

KYOTO PROTOCOL MECHANISMS FOR MODERNIZATION OF HEAT POWER ENGINEERING

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The main principles of the international mechanisms of affecting the limitations of greenhouse gas emission into the atmosphere, assigned by Kyoto protocol by the UNO framework convention in climate change as well as the possibility of their application in Russian heat power engineering to reequip heat power stations are considered.

Introduction

As early as at the beginning of the XIX century Fourier suggested that the atmosphere played a special role in the heat conditions of the Earth, passing solar radiation to the planet surface and capturing the part of reflecting thermal radiation. At the end of the century theoretical ideas about greenhouse effect as a process of increasing near-Earth temperature owing to the change of atmosphere composition due to growing emissions of carbon dioxide by enterprises, appearing during Industrial revolution. It was until 1957 when the foundation for revealing planetary processes and the role of anthropogenic factor in them was created due to International geophysical year held by scientific society. The monitoring showed continuous increase of carbon dioxide concentration in the atmosphere, which resulted in discussion of possible global climate changes because of greenhouse effect and creation of appropriate international institutions.

The world program of climate investigation established at the First World Climate conference in 1979 coordinated people's attention to ecological problems, that in 1988 provided the creation of intergovernmental group of experts in research of climate change under the aegis of UNO, its work resulted in subscription of UNO framework climate change convention in 1992 forming the legal and political bases for further actions in this direction [1]. Kyoto protocol (KP) for framework convention of 1997 combines various tendencies aimed at solution of the problems of ecology and economy under the global conditions in preventing from climate changes.

In view of political direction of Russia to integration into World Economic area the application of KP mechanisms to the problems (including regional ones) of modernization of heat engineering responsible for greenhouse gases generation is of great interest.

Principles of Kyoto protocol

The main principle of KP is introduction of limits of greenhouse gases emission in 2008-2012 for all developed countries. According to the protocol the gases resulting in greenhouse effect include: carbon dioxide (CO₂), methane (CH₄), protoxide (N₂O), hydrofluorides, perfluorinated hydrogen, sulphur hexafluoride (SF₆). Among them the main ones are considered carbon dioxide and methane [2]. The total 5 % decrease of

this gas emission is supposed to achieve in comparison with the level of 1990. In this case overall emission of the enumerated gases by the countries signed KP is to amount not less than 55 % of that of 1990. This is the starting condition of the protocol action [2].

United responsibilities of the countries participated in KP are made easier due to flexible mechanisms that at the same time are aimed at their redistribution among more number of countries. The action of the mechanisms results in the fact that emissions in each separate country can be sufficiently different from the initially assumed obligations owing to provided system of passing quotas and foreign investments, which introduce international market techniques.

There provided three mechanisms: 1) the way of pure development (PD); 2) projects of joint performance (PJP); 3) quota trade (QT) of greenhouse gases among the countries participated in KP. Though different constituents of these mechanisms can be included into the same category, but the rules of certification, monitoring, accountancy etc. are specific.

The protocol defines also the range of possible, desirable and distinctly determined measures, which in future will be considered as a subject of further negotiations.

Some statements of KP are completely referred to developing countries and can assist to include them into active participation in emission struggle in the process of formation and consolidation of their economy as well as to increase their opportunities due to, for example, development of cadastre, planning, account systems, participation in negotiation about delegation of authorities.

Mechanisms of regulation of greenhouse gas emission

The mechanism of PD is assigned to be used in developing countries according to the following scheme: country-investor carries out environmental project in host country completely at its own expense, the registration of decrease obtained of possible greenhouse gas emission is made in the host country by sufficiently complicated methods and procedure, but then there follows compensation set-off of investor's obligations in its own country. In this case the stock-exchange principles are not possible since only countries including into KP agreement (potentially developed countries and countries

with transition economy, including Russia) have the right to use PD mechanisms by investing into performance of arrangements in developing countries [3, 4].

The mechanism of QT represents a system of transmitting if excess units of the stated quantities among the countries (industrially developed countries) according to existing at the given moment world market price.

The mechanism of PJP is intended to realize it in the industrially developed countries (assuming the obligations in greenhouse gas emission) or among them, where an investor finances the project with regard to the cost of obtained reductions, on the bases of the market price. The volume of investment formation for the countries performing PJP can be estimated as that of reduced and prevented emissions multiplied by the price of emission unit. In general, the mechanism permits the country, which cannot fulfil the commitments for some reason in its own territory, invest the means into project realization in some other country. «The unites of emission reduction» obtained in the process of project realization are shared among participants of agreement or delegated to investing country.

Under the conditions of presence of appropriate governmental political solution, assignment of coordinate committee on PJP performance and development of a definite legislative base the mechanism of PJP have sufficient advantage over the PD mechanism, since the procedure of acknowledgement and registration is simplified in this case [3, 4]. According to KP (Marrakech agreements) there are two variants of PJP performance: «Track-1» and «Track-2». Track-1 is characterised by its simplicity of performance, as it provides the condition of performance of all the procedures assigned by KP by a country, namely, accordance of all necessary accounts of greenhouse gas emission, including emission cadastre and quota register. Track-2 requires a more detailed ground of the project, increase additional expenditures connected with verification and monitoring of the project at international level [3–5].

According to this scheme all «reduced emission units» of greenhouse gases obtained in project realization are given to investor. The investor of the project presents the accounts of performing his obligations on the volume of permitted greenhouse gas emission to his government and after proper check-up he gets the offset of his obligations. Both governments of the country giving «reduced emission units» and the country getting them prepare annual account on performance of obligations for KP convention secretariat or its representative.

In the absence of potential investors the current projects on reduction of emission can take part in tenders for buying reduced emissions made by government of some countries. For example, such tenders are provided by Holland program on buying the units of reduction emission of greenhouse gases [6] and Danish program on buying units of reduction emission of greenhouse gases [7]. Holland tender represents two-phase procedure of purchasing. In the first phase there is a selection of the most attractive projects, in the second phase the winners are revealed on the bases of spe-

cial documents and proposals in price and quantity of goods. The projects are accredited by the amount of 50 % of the purchase cost; the other 50 % are given within the period from 2008 to 2012 after presenting «reduced emission units» of greenhouse gases.

Specific character of Kyoto protocol application to Russian thermal engineering

Ratification of KP by Russia at the beginning of 2005 marked the beginning of its action, since greenhouse emission by Russia in 1990 amounted 17 % and even after refusal of such countries as USA (36 %) and China from KP ratification the condition of coming into the effect of protocol agreements is fulfilled with participation of European community (24 %) [3]. The latter became interested in ratification of KP by Russia more than other participating countries as it possesses the excess of emission quota, whereas among European countries only Great Britain and Sweden are able to realize actions in assumed obligations, the other countries face 30...40 % increase of level of 1990, they will need to buy quotas [4].

It was calculated that in Russia, the territory of which is mostly situated in the geographical zones with inclement continental climate, up to 98 % of carbon dioxide emissions are produced by technologies of fossil fuel combustion [3, 4], including the objects of thermal engineering. The other peculiarity consists in steady growth of scale of depreciation and obsolescence of the main production means, thermal mechanical equipment first of all [8]. Therefore possibilities of the most significant decrease of emission can first of all be realized in this branch owing to utilizing more pollution-free fuel. Simultaneously, taking into consideration the specific character of supply-demand balance with prevalence of solid organic fuel, to achieve reduction of emission is necessary in terms of measures in increasing efficiency of production and application of thermal and electrical energy in first of all solid fuel thermal power stations, which is inevitably connected with application of modern equipment and engineering processes. Hence, combination of these sufficiently opposite tendencies should be considered as one of specific conditions of successful KP application to Russian thermal engineering.

These considerations agree with conclusion from the analysis of KP mechanisms applicable to Russian economy [4]. Firstly, in the context of the facts mentioned above the mechanism of PJP has an advantage, since it permits to obtain target long-term investments into main means of production and in doing it to make easy the way out of approaching situation in thermal engineering due to their scale runout. Secondly, according to the directive on emission trade of 2003 the enterprises on European community have the right to participate only in the given mechanism of redistribution of rights for emission.

Other mechanism of KP with reference to the Russian thermal engineering are supposed to be less attractive. Participation in QT mechanism is completely under jurisdiction of the government, since quotas of emission

reduction with respect to basic 1990 are in its property. However, investments in modernization of thermal engineering in terms of QT mechanism is a passive way, as there are no guaranties in buying Russian excess of emission quotas first of all. Besides, the given mechanism initially suggests the transfer of a part of own quota of Russia (excess of «units of stated quantities») without real reduction, which, in experts' opinion [3, 4], is appropriate to keep for the future period as a resource of economic growth. Application of PD mechanism is possible for Russia only as a result of investment activity of Russian organizations in developing countries.

Thus, PJP mechanism is the most perspective one for revealing possibilities of direct foreign investments into modernization of thermal engineering of Russia. Investments in PJP of such kind can be started before the beginning of the first period of KP obligation performance, using «units of stated quantities» of emissions as a guaranty for earlier reduction of emissions. Application of PJP can decrease the volume of attracted investments at the interest, but closing forward transactions of the delivery of reduced emissions as a result of project realization during 2008-2012 can serve as a guaranty to get necessary volume of financing in different investment companies at the stage of realization project. Besides, PJP can make projects with negative efficiency economically attractive.

Because of the absence of national emission cadastre, quota register and account of transactions PJP in Russia can be performed in Track-2 scheme and are complicated by the following factors [2, 4, 9, 10]:

- absence of national examination and project approval procedures;
- necessity of making double examination: internal and international (consequently, increase of existing costs for monitoring and verification of each project regardless of its scale);
- necessity of obtaining governmental license by Russian company for production of выпуск «reduced emission units» to sell them to investor;
- necessity of governmental guaranties in transferring reduces emissions from Russia to country-investor (for example, by means of intergovernmental agreement);
- presence of risk conditioned by the possibility of the prepared projects by «Board of inspectorate» (KP governing body).

The basic criteria of making decision by representative body of the country, transferring quotas, is relationship of cost amount and achieved volume of decreasing greenhouse gas emission, as well as correspondence of project concept and plans to the statements of national strategy in reducing greenhouse gas emission of the country produced «reduced emission units» of greenhouse gases. After meeting the approval in transfer of quotas an originator of project submits the conditions of transferring reduced greenhouse gas emission units to investors. Investor should inform his government on interesting projects or carry on negotia-

tions with representative body of this government on the questions of future registration of the project. After meeting the approval in transfer of «reduced emission units» by the country of project originator and approval for their obtaining by the country of investor the preparation and subscription of corresponding contract takes place, on the bases of which advance cover of quota production cost by the investor is performed. At negotiation engineering data, guaranties etc. of the projects are discussed. Then project originator and investor are fully responsible for performance of this contract.

Despite the complexity of layout of PJP and absence of precedents, for Russia, which is too far from the level of production and amount of emissions compared with the level of reference 1990 (even taking into account the assumed obligations in 5 % decrease of the emission amount by 2012), it means a wide field of action and real perspectives if investment attraction, particularly, in fuel and energy complex.

Interest to KP in Russia is proved by creation of support infrastructure: Non-profit-making partnership «National organization of project support in hydrogen absorption» [9], Energetic hydrogen fund of «Russia UEC» [10], Non-profit-making partnership «National hydrogen agreement» [11], Russian regional ecological centre [12].

To the technological peculiarities of PJP the following items are related [10]:

- conversion of thermal power stations to more pollution-free fuel (i.e. from coal to gas or from black oil to gas);
- increase of efficiency of heat and energy production introducing modern equipment and technological processes;
- development of renewable sources of energy (except hydro power stations of more than 200 MW power);
- development of heat supply system and combined production of heat and electrical energy;
- local improvement of technologies and actions in energy savings.

Regional problems of technical modernization of thermal power stations

The current engineering level of thermal coal power stations of a typical regional engineering company can be characterised by the following:

- operation life of less than half of the main equipment exceeds 45 years;
- steam parameters are at the level of standard model of the 1950's of the last century: nearly one third of the equipment (boilers and turbines) has the parameters of lower than 10 MPa and 510 °C;
- low level of heat utilization of boiler releasing gases and compaction of gas paths, decreasing economic efficiency of their operation;
- insufficient level of boiler equipment with the means of cleaning smoke fumes and, as a result, increase of

emission volumes of harmful substances over authorized ones;

- absence of environmentally and economically efficient fuel technologies of modern design.

There is a number of circumstances for Russian power engineering that objectively form the problems of technical reequipment or do not stimulate their solution in the regions:

- Relatively low prices for fuel (coal);
- Insignificantly small sizes of payment both for authorized release and unauthorized release of harmful substances into the atmosphere not stimulating the increase in efficiency of gas-cleaning system at thermal power stations;
- existing system of tariff formation for manufactured production;
- absence of even in the form of pilot or experimental-industrial installations of generally recognized and applied in the world perspective technologies of electrical energy production of solid fuel: coal combustion in circulating boiling layer and combined-cycle plant with transannular gasification, conversion to supercritical steam parameters (30 MPa and 600/650 °C) [13-15];
- absence of governmental support and governmental engineering policy in the questions of building and financing engineering objects using new technologies, stimulating researches in development and introduction of progressive technologies.

Conclusion

In the conditions of present formation of bases for investment program development [8] there are not any

projects of modernization and new building of thermal power stations using progressive technology and equipment with parameters corresponding to international level. Engineering organizations will try to replace worn equipment at the shortage of investments and time for project realization. Necessary utilization (saving) of traditional and technologically out-of-date solutions in constructional volume of buildings in unsatisfied conditions and of unacceptable operation life are the consequences of it. Environmental problems either are not solved by this method at all or solved partially. Needless to say of ensuring the necessary rate of removing technical lag of thermal power stations.

Existing situation is, in a number of cases, menacing for the economy of power engineering companies and system of region life support, but it provides the possibility of searching for non-standard investment projects. The mechanism of KP realization in PJP variant gives such possibilities. Taking into consideration the structure of fuel consumption, investment projects should combine the variants of thermal power station conversion in more environmentally-friendly fuel (as the most efficient in terms and volume of production of transferred «reduced emission units»), with variants of transmission of the part of attracted investments into modernization of heat power stations on the basis of modern and environmentally developed technologies of solid fuel utilization. Application of the given strategy in using KP mechanisms in the concrete region depends, first of all, on: transformation of fuel source base and processes in the sphere of utilizing energy resources, rates of development of certain technologies and appearance of new ones in engineering and its nature-conservative measures, change of volume and structure of energy consumption, course and results of structural changes in engineering companies.

Literature

1. Framework convention of United Nation Organization in climate change (New-York, 9 May 1992): Ratified by Federal Law 04.11.94. № 34-FL // Konsultant Plus. Version Prof.: Ref.-leg. system.
2. Grab M., Wrolick K., Brak D. Kyoto protocol. Analysis and interpretation. – Moscow: Nauka, 2001. – 303 p.
3. Greenhouse gases – global ecological resource / V.H. Berdin, I.G. Gritskevich, A.O. Kokorin, Yu.N. Fedorov. – Moscow: WWF, 2004. – 135 p.
4. Kokorin A.O., Gritskevich I.G., Safonov G.V. Climate change and Kyoto protocol concept and practical possibilities. – Moscow: WWF, 2004. – 604 p.
5. Strategic analysis of Kyoto-Marrakech system / M. Grab, T. Brayer, B. Muller et al. – Moscow: WWF, 2003. – 12 p.
6. www.carboncredits.nl
7. www.danishcarbon.dk
8. Zemtsov A.S. Development of modernization program of the main equipment of TPS till 2010 // Thermal Engineering. – 2004. – № 9. – P. 2–7.
9. www.ruscarbon.ru
10. www.carbonfund.ru
11. www.natcarbon.ru
12. www.resrec.ru
13. Olkhovskiy G.G. Perspectives of coal application in power engineering of Russia // Power Stations. – 2004. – № 12. – P. 7–11.
14. Steam-gas installations with internal cycle gasification of fuel and environmental problems of power engineering / V.M. Maslennikov, Yu.A. Vyskubenko, V.Ya. Shterenberg et al. – Moscow: Nauka, 1983. – 286 p.
15. Olkhovskiy G.G. Tumanovskiy A.G., Trembovlya V.I. Reserves of energy and resource-saving in large boiler industrial and municipal engineering // Industrial Engineering. – 2004. – № 1. – P. 6–9.