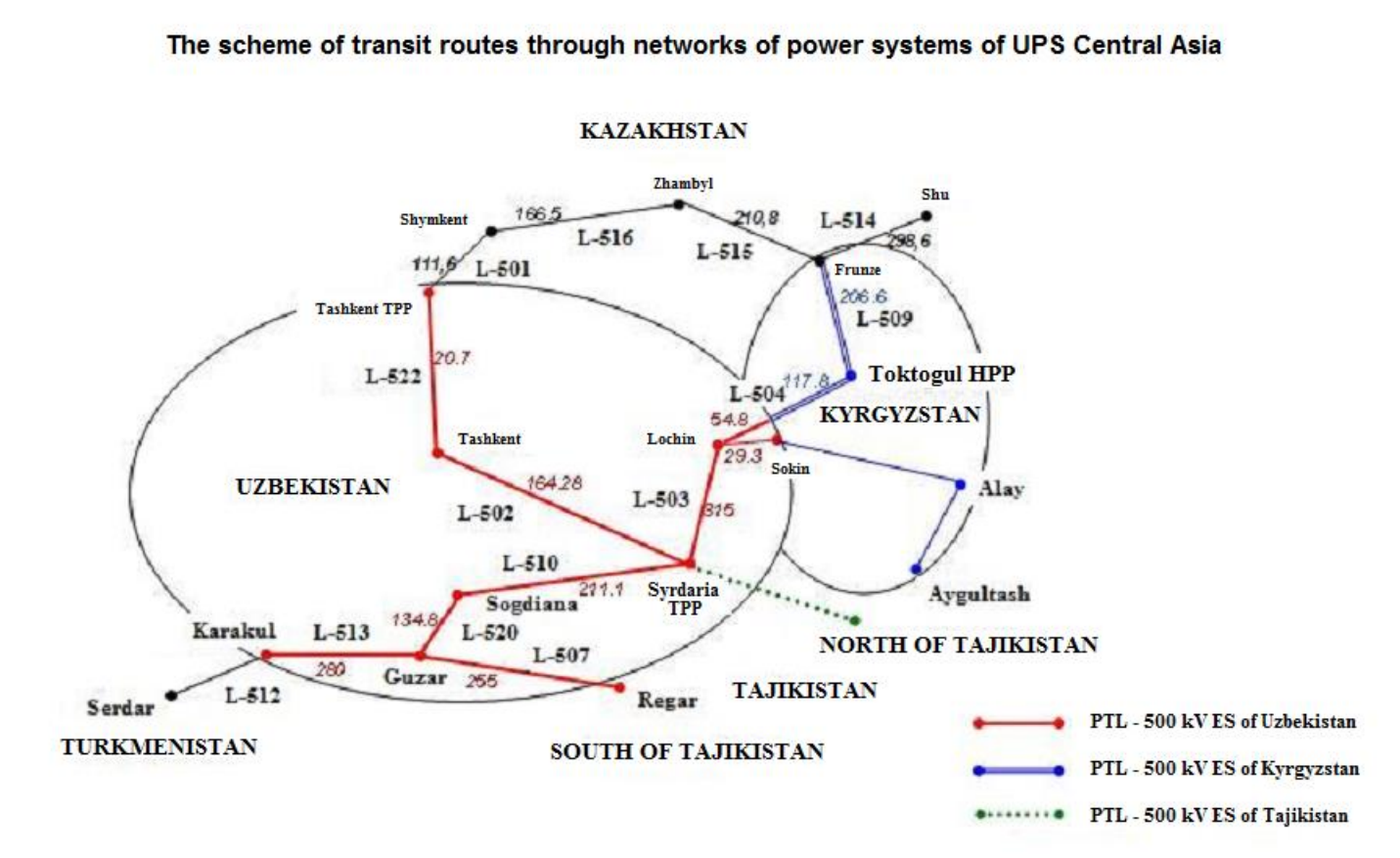
In summary of given aspect:

- In the UPS CA the payment for electricity (kWh) and also for power regulation takes place.
- UES of Kazakhstan is in charge of technical and financial duties due to deviation between UES of Kazakhstan and UPS of Russia.
- The power systems which make a deviation of power are responsible (in shareholding) for it between UPS CA and UPS of Kazakhstan.
- External power system that buys the electricity from any other power system of UPS CA is responsible for its deviation to supplier of electricity.

- **The next feature** which potential energy customers from UPS CA should take into account is **transit of electricity**.
- In principle, the payment for transit is not feature, it is generally accepted approach, according to which it is necessary to pay to owners of transit networks for usage of these networks.
- The feature is a system of estimate of transit service volume accepted in UPS CA.
- The transit of electricity is:
  - Transmission by power networks of Party (B) of electrical energy, produced by one party (A) and intended for other Party (C)

  - Transmission by power networks of Party (B) of electrical energy, produced by other party (A) and intended for this Party (A), only if both Parties do not make joint other resolution.

- In UPS CA still exists the methodology of estimate of regulation service volume which was accepted in 2000.
- According to this methodology there are various negotiated transit routes between energy systems which are being implemented by conventionally 500 kV HVL, i.e. the whole transit flow that usually spreads on many lines is considered conventionally as a trajectory of power flow through 500kV HVL.
- Methodology provides for the cases when part of the electricity flows through one path, and the remaining part of it - on the other.



- Concerning tariff for transit: within the scope of current methodology tariff for transit was accepted as 0,5 cent/kWh for each 1000 km of conventionally dedicated path.
- This tariff was fixed in 2000 and was not revised, however, in recent years the energy systems practise usage of cross-boarded power flow tariff, fixed by national regulating authority for their internal power flows.
- The methodology for transit is oriented on existing configuration of UPS CA with one 500 kV ring circuit.
- In recent years rather active power grid construction is under way, configuration of network becomes multiring and methodology of transit requires to be changed.

- Currently, by the Working Group of UPS CA the work on the adaptation of European model of cross-boarded power flow exchanges is underway and hopefully coming to an end.
- This so called ITC-model is made for the actual and not for conventional cross-boarded grid.
- Work on the development of a new model of electricity transit is of great importance. Let me remind you that in 2003 due to transit problems the energy system of Turkmenistan walked out of the parallel operation with UPS CA.
- In the region of Central and South Asia two large-scale projects is progressing such as CASA-1000 and TUTAP, which will be undoubtedly associated with transit issues. The lack of transparent rules and procedures for transit can create serious obstacles to the realization of these projects.

- Third feature, inherent for UPS CA – extensive use of **emergency automation** equipment.
- A special presentation was devoted to this topic on one of the conferences of CAREC, that is why I will not go into detail on it.
- I will just remind that usage of emergency automation allows increasing the transmission capacity of power networks, limited by static and dynamic stability.
- Thanks to emergency automation it is possible to significantly raise security of power networks, especially those where the security principle N-1 is not held.

Let me illustrate the above-mentioned by an example.

- Assume that two energy systems are connected by two overhead HVL. The line capacity of both of them not more than 300 MW. Does it mean that these two lines are able to pass totally 600 MW?
- Based on the principles of reliability, in case of the absence of emergency control - the answer is negative.
- Indeed, while tripping one of these lines the total load of 600MW falls on the second one and it will result in shutting down from overload. Therefore, without automation, these lines can be loaded only up to 300 MW.
- If emergency automation is applied, i.e. while tripping one of these lines it will lead to short-time shutdown in the receiving part of the power system on “L” MW, then the loading of above mentioned lines can be carried out up to 300 MW + “L” (in the limit of up to 600 MW). It means that by agreeing to short-time shutdown of preselected costumers it is possible to have full loaded lines when emergency situation appears.

- In the given example the elementary model of emergency automation is shown. In practice in UPS CA the set of emergency automation is used, representing complex set of logically connected with each other various automation devices.
- Does the construction of newly commissioned power grid effect on the existing automation?
- Of course, it does. Sometimes it simplifies the automation, or vice versa complicates it, but in any case the reconfiguration of embedded logic is required.
- In other words, the network project must include the chapter, devoted to emergency automation, where the adequacy of existing automation is checked.
- If necessary, new emergency automation equipment must be implemented, its setting must be done and corresponding regulatory documents for staff must be designed

- For instance, is it possible to put into operation the DC line provided in CASA-1000 without reviewing of emergency control?
- Consider the condition when energy systems of Kyrgyzstan and Tajikistan by parallel working as part of UPS CA will transfer 1300MW to Afghanistan and Pakistan via HVDC line. And it is possible that this line could be shutdown.
- In one of the presentations devoted to the use of the HVDC, it was assured that the simultaneous tripping of both bipoles is practically impossible. And the capacity of transmitted power will not reduce while shut downing one of these bipoles.
- Recent shutdowns of lines due to disruption of the transmission towers, which carried supplies from Uzbekistan to Afghanistan, show that it is not impossible to exclude the possibility of full tripping of the HV DC Sangtuda-Kabul-Peshawar.

- While shutdown of HVDC and by absence of so called generator tripping automation uncompensated generation surplus of 1300 MW will hit at connection UPS CA – UES of Kazakhstan where permissible power surge is limited by 500 kW.
- It will result in extension of emergency not only in UPS CA and UES of Kazakhstan, but also in UES of Russia.
- On this basis, in the absence of automation it is possible to transfer maximally 500 MW by above-mentioned line.
- At the same time in the part between Afghanistan and Pakistan due to the absence of load tripping automation the power shortage of 1300 MW will appear, and it can lead to the occurrence called collapse of frequency, when avalanche-type frequency reduction results in a loss of auxiliary of power plants and their complete shutoff.

- Taking the opportunity, I draw your attention to the fact that in order to develop the project it is necessary to involve specialists in emergency automation
- Otherwise, the volume of future supplies can be considerably less than the planned value.

Thank you