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Addition to the concept of choosing a location for the construction of thermal power plants

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Abstract: The problem of determination of placements of a new Heat Power plant has always been a multi-parameter problem, the solution of which is a detection of the optimum ratio of the price to a number of different parameters as electric and heat power demand, the cost of fuel resource considering the transport rates, the access to the High Voltage Lines, etc.

The concept of choosing the allocation for the construction of Heat Power Plant must include also the opportunity of co-generated heat power sales. It is supposed to use the power market regulating tools by setting the reasonable price and tariff for generated heat power, or it might be done through the opportunity of direct electric power supply from thermal plant bypassing the main and distribution electric lines. The development of such heat consumption will contribute to the life and work activity diversity of labor resources of town nearby.

Key words: Heat power plant, energy, fuel, natural resources, thermal, electric, cogeneration, regulation, emissions

The selection of location for the new Power plant is a beginning and most important stage of designing and construction of it, since the determination of site will cause the duration and cost of the whole construction process and future effective operation conditions of power plant. The optimal resolve of this task is possible only in the case of careful analysis of many issues as economic, technical, social, physical and geographical, including the prospects of power industry development and related branches of other economy sectors. A detailed analysis of all factors that directly or indirectly affect the placement of energy facility allows to choose the right platform for the construction.

Thus, the selection of the location of a new thermal power plant is always a multi-parameter task, solution of which is to identify the optimum price ratio of a number of values:

- *Electric and heat power demand in certain region;*
- *Cost of fuel including a transportation cost of it – from this point of view Power plant is supposed to be built in the vicinity of coal mining site;*
- *Cost of water delivered for operation needs – hence the location of HPP should be as close to a water source; [1]*
- *The presence or absence of electricity transmission lines or heat backbone networks (possibility of conveying heat or electricity to the consumer), [2]*
- *The level of permissible emissions (by this factor it is necessary to choose location of HPP as far as possible from other existing operating productions)*
- *There must be a qualified personnel (HPP should be placed as close as possible to the towns, settlements or cities), etc.*

In previous years a selection of the type of HPP - operating in condensing mode (GRES - National Regional Power Station) or working in cogeneration mode (CHP), was motivated by the need for electricity or cogenerated heat and electricity.

Choosing the type of equipment for each of them was conditioned from the point of view of high fuel efficiency on the unit of production, which was achieved by use of equipment having the highest steam parameters.

However, achieving the fullest possible use of fuel energy in the process of conversion was taken into account implicitly (through the lowest specific fuel consumption per unit of generated energy As a result in the Former Soviet Union countries there were built a lot of condensing heat power plants, which had the best performance with respect

to similar HPP, in which the usage level of fuel energy was at level of about 40% and even less. If, in one condensing unit combine TES highest steam parameters (temperature and pressure) achieved in recent years in the world, then even in this case, the degree of conversion of fuel energy into electricity reaches 50%. It is obvious that there is a option to use a combined cycle for condensing heat power plants producing only electricity, burning the natural gas or fuel oil. In case, when the gas turbine and steam turbine installed respectively before the boiler and after on the power unit, and the utilization of fuel energy for generation of electricity increases up to 55%.

But even in this case, almost half of the fuel energy is discharged into the environment (sea water bodies in the river, in the tower) on these type of power plants. There is no a broad experience in the use of combined cycle coal-fired yet. There are several experimental units. It can be expected that interest to coal gasification will increase due to the increase of expenses for gas and fuel.

In water heating boilers burning coal the energy efficiency or degree of fuel energy conversion into energy of hot water, is above 60%/ It is so even for the old-designed boilers with layered firebox, which have a relatively low efficiency [3]. The efficiency of boilers combusting natural gas reaches 92% and it could be increased up to 94%. This means that energy efficiency in the separate generation of only thermal energy almost achieves the upper technological limit or upper technological value. Comparison of the energy efficiency of the production of heat and electricity shows that search of paths for improvement of the efficiency of use of fuel energy should be directed primarily to the generation of electricity.

The observed difficulties of the energy market of Kazakhstan caused by electricity from the Zhambyl state district power station (Zhambyl GRES), due to burning expensive fuel oil or gas and operating in the condensing mode, can be a good example of the tough need to find these solutions. By the way, in the former Soviet Union, this power station was one of the best thermal power plants and was honored with many different awards.

In district heating power plants (co-generating power plants), the average degree of fuel energy conversion into electricity and heat even at moderate steam parameters exceeds 50%. The efficiency of the heating season reaches 70-75%, and decreases to 40% in the absence of heating in off-season and summer time. Due to these indicators of efficiency there is a certain interest increase in the construction of power plants and development of district heating in some Western Europe countries. However, one of the necessary requirements for the construction of thermal power station - it is quite close location to the heat consumers. [6] The development of heat transport equipment, (as pre-insulated plastic pipes), allows to come to an acceptable heat transport distance of up to several dozens of kilometers. In some developed countries there is an experience of heat transport from one city to another. In the beginning of 80-ties in Kazakhstan there was the first pilot project of the construction of "long-distance" main heating networks in the Karaganda region with sharp climate conditions. It was done specifically for recovering heat from stations operating in the condensing mode. The increase of heat transport distances significantly simplifies the selection of the heat energy consumer.

Comparison of the efficiency of conversion of fuel energy for HPP and district heating cogenerating plants shows that in the current conditions of efficiency level the cogeneration is the most promising sources for electricity generation.

"The inclusion" of the degree of fuel energy use among the factors which determine the choice of the place of accommodation of a new thermal power plant, essentially means the transition to the construction of co-generating power plants mostly. With such an approach the quite surprising result may appear – that it will be possible to use the steam of lower (not super-high) pressures and temperatures, which significantly reduces the requirements for boiler and turbine equipment, but at the same time the share of more expensive form of energy – electricity, will become slightly less!

Under the planned economy administrative management system “GosPlan” would just plan the simultaneous construction of the heat consumer next to the point construction of HPP. Under the market economy conditions there are several options for “supporting” of thermal power plants with heat consumers. One of them has already been discussed – it is the placement of thermal power plants near the large cities.

Another option would be a purely market-based approach – to "tempt" the possible future consumer with very low cost of thermal energy, with a virtually unlimited range of parameters of thermal energy delivered, from the range of the supercritical steam to the hot water supply.

The guarantor of the preservation of value may make the Agency for Regulation of Natural Monopolies (AREM), which can control the sale of electricity at market prices and to monitor the establishment of the heat at the level of the price of its value at the boiler, or even lower, because with this approach the heat becomes incidental, almost a "dumping" product. Moreover, it can be provided an option of a direct supply of electricity from the power plant conductors to the consumer receivers. At the same time the price of electricity of such user would be much lower than the price of other end-user, to the amount of the cost of transmission and distribution via electrical grids, which often happens to be higher than or comparable to the cost of electricity production.

This approach essentially means creating a kind of transition to the energy cluster. In one compact region posted: a source of fuel, a coal for instance, fuel energy conversion into electricity or heat HPP, the consumer of the thermal energy and electrical energy. Creation of a "cluster" solves additionally some social problems. “Energy” town ceases to be a city with a small set of occupations in demand (power engineers, coal miners and some builders and repairers). There will be a diversification of the jobs, simplifying the employment of family members which are not involved in the energy cluster, and this also can significantly increase the population in the locality. In other hand, the population growth simplifies the development of social facilities.

At the same time, in spite of the existence of market economy in the energy sector, for objects with the state shares the requirements for cogeneration can be mandatory.

When choosing accommodations of HPP near towns the considerable impact will be the distance of fuel transportation, which affects the tariffs for power consumer through costs for railways and tracks transportation.

Another way of organizing the production of electricity with high fullness of fuel use should be the transfer of boiler houses to the mode of small cogenerating heat power plant. In this case, the utilization of fuel energy for combined electricity and heat production will be very high.

The implementation of both approaches requires the active participation of the state authorities in regulating in electricity production.

Another factor contributing to the transition to the stations with co-generation, is the need to reduce the volume of greenhouse gas emissions per unit of electricity. For purposes of the generation of one product (either heat or electricity), the one of them becomes a tailwind and its producing is like disposal of unused portion of the fuel energy.

Finding ways to increase the *degree of utilization of the fuel energy* is especially important for Kazakhstan. At present one of third part of electricity in Kazakhstan is produced at condensing thermal power plants. Moreover, there are plans to launch more blocks of Ekibastuz GRES-2 and construction of Ekibastuz GRES-3 on the combined platform with Eki GRES-2.

In connection with the need to increase the degree of utilization of fuel, with all its consequences, the owners of the power plants and the country's government now must take immediate steps to place a large heat consumers near the GRES-2 settlement. Dumping of more than 60% of the fuel energy in the reservoir into environment in electricity production process is already an unaffordable luxury!

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