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USSR Report

ENERGY

(FOUO 15/81)

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CONTENTS

ELECTRIC POWER

UDC 621.039.001.4

PRESENT, PROPOSED APPLICATIONS OF NUCLEAR POWER DISCUSSED

Moscow ATOMNAYA ENERGIYA in Russian Jun 81 pp 371-376

[Article by Petros'yants, A. M. and Baturov, B. B.: "The Role of Nuclear Energy in the Country's Energy Complex"]

[Text] The resolutions of the 26th CPSU Congress provide for the advanced development of the nuclear power industry in the European sector of the USSR, where the primary energy consumers are concentrated and where the shortage of cheap fossil fuel is growing more acute. This shortage is made up primarily by deliveries of fuel from the country's eastern regions. AES's, atomic central-heating and power plants (ATETs's) and, in the long-range plan, atomic heat-supply stations (AST's) will in the near future replace greater and greater amounts of fossil fuel in regions where this is economically justified. The area of technically and economically substantiated utilization of nuclear fuel in the economy is being systematically expanded and encompasses all new classes of installations and the economic regions.

Several basic features determine the approach to assessing the role of nuclear energy in the electric-power industry and in the fuel and power complex as a whole. In the first place, the primary economic impact from the replacement of fossil fuel with nuclear (in connection with its high caloric value) is obtained by the economy not only directly at the AES's and in the electric-power industry, but also in the spheres of mining and delivering fossil fuel. In this manner, the impact from the introduction of nuclear fuel is determined on an interindustry basis and not only on the economy of the AES proper. This results in the necessity of jointly examining the question of the economy of atomic electric stations and their fuel cycle and of thermal electric stations and their fuel base.

In the second place, AES capital investment can exceed that for a thermal electric station by a factor of 1.5. Despite this fact, AES's are economically advantageous as a result of considerably lower capital investment in fuel-cycle enterprises in comparison with capital investment for expanding extraction operations and transportation facilities for solid organic fuel. Moreover, the technology of nuclear fuel and fuel-cycle enterprises is, in the engineering respect, immeasurably more complicated than that for the extraction and delivery of fossil fuel. In connection with this there arises the necessity for a higher level of engineering and industrial readiness in the spheres of construction, production, operation and personnel training. This, in the final tally, determines the economy and potential scale of development of AES's.

Thirdly, the construction of AES's and the broad application of nuclear fuel to obtain thermal and electric power make it possible under the conditions found in our country to reduce by a factor of 2 or 3 the level of labor productivity in the spheres of extraction, conversion and utilization of energy reserves in comparison with the production of power at thermal electric stations using imported solid fuel. This cannot be directly traced in the economic indicators of thermal and electric power stations. In the electric-power cost structure the wage component is equal to a few percent. Moreover, the introduction of nuclear fuel entails an acute reduction of labor expenditures in the spheres of extraction and delivery of fossil fuels and a considerable increase in labor productivity per unit of generated power in the electric station-fuel supply system. For this reason, labor expenditures for the production of power must be examined not only on the basis of the staffing factor at electric stations, which characterizes the final stage in the utilization of fuel to obtain power but also taking into account the fuel-power complex as a whole.

The development of the nuclear power industry has now acquired broad dimensions. The toal output of AES's at the beginning of 1981 amounted to more than 14 million kW. Their share in the generation of electric power was more than 5 percent. At the first stage, nuclear fuel is drawn into a country's fuel and power balance through the construction of nuclear condensing electric-power stations.

At the present time, the construction of these stations is being carried out at more than 20 sites with the gradual displacement of fossil-fuel fired base electric-power stations in regions of the northwest, west, center and south of our country's European sector. AES's are being built in regions of the Caucasus, the Povolzh'ye and the Urals. The growth in the installed power of AES's in the 11th Five-Year Plan will occur due to the preferred introduction of 1,000-MW power units with RBMK-1000 and VVER-1000 reactors. A pilot unit with an RBMK-1000 was commissioned in 1973 at the Leningrad AES. At present, a great deal of experience has been accumulated in the operation of such units at the Leningrad, Kursk and Chernobyl'skaya AES's. Further construction of such stations continues with the number of units at a single site being brought up to 4 to 6. The Ignalinskaya AES--largest in Europe--is being built with reactors possessing unit outputs of up to 1,500 MW.

The cost indicators for electric power from AES's confirm their efficiency (Table 1), despite the higher capital investment. The installed-capacity utilization coefficient (KIM) of the AES's of the USSR Ministry of Power and Electrification for 1979 comprised 68.9 percent. The maximum values for the utilization coefficient were found at the Novovoronezhskaya (78.8 percent) and Kol'skaya (76.5 percent) AES's. High values (70 to 78.1 percent) were achieved at the Leningrad AES and at other stations with uranium-graphite reactors. On the average, the utilization coefficients for our country's AES's in 1979 were 10 to 15 percent higher than at similar stations in the United States, West Germany, Japan and France. The cost of electric power has been reduced compared to 1978 from 0.86 to 0.79 kopecks per kWh. This is close to the cost of electric power generated by a thermal station (0.753 kopecks per kWh) in 1979.

Many years of operational experience testify to the reliability and safety of AES performance. For example, radioactive wastes are, as a rule, one to two orders below the norm (Table 2).

Table 1. Economic Indicators for AES's of the USSR Ministry of Power and Electrification for 1979

Indicator	Novovoronezhskaya	Kol'skaya	Kurskaya	Armyanskaya	Chernobyl'skaya
Installed capacity, MW	1,445	880	2,000	815	2,000
Generation of electricity, million kWh	9,915.2	5,900.4	10,345.6	2,385.8	12,233.2
Utilization of installed capacity, hours	6,814.6	6,705.0	5,172.8	5854.7*	6,616.6
Cost of electricity, kopecks per kW	0.613	0.73	0.785	1.032	0.706

* Not counting the second unit

Table 2. Release of Aerosol Radiation from AES's in 1979, Curies/year

AES	RIG	Long-life aerosol radiation	$Sr^{89}+Sr^{90}$	I^{131}
Kol'skaya	$1.9\cdot10^3$*	$1.1\cdot10^{-2}$	$2.1\cdot10^{-5}$	$1\cdot10^{-3}$
	$6.3\cdot10^5$**	91.2	0.182	18.2
Novovoronezhskaya	$6.6\cdot10^3$	0.3	$3.1\cdot10^{-3}$	$5.5\cdot10^{-3}$
	$1.3\cdot10^6$	219.4	0.365	36.5
Armyanskaya	$1.8\cdot10^3$	$1.1\cdot10^{-2}$	-	0.2
	$3.2\cdot10^5$	45.6	-	9.1
Kurskaya	$5.0\cdot10^4$	48	-	0.02
	$7.6\cdot10^5$	109	-	22
Chernobyl'skaya	$4.9\cdot10^4$	0.3	$6\cdot10^{-5}$	0.14
	$7.6\cdot10^5$	109	0.22	22

* and ** The first value is actual, the second is the allowable release. The latter is determined by an AES operational engineering regulation based on existing standards and specifications (SP-AES-79, OSP-72, NRP-76). RIG is radioactive inert gases with a half-life greater than 10 minutes. Long-life aerosol radiation has a half-life greater than 24 hours.

The planned development of the nuclear power industry as early as the 1990's will lead to a considerable increase in its role in the power-generation structure. The production of electric power will reach 20 to 25 percent of the overall generation, percent:

Condensing AES	34-38
TETs	20-23
GES and GAES	18-20
AES	20-25

According to data from the American Atomic Industry Forum (1980), the production of electric power at AES's in the United States will comprise 16 percent of the country's total electric-power generation in 1990.

As was already pointed out, the considerably higher capital investment in AES construction causes degradation of such electric-power indicators as capital returns and the unit expenditures for the introduction of electric-power station capacities. This is because the chief economic impact derived by the economy from the introduction of AES's is outside the electric power industry; that is, it is due to the reduction in the scale and rate of growth of capital investment and labor expenditures in the coal mining industry and in rail transport. On the whole, the construction of AES's is advantageous both economically and with respect to the expenditure of labor resources. This is the result of two basic factors--characteristics of the disposition and consumption of fuel and power resources in our country and the high caloric content of nuclear fuel. One of the features of the fuel and power situation consists of the fact that expenditures for the expansion of the fuel base and for transport (mines, open pits, rolling stock, secondary routes, etc.) in the development of fossil-fuel based power generation are comparable with respect to their overall scale. When the fuel is imported over long distances, however, these expenditures exceed those for the construction of the thermal electric station proper. For this reason, the overall economic expenditure for the creation of new thermal electric station capacities and the development of the fuel base are very great (Table 3).

With a predicted increase in the level of capital investment in the mining and delivery of solid fuel for consumers in the European sector of the USSR to 40 rubles/ton of conventional fuel and to 80 rubles/ton, the higher level of AES capital investment in comparison with thermal electric stations (300 to 350 rubles/ton) does not exceed the limits of economic competitiveness when evaluated on an interindustry basis. Analysis shows that this conclusion holds firm for the long-range prospect as well. It follows that it is more advantageous to put capital investment into the construction of AES's, the mining of uranium and atomic-machine construction than into the development of coal mining and the transport of coal.

In comparison with traditional power generation, the chief advantage of nuclear power generation, as was already noted, lies in the high caloric content of nuclear fuel. On the basis of units of mass, it has approximately 2 million times the caloric content of fossil fuels. The volumes of consumed and processed fuels in the fuel cycle are tens of thousands of times less than the volumes of fossil fuels mined, transported and burned with the same rates of power consumption. Thus, the development of the nuclear power industry of the large scale desired with a practicably attainable rate of growth of AES capacities (not more than 20 percent annually) requires approximately 0.3 tons/year of natural uranium for 1 MW of commissioned and operational capacity. This means that for the development of nuclear power production with an output of 100 million kW, the fuel requirement will not exceed 30,000 tons of natural uranium annually, while a corresponding requirement in fossil fuel would amount to 200 million tons of conventional fuel annually. When AES's with thermal reactors are in operation, 1 ton of natural uranium is equivalent with respect to power generation to 12,00 to 25,000 tons of conventional fuel (depending upon the depth of the dump for the separation process and the reactor's physical characteristics).

With the growing level of utilization of fossil-fuel resources, a crisis situation also appears in the increasing environmental pollution due to ash wastes as well as exhaust gases. At a modern 2.4 million-kW coal-fired GRES about 5 million tons of coal are burned annually. About 0.5 to 1 million tons of ash are formed in the process, out of which 1 to 2 percent (that is, 10,000 to 20,000 tons annually) are released into the atmosphere, leading to various negative consequences. Particularly harmful are the gaseous wastes.

The content of sulfur in the fuel can reach 3 percent with respect to mass. Consequently, the discharge of sulfur through smokestacks in the form of sulfurous gases can amount to 150,000 tons per year for the station outputs mentioned. According to foreign estimates, the effectiveness of sulfur-scrubbing can be increased only by a 20 to 30 percent increase in capital investment in thermal electric stations. Even in this case, however, the level of scrubbing is insufficiently great. In contrast to coal-fired thermal electric stations, there are none of these harmful wastes from an AES. The radioactivity of the exhaust gases is relatively low and, as experience shows, it is considerably lower than the allowable concentrations provided for by health standards.

In order to develop the nuclear power industry, it is necessary to perfect industrial production (including the radiochemical processing of spent fuel), increase the quality of the product and organize special machine construction. This is associated with special requirements for the reliability of nuclear-class equipment and for the quality of materials used. For example, in comparison with coal-fired thermal stations, an AES requires four times the amount of high-alloy and stainless steels, although the overall amount of steel used is reduced by 40 percent. In this manner, the development of nuclear power production brings about an improvement in the quality of materials, equipment and construction work as well as a corresponding increase in the volume of associated capital investment. This circumstance, however, does not alter the overall picture in connection with the increase in expenditures for the mining and delivery of fossil fuel.

In comparison with thermal stations, the advantages of AES's are determined not only by the initial outlay but, as was already mentioned, by the savings in labor resources. In this case, one must consider the labor expenditures both in power production and in the sectors of the economy associated with it which, through their activities, insure delivery of the final product--electric and thermal power. That portion of the cost of electric power that goes toward the salaries of electric-station workers amounts to only a few percent, which reflects the high percentage of labor expenditures during its generation. The major portion of the labor expenditures is due to the mining and delivery of fossil fuel and is reflected in its

Table 3. Structure of Specific Capital Investment in Electric-Power Supply for the Construction of Condensing Electric-Power Stations, Percent of the Cost of an AES

Components	AES	Coal-Fired Thermal Station
Electric stations	100	60
Transmission lines	20	20
In all: direct capital investment	120	80
Fuel-supply enterprises (including transportation)	25	60
In all: direct capital investment	145	140
Associated capital investment	90	120
including:		
plants for ferrous and nonferrous metallurgy	20	30
plants for power, transportation and general machine construction	25	20
construction industry and construction materials	10	10
In all: total capital investment	235	260

Table 4. Unit Labor Expenditures for Coal-Based Power Generation, men/MW

Coal Basin	Mining	Delivery	Thermal Station	Total
Donets with shaft mining	4.5-5	1.5-2	0.6-0.7	6.6-7.7
Kuznets with shaft mining	2.5-3	4.5-6	0.6-0.7	7.6-9.7
Kuznets with open pit	0.8-1	4.5-6	0.6-0.7	5.9-7.7

Table 5. Potential for Utilization of World Reserves of Natural Uranium as a Power Resource, Billions of Tons of Conventional Fuel

Reserves, millions of tons	In thermal reactors			In breeder reactors
	Without uranium recovery	With uranium recovery	With repeat use of plutonium	
5 (proven)	81	118	236	8,850
25 (predicted)	405	590	1,180	44,250
2,500 (using world ocean reserves)	40,500	59,000	118,000	4,425,000

cost and even in the cost of electric power. At AES's, the fuel component of the cost is considerably lower than at thermal electric stations, although the personnel factor and the qualifications of the production personnel are higher, which points out the higher level of engineering requirements for AES operation. An analysis of labor expenditures for the production of electric power on the whole at AES's and thermal electric stations, including the fuel base, points out the following: with the present and planned scale of development of electric-power capacities in our country, the utilization of Kuznets and Donets coal as fuel in regions of the European sector would lead to a considerable increase in the number of workers in fuel and power industries. The approximate unit labor expenditures are estimated through the data presented in table 4. The number of personnel for nuclear power production, based upon the mining, transportation and processing of nuclear fuel at all stages of the fuel cycle and calculated in units of electric power (men per MW), comes to:

Mining and processing of ore	0.033-0.062
Production of uranium hexafluoride and separation of isotopes	0.03-0.05
Manufacture of fuel elements and zirconium production	0.036-0.04
Recovery of fuel elements, production, processing and waste storage	0.02-0.04
Transportation of nuclear fuel among all enterprises	0.02-0.04
For fuel-cycle enterprises, in all	0.14-0.23
AES's (prototype units)	1.1-1.3
Total for AES's and enterprises in the fuel cycle	1.24-1.53

The values cited are 4 to 6 times lower than similar indicators characterizing the development of power production based on imported fossil fuels. Even if one were to adopt an error factor of two for calculating the figures for enterprises serving the nuclear power industry, labor productivity in that case would prove to be higher by a factor of 2 to 3. Thus, nuclear power production not only saves a great amount of fossil fuel but also insures the highest level of labor productivity per unit of power generated and consumed by the economy (with the exception of hydroelectric stations). A rise in the costs of fossil fuels increases to a greater degree the advantages of AES's in comparison with thermal electric stations and also increases the savings of labor resources.

Despite the general trend toward the construction of large-scale industrial complexes in the country's eastern regions, intensive development continues on the existing industrial centers in the European sector. Heat supply in these regions is no less urgent than the electric-power supply. The utilization of nuclear fuel for the production of thermal power makes it possible to reduce considerably the fossil fuel used. As in the case of combustion-based power generation, nuclear power generation brings about a technical-economic advantage when the combined generation of heat and electric power at a TETs is compared to the separate generation of heat at an AST and electric power at an AES. The results of studies indicate that nuclear fuel's contribution to meeting the regions's demand for heat in industrial and domestic heat supply (both on the basis of AST's and ATETs's) is accompanied by a reduction in the power industry's overall consumption of fuel reserves. In the case of an AST, the absolute reduction in the overall consumption of fossil fuel (fuel oil) when the overall expenditure of nuclear fuel is kept constant can amount to approximately 0.17 tons of conventional fuel annually per kW of installed thermal capacity of AST reactors (when utilized 4,000 to 4,500 hours annually). In the case of replacement of a TETs with an ATETs using equal initial parameters, the saving of fossil fuel reaches approximately 0.45 tons of conventional fuel annually per kW of installed thermal capacity of ATETs reactors. When the initial parameters are reduced to the level of those at modern AES's, the fuel saving is reduced but does not go below 0.25 tons of conventional fuel annually per kW.

At the present time, construction has begun on the Odessa ATETs with VVER-1000 reactors and TK-500-60 central-heating condensing turbines. Long-range plans have been made for the construction of several more ATETs's of the type mentioned. Construction began during the 10th Five-Year Plan on AST's with lower parameters for the reactor's cooling agent. This, then, increased the reliability. Such AST's, according to radiation-safety requirements, can be situated in the immediate vicinity of industrial and housing developments. This reduces considerably the need for large-diameter pipelines for direct mains. The Gor'kiy and Voronezh AST's will be put into operation during the 11th Five-Year Plan.

For central heating it is necessary to make maximum use of the unregulated steam bleed-off at AES's. At the present time, heating steam is being extracted for heat supply at the Beloyarskaya, Kurskaya, Chernobyl'skaya, Novovoronezhskaya, Kol'skaya and Armyanskaya AES's. Plans have been made for the construction of a prototype high-output central-heating installation at the Rostovskaya AES. The construction of the Bilibinskaya ATETs on Chukotka during the 10th Five-Year Plan can serve as an example of a solution to the problem of heat and electric supply to remote regions throught the use of nuclear fuel. It is composed of four power-generating units with channel-type uranium-graphite reactors of 12 MW capacity each (electric output) and with central-heating bleed-offs with a combined capacity of 100 GCal.

The extensive involvement of nuclear fuel in the country's fuel and power complex requires a step-up in the work on its expanded production. The reserves of inexpensive uranium whose use at present insures that AES's are competetive with modern fossil-fuel fired thermal stations will be exhausted in the next decades with today's rate of growth of the nuclear power industry. Table 5 presents figures for the approximate worldwide reserves of natural uranium and their probable degree of utilization in various types of reactors. With their utilization in thermal reactors, the available reserves of uranium are only equivalent to the world reserves of petroleum. This, naturally, does not solve the problem of supplying power to mankind. Breeder reactors will make the nuclear industry's fuel base dozens of times as large, owing to the incorporation of U^{238} and Th^{233} in the cycle. In this connection, the commissioning of the third power unit of the Beloyarskaya AES with the BN-600 was an important event in the domestic and worldwide nuclear industries. The design of the BN-600 makes it possible to verify engineering decisions and the economy of AES's with such reactors on an industrial scale. The extensive introduction of fast reactors and the solution to the problem of recovering nuclear fuel will make the cost of nuclear power immune to increases in the cost of natural uranium.

In the "Basic Directions for the Economic and Social Development of the USSR for 1981-1985 and for the Period to 1990," the tasks for the development of science and industry, including the area of electric-power production, are determined thusly:

"In the area of the natural and the technical sciences, efforts must be concentrated on solving the following important problems:

development of the physics of elementary particles and the atomic nucleus, solid-body physics, optics, quantum electronics and radiophysics;

development of nuclear power engineering, the creation of the bases of thermonuclear power engineering and the improvement of methods for the conversion and transmission of energy."

"We must improve the utilization of fuel and power resources, reduce the consumption of oil and petroleum products when used as fuel in boilers and furnaces and develop the nuclear power industry at an accelerated pace."

"In the electric-power industry we must bring the generation of electric power to 1,550 to 1,600 billion kWh by 1985, including the generation at atomic electric stations to 220 to 225 billion kWh and that at hydroelectric stations to 230 to 235 billion kWh. We must insure the increase in the production of electric power in the European sector of the USSR at atomic and hydroelectric stations, primarily.

We are to commission 24 to 25 million kW of new capacity at atomic electric stations. We are to continue work on mastering breeder reactors and on utilizing nuclear fuel for generating thermal power."

"In the power-engineering industry we are to insure a considerable increase in the production of equipment for nuclear, hydraulic and thermal electric stations, including nuclear reactors with outputs of 1 to 1.5 million kW and power units of 500,000 to 800,000 kW for thermal electric stations operating on low-quality coal. We are to manufacture and deliver the first nuclear reactors for heat supply to large cities. We are to develop new designs for power units with breeder reactors of 800 to 1,600-kW capacities and designs for the equipment of highly maneuverable power units of 500,000-kW capacity."

"In the RSFSR we are to increase the output of industrial products by 24 to 27 percent.

We are to put into operation new capacities at the Smolenskaya, Kalininskaya and Kurskaya AES's."

"In the Ukrainian SSR we are to increase the output of industrial products by 20 to 23 percent.

In 1985 we are to bring the generation of electric power up to 280 to 290 billion kWh and obtain its basic growth through atomic electric stations. We are to commission capacities at the South Ukrainian, Khmel'nitskaya, Zaporozhskaya, Krymskaya, Chernobyl'skaya and Rovenskaya AES's and the Odessa ATETs."

"In the Lithuanian SSR we are to increase the output of industrial products by 21 to 24 percent and the generation of electric power two-fold.

We are to insure the commissioning of the first phase of the Ignalinskaya AES, the Vilnius TETs-3 and the second phase of the Mazheyskiy oil refinery."

The extensive introduction of nuclear power into the economy will entail the most important technical, economic and social consequences, the content and significance of which cannot be confined to the contribution of AES's in the structure of generating capacities and power output at this modern stage. The massive construction of AES's leads to a fundamental review of the production structure throughout the entire fuel and power complex, including mining and transportation, on the basis of modern technology and the latest scientific and technical achievements which insure a considerable economic impact and a substantially higher degree of labor productivity in the fuel and power industries.

In addition to the high degree of economy and the efficiency of utilizing labor resources, the power industry creates conditions for better maintenance of the environment, a reduction in expenditures for the transportation of power and fuel, the nearness of production centers and the consumption of power as well as grounds for eliminating the threat of the so-called "energy crunch."

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ELECTRIC POWER

UDC 621.039.524.44:621:0.39.56

REACTOR'S ENERGY DISTRIBUTION MONITORED WITH EXTERNAL SENSORS

Moscow ATOMNAYA ENERGIYA in Russian Jan 81 pp 423-425

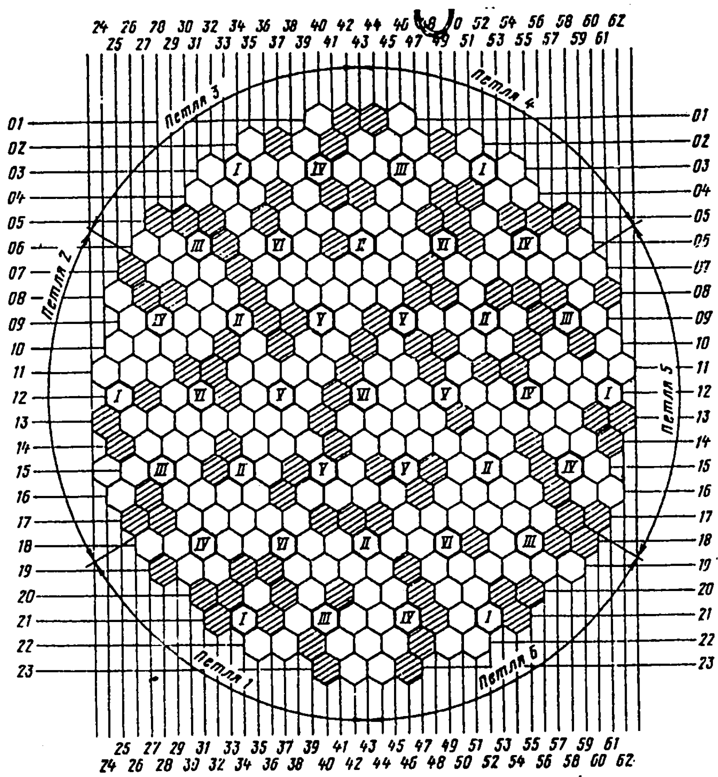
[Article by L. N. Bogachek, et al: "Monitoring Energy Distribution in the Active Zone of the VVER-440"]

[Text] Energy distribution in the active zone is usually monitored with the aid of a system of internal reactor sensors [1]. In addition, a six-loop cooling circuit in the VVER-440 reactor provides the basis for monitoring in each of six sectors of the reactor's active zone the energy carried off by the coolant in the corresponding circulating loops (see drawing). This being the case, the sensors necessary to measure this energy can be located outside the reactor.

Experiments were conducted on the reactor of the first unit of the Armyanskaya AES in order to substantiate such a method of monitoring. Two methods were used to determine the thermal energy transported in the loops of the first circuit: using the thermal balance and using the N^{16} content in the coolant. The first method is based on the measurement of the differences in temperature of the coolant in the hot and cold sections of the circulating loops through the use of standard thermocouples. The second method is associated with the registration of the gamma radiation from the N^{16} using sensors designed to determine the rate of flow of coolant in the loops [2] (see actual product, page 420). Since the radioactivity of the heat-transfer agent in water-cooled reactors is proportional to the density of the stream of neutrons, one can use the variation of the N^{16} gamma-ray intensity to judge the variation in energy liberation in that part of the active zone's volume through which the coolant in a given loop circulates.

The experiments were conducted at the beginning and end of the second reactor run at approximately 35 percent of nominal power with identical conditions for the steam bleed-off from the steam generators. The first series of tests involved a determination of the capacities of the individual loops with symmetrical energy distribution in the active zone. Before similar measurements were taken in the second and subsequent series, the energy distribution was "perturbed" beforehand by means of full immersion of the absorbers in one or two of the automatic regulating assemblies (ARK) in one or two corresponding sectors of the active zone. The same procedure was observed at the end of the run.

The table presents the capacity ratio of the loops with perturbed and symmetrical energy distribution. It shows the reaction of the rate of flow in individual loops when the absorber is introduced into the active zone. The data obtained by the two methods are in agreement within the limits of measurement error.



Collation map for the distribution of fuel assemblies in the active zone of the reactor and of the loops in the first unit of the Armyanskaya AES; heavy lines--fuel assemblies; crosshatch--operational assemblies; blanks--working assemblies with thermocouples

Relative measurement of the loop capacities and energy liberation in the corresponding sectors of the active zone

(1) Координата сброшенной кассеты СУЗ	(2) Метод определения *	(3) Номер петли (сектора) 1	2	3	4	5	6
12-25	I	0,96±0,02	0,82±0,03	1,01±0,03	1,09±0,03	1,09±0,03	1,05±0,03
	II	0,97±0,03	0,84±0,04	1,02±0,05	1,09±0,04	1,09±0,03	1,02±0,05
	III	1,01	0,88	1,01	1,03	1,03	1,03
18-49	I	1,00±0,03	11,1±0,04	1,11±0,04	1,10±0,03	0,94±0,05	0,73±0,02
	II	0,98±0,03	1,08±0,06	1,16±0,05	1,06±0,03	0,96±0,08	0,76±0,06
	III	1,01	1,06	1,07	1,06	1,00	0,79
18-49 и 06-55	I	1,14±0,04	1,20±0,04	1,16±0,04	0,82±0,03	0,83±0,03	0,82±0,03
	II	1,15±0,01	1,26±0,09	1,19±0,04	0,81±0,03	0,81±0,03	0,78±0,06
06-55	II	1,14±0,03	1,09±0,03	0,98±0,06	0,74±0,03	0,94±0,04	1,11±0,05
	III	1,06	1,06	1,04	0,81	0,96	1,05
06-43	II	1,09±0,06	1,03±0,04	0,84±0,06	0,86±0,03	1,08±0,09	1,16±0,07
	III	1,06	1,04	0,88	0,91	1,04	1,06
03-40	I	1,07±0,03	1,01±0,03	0,83±0,03	0,93±0,03	1,06±0,03	1,10±0,03
	III	1,05	1,04	0,84	0,97	1,05	1,05
06-49	I	1,07±0,03	1,05±0,02	0,98±0,02	0,83±0,03	1,00±0,03	1,07±0,03
	III	1,05	1,04	1,00	0,85	1,01	1,04
03-40 и 06-49	I	1,17±0,03	1,05±0,03	0,82±0,04	0,83±0,04	1,03±0,03	1,11±0,03
	III	1,11	1,09	0,84	0,78	1,06	1,11

(4) * I – по измерению разности температур ΔT; II – по измерению активности γ-излучения ^{16}N; III – расчет по программе БИПР.

Key:

1. Coordinates of the dropped control and safety rod assembly
2. Method of determination
3. Number of the loop (sector)
4. *I - using the measurement of the difference in temperature; II - using the measurement of the N^{16} gamma radiation; III - calculation according to the BIPR program.

In order to prove that the redistribution of thermal energy in the circulation loops brought about by the deformation of the energy distribution corresponds to its variation in the active zone sector adjacent to the loops, the energy liberation in the sectors was calculated according to a three-dimensional program from BIPR [expansion not provided] [3]. In their calculations, they simulated the reactor's state during the experiments. The experimental values for the capacity of the circulating loops dictated by the deformation of the energy distribution in the active zone were compared with the calculated variations in the energy liberation in the sectors. A slight disturbance in the coolant flows in various circulating loops was revealed when the flow rates in the loops were equal. This feature makes it possible to monitor the energy distribution in the active zone by measuring the loop capacities using means outside the reactor.

BIBLIOGRAPHY

1. Mitel'man, M. G. et al, "Detektory dlya vnutrireaktornykh izmereniy energovydeleniya," [Detectors for Internally Measuring Reactor Energy Distribution], Moscow, Atomizdat, 1977.

2. Bogachek, L. N., et al, ATOMNAYA ENERGIYA, Vol 46, Sec 6, 1979.

3. Petrunin, D. M., Belyayev, E. D. and Kireyeva, I. L., Preprint of IAE-2518, Moscow, 1975.

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FUELS

WAYS TO IMPROVE PRODUCTION EFFICIENCY, WORK QUALITY OUTLINED

Moscow NEFTYANAYA PROMYSHLENNOSTI' SERIYA ORGANIZATSIYA I UPRAVLENIYE NEFTYANOY PROMYSHLENNOSTI in Russian No 6, 1981 pp 2-6

[Article by N. A. Mal'tsev, minister of the oil industry: "Increase in Production Efficiency Is the Main Task of the Oil Workers in the 11th Five-Year Plan"]

[Text] In accordance with the decisions of the 26th CPSU Congress, in the 11th Five-Year Plan the Communist Party will successively continue to implement its economic strategy. Its highest goal is a steady rise in the welfare of the Soviet people based on the stable and progressive development of the national economy, acceleration of scientific and technical progress, more complete use of intensive factors of development, efficient use of the country's production potential, all possible conservation of all types of resources, and improvement in the quality of work.

The chief task in the new stage of economic construction is to make the maximum use of the advantages of the socialist system of economy, actuate the enormous economic potentialities and reserves, and make a transition to intensification, and improvement in production efficiency and work quality.

It is known that the level of extraction of oil with gas condensate in the country in 1980 exceeded 600 million t. In 1976-1980, new large facilities for oil extraction were started up.

The implementation of the decisions of the 25th Party Congress for further development of the country's largest fuel and energy base in West Siberia is a significant achievement. During the last five-year plan, oil extraction in this region rose by more than 9-fold, and in 1980 reached 312.6 million t. As a result of the selfless labor of the Siberian drillers, the oil workers of Tatariya, Bashkiriya, the Ukraine, Belorussia, and Saratovskaya and Kuybyshevskaya Oblasts, the volume of drilling operations in the West Siberian regions more than tripled.

A lot of work has been done in the sector to improve the efficiency of oil production. During the 10th Five-Year Plan, 108 complex-automated fields were started up. Experimental-industrial tests were made on new methods of improving the oil output of the beds. New facilities were started up to refine oil gas.

The system of main oil pipelines which transport over 95% of the extracted oil was further developed. This permitted a sharp reduction in oil shipments by railroad.

The broad complex of social measures aimed at further improvement in the conditions of working, daily life and rest of the oil workers had a positive effect on the results of the sector's activity. These measures include development of housing construction, improvement in health protection and medical services, improvement in the skill of the personnel, rise in the educational and cultural level, and creation of a healthy social and psychological climate in the production collectives.

All of these results were attained because of the constant attention of the party and government to the development of the oil industry, continuous improvement in skill and inspired labor of the oil workers, workers, technicians, engineers, scientists and all of those who promote the development of the oil resources, builders, power engineers, metallurgists, machine builders, transportation workers, and toilers of other professions.

The main directions for economic and social development in the 11th Five-Year Plan define the task of providing extraction of oil (with gas condensate) in a volume of 620-645 million T in 1985.

The invariable requirement was heard at the 26th Communist Party Congress to all party, Soviet and economic agencies to make more complete use of all the enormous economic potential that our country has.

Comrade L. I. Brezhnev stated in his fiscal report to the 26th CPSU Congress: "A number of Plenums of the CPSU Central Committee have stressed that our further progress will depend to a greater measure on the skilful and effective use of all available resources, labor, basic funds, fuel and raw material, and products of the fields and farms.

We, comrades, are now capable of solving the largest and most complicated tasks. But a matter that seems to be very simple and prosaic is becoming the core of our economic policy, a thrifty attitude towards the public good, and the ability to make complete and expedient use of all that we have. The initiative of the labor collectives and party-mass work must be aimed at this. The technical policy, and the policy of capital investments as well as the system of planning and fiscal indicators must be aimed at this."

The party and government, attributing enormous importance to the questions of successful development of the oil industry direct enormous material and financial resources at creating new oil extracting facilities. But in addition to guaranteeing timely start-up of the new facilities for oil extraction, we need to persistently work on the old well fund, achieving high technical and economic indicators.

In many oil regions, this work is correctly set up. For example, in the associations "Tatneft'," "Bashneft'," "Ukrayneftegaz," "Udmurtneft'," and "Ukrneft'" control over fulfillment of the technological projects has been noticeably strengthened. Precisely in this [control] lies the main potential for guaranteeing current oil extraction and attaining the highest final output.

Business should be conducted so that we control the process of working. We have the necessary means for this.

The production associations, oil and gas extracting administrations and scientific research institutes need to make a thorough analysis of the condition of working of the fields, output of reserves for each bed, section and block, find and use new technical solutions and more advanced technological modes that guarantee the maximum intensification of the process. In this case, one should bear in mind first of all the working of oil reserves that are not covered by the displacement process, and intensification of work to affect the critical well zone. There are still shortcomings in this matter, while the organizational and technical measures taken do not always reach the planned goals. The collectives of the oil extracting enterprises should impose the proper order in using the well fund, should activate construction and start-up of the field facilities, primarily the gas-lift complexes at the Samotlor and Fedorovskiy fields to involve the fund of wells that were flooded during working and have stopped gushing.

In the 11th Five-Year Plan, the wells that are operated by mechanized method will comprise roughly 85%. In this respect, the increase in the between-repair period of operation of the equipment acquires decisive importance. This work must be constantly monitored by the technical services. In addition to improving the quality and reliability of the employed equipment, the level of its technical operation acquires great importance.

More attention should be focused on reconstruction and updating of our oil production. Our party's requirement is that the capital investments for the maximum output should be aimed primarily at reconstruction and technical re-arming of the active enterprises. Of course, one should not in all cases without exception oppose reconstruction and updating to new construction. The volumes of capital investments into production and the creation of an infrastructure at the new fields and in new regions will constantly rise in the sector.

It is the task of all administrations of the ministry, associations and enterprises to conduct all this work thriftily, carefully substantiating its need in each case.

Progress in the oil industry requires constant replenishment of the raw material base with new explored reserves, creation of new oil extracting by means of drilling and starting up new wells, and construction of facilities for complex development of the fields and regions.

Considerable financial resources and material-technical resources are allocated for these purposes. They must be used efficiently and effectively. Unfortunately, this is not always attained in the sector.

The board of the Ministry of the Oil Industry in 1980 examined and approved for each region complex projects for geological exploration and measures to improve their effectiveness that were formulated by the scientists of IGiRGI [Institute of Geology and Development of Mineral Fuels] jointly with the specialists of the territorial scientific research institutes and geophysical services. These documents were the foundation for the work of the geophysical, geological exploration, and drilling organizations.

The task is for each collective, and mainly, the scientific workers to display sufficient enterprisingness, initiative and creative search in implementing the projects to fulfill the tasks set to provide the necessary volumes of increase in oil reserves.

The branch drillers have been given great and important tasks in the imminent five-year plan. By 1985, the volumes of drilling operations have to be increased to 35 million m, and the main drilling increases have to be made in the West Siberian regions. It should be stressed that this work has to be done mainly by improving the technical and economic indicators, raising labor productivity, accelerating technical progress and further perfection in labor organization.

Currently a large program has been planned for technical reequipping and improvement in organization of drilling operations for oil and gas. It is now necessary to implement a lot of organizational work by the services of the central agencies, scientists, collectives of the production associations, administrations of drilling operations, aimed at realization of the planned program.

Complex tasks remain to be solved in the area of capital construction.

In order to further improve the efficient use of capital investments, to concentrate them in the most important construction sites, and to accelerate start up of production facilities, the ministry has stipulated measures for transition from making individual block production units to production and complete-set shipment to the construction sites of whole complexes of field facilities of plant manufacture, and namely:

guarantee further development and introduction of automated systems of planning operations in the branch institutes, bringing the level of automation in planning to 20% (no less) of the volume of work to be done by the end of the five-year plan;

develop and implement a program of organizational-technical measures to significantly improve labor productivity in in-house construction organizations and bring the volumes of work by the end of the five-year plan to 700-800 million rubles without increasing the number of workers;

take measures to reduce by 10-15% the cost of building roads by improving the quality of planning, organization of construction and improvement in their operation;

guarantee fulfillment of the set plans for construction and introduction of housing, children's preschool institutions, sanatoriums-dispensaries, the network of educational institutions to train workers and specialists in the middle link of basic activity, as well as in the field of trade, public nutrition and social-general services.

In order to solve these questions, it is necessary: to formulate jointly with the construction organizations of the contracting ministries specific organizational and technical measures and construction schedules, after stipulating in them concentration of all necessary material-technical and labor resources, appointing the persons resonsible for construction and start-up of each facility. In this case special attention should be paid to construction of facilities on complete-set imported equipment.

Of great importance in the organization and normal course of construction is the service of the customer. In the final analysis, the successful assimilation of capital investments and start-up of the facilities must be guaranteed by the oil and gas extracting administrations, oil pipeline administrations, administrations of drilling operations, i.e., the client enterprises.

It is not only important to provide the builders with a plan, but to also create the conditions for its fulfillment, timely start-up of the facilities, to regulate the interaction of the related services, establish the degree of responsibility of each for the final results, and strictly inquire about the assigned work.

Scientific and technical progress has enormous importance in improving production efficiency.

Working out of the most important branch problems is mainly united into two national economic programs:

creation and mastery of production processes and technical resources for drilling oil and gas wells;

creation and broad application of production processes and technical resources to improve output of the oil beds.

In our work we must start from the principle that the effect of scientific and technical progress on production efficiency will be more significant if, in addition tointroducing new equipment and technology, the technical potentialities of the available equipment are completely utilized because the equipment indisputably has large productivity reserves. It is necessary to precisely see the boundary between the sphere that refers to organization of production, and the sphere of new equipment and technology. This is very important since often these two concepts replace each other. This prevents attainment of the desired results.

Questions of social development and improving the welfare of the Soviet people were given a large place in the decisions of the 26th CPSU Congress. All of our organizational work must be aimed at solving this important national economic task.

This work is complicated and multifaceted. It is housing construction and public nutrition, supply of children's preschool institutions and organizations for the spare time of youth, condition of dormitories and taking of therapeutic-sanitation measures. Heat and water have to be supplied in time. The question of the specialized employment of adult family members, tens and hundreds of major and minor questions have to be answered.

Questions of improving the occupational skill of the workers, their cultural and general educational level must occupy a special place in this work.

The ministry attaches great importance to solving social questions, allocating considerable resources for these purposes.

This approach to solving social problems promotes the efficient evolution of the branch, and most important, the creation of favorable working and living conditions for the people.

At the same time it should be noted that the plans of housing and social-general construction are not completely fulfilled.

In order to eliminate the existing shortcomings, the ministry and the central committee of the trade union of workers of the oil and gas industry have defined a number of measures that will improve the working and living conditions of the workers in our enterprises. It is stipulated in particular:

guaranteed fulfillment of the complex plan for improving the working conditions and sanitary measures for 1981-1985 approved by the board of the Ministry of the Oil Industry and the presidium of the trade union central committee;

taking additional measures to strengthen major construction in West Siberia, having in mind implementation of complex building up of the workers' settlements, with regard for the creation of the proper conditions for daily life and rest of the workers;

formulation and implementation of measures for 1981-1985 to strengthen the material and technical base of the trade organizations, sovkhozes and auxiliary services and their further development;

formulation of a system of measures to strengthen the dependence of the size of wages on the final results of the work of the collective and each worker, increase in its stimulating role in the rise of labor productivity, improving the quality of products and conservation of all types of resources, perfection in the tariff system and standardization of labor.

All these measures must promote the creation of stable collectives with a high level of awareness and responsibility for the entrusted work.

Resolution of the problems facing the branch depends a lot on the level of leadership, planning and control. Under modern conditions, the value of discipline and personal responsibility for fulfillment of the state plans rises many times.

Comrade L. I. Brezhnev in the fiscal report to the congress indicated: "The time has apparently come to make stricter requirements both for the planning discipline, and for the quality of the plans themselves. There is no doubt that the plan must be realistic and balanced."

In 1979, the CPSU Central Committee and the USSR Council of Ministers adopted the decree "On Improving Planning and Strengthening the Effect of the Economic Mechanism on Improvement in Production Efficiency and Work Quality." It has become the guide to action for the production organizers. The board and central committee of the ministry to improve branch planning and the economic mechanism of control, and the commissions of the local enterprises have done a lot of work to realize this decree. I would like to dwell on that part of it that is directly tied to production organization and perfection of the economic mechanism.

First of all, we should isolate such an important aspect as subordination of the interests of each worker, each collective and enterprise to the attainment of high final results of our oil industry, fulfillment and overfulfillment of the set asssignments for extraction of oil and gas with all possible conservation of resources. This is the main criterion of our activity in the interests of the country's national economy.

What are the ways to achieve this goal? They are a well-thought-out system of planning-estimating indicators of activity, and a system of unified start-to-finish order in the lower collectives and brigades, introduction of the leading experience and broad socialist competition.

It is necessary to dwell on the development of a system of cost accounting, especially lower, as an effective form of improving the level of production organization. Constant correlation of the obtained product and the production expenditures and finding new reserves are the main methods of working of the manager and the practical man of socialist formation. Cost accounting is based on record keeping, as is known. We have a lot to do in this area.

Speaking of the improvement in production organization, I would like to stress the importance of widespread introduction of brigade forms of labor organization. In recent years, the board has adopted definite measures to strengthen this most important lower production link. The brigades have been renewed for oil extraction in the main industry and the role of the foremen has been strengthened.

At the same time, as analysis has shown, brigade forms in a number of associations have only covered 50-55% of the workers. Work of the leading enterprises in the country shows that success is only attained on the basis of complete use of the brigade forms of labor organization. We need to extensively study and broadly disseminate this experience in the branch.

Our branch has considerable teams of workers, clerical workers and engineering-technical workers.

The successful work of the enterprises and organizations depends a lot on the style and level of work with the personnel.

Our task is to work out, as L. I. Brezhnev stated, that style of work "which organically combines peformance efficiency, discipline and bold initiative and enterprisingness. Practicality and business-like efficiency with striving for greater goals. A critical attitude towards shortcomings with firm confidence in the historical advantages of our selected path."

The CPSU Central Committee, USSR Council of Ministers, AUCCTU and Komsomol Central Committee have adopted the decree "On All-Union Socialist Competition for Successful Fulfillment and Overfulfillment of the Assignments of the 11th Five-Year Plan" which notes that socialist competition is unfolding widely in the labor collectives for improvement in efficiency and quality of work, acceleration of scientific and technical progress, and successful fulfillment and overfulfillment of the assignments of the 11th Five-Year Plan. The decree defines the specific tasks in organizing socialist competition.

The main motto of the competition must be: "Work efficiently and with quality!"

At the 26th CPSU Congress, General Secretary of the CPSU Central Committee, Comrade L. I. Brezhnev stated: "Socialist competition is creativity of the masses. In its very essence it is based on high awareness and initiative of the people. Precisely this initiative helps to reveal and actuate the reserves of production, improve efficiency and quality of work."

Entering the 11th Five-Year Plan, the labor collectives of oil workers have adopted intensive commitments and counterplans.

Many collectives that have been included in the socialist competition in honor of the 26th CPSU Congress have successfully fulfilled the adopted commitments for extraction of oil and have laid the foundation for stable and fruitful work in 1981.

Now our main task is not only to preserve the glow of the precongress socialist competition, but also to multiply its success, in every possible way developing creative activity of the workers, aiming it at resolving the tasks set by the 26th CPSU Congress.

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FUELS

UDC 65.012.6:[622.323+622.24]

INDUSTRY COMPETITION WINNERS NAMED FOR FIRST QUARTER OF 1981

Moscow NEFTYANAYA PROMYSHLENNOST' SERIYA ORGANIZATSIYA I UPRAVLENIYE NEFTYANOY PROMYSHLENNOSTI in Russian No 6, 1981 pp 40-42

[Article: "Results of All-Union Socialist Competition of Collectives from the Enterprises and Organizations of the Ministry of the Oil Industry to Improve Production Efficiency and Work Quality, Fulfillment of the Plan and Socialist Commitments for the First Quarter of 1981"]

[Text] Workers, engineering-technical workers and clerical workers of the oil industry have extensively unfolded socialist competition for further improvement in production efficiency and work quality and are laboring successfully in the first year of the 11th Five-Year Plan.

The plan for the first quarter of 1981 for extraction of oil and gas condensate was fulfilled by 100.6%. A total of 848,000 tons above the plan was extracted. Because of the introduction of new methods, the increase in oil bed output reached 600,000 T of oil. The specific labor outlays to service one well diminished by 3.1%.

In the first quarter of 1981, 4.5307 million m of rock were drilled, including 181,100 m above the plan. A total of 2013 wells were put into operation with a plan of 1892.

The volumes of construction-installation work by in-house forces were fulfilled by 107.1%. Labor productivity in construction improved by 5% with a commitment of 3.5%.

The plan to realize the products of the Ministry of the Oil Industry was fulfilled by 101% and 2.5 million rubles of above-plan profit were obtained.

The greatest contribution to the labor successes of the branch were made by the collectives of the enterprises and organizations of Glavtyumenneftegaz, the associations "Tatneft'," Bashneft'," Komineft',""Grozneft," "Nizhnevartovskneft'," "Saratovneftegaz," "Kuybyshevneft'," "Udmurtneft'," "Ukrneft'" and "Orenburgneft'."

The planned assignments and socialist commitments were fulfilled by the collectives from the enterprises and organizations of the associations "Soyuzneftegazpererabotka," "Soyuzneftemashremont,""Soyuzneftespetsmaterialy," the enterprises and organizations of the Administration of Field and Industrial Geophysics and the Administration of Worker Supply.

Socialist competition for a worthy meeting of the 26th CPSU Congress was very instrumental in promoting the smooth and stable operation of the branch in the first quarter of 1981.

By 23 February 1981, all the associations, over 800 enterprises, 8000 brigades and about 87,000 workers had fulfilled the precongress commitments. The oil workers extracted over 500,000 T of above-plan oil with a commitment of 450,000 T.

The collectives of the oil and gas extraction administration "Al'met'yevneft'" of the association "Tatneft'" and the Administration of Main Oil Piplelines of West and Northwest Siberia presented an initiative to develop socialist competition for prudent and efficient expenditure of fuel and energy resources. They adopted increased commitments for conservation of electricity, heat and comparison fuel, and appealed to the workers of the branch to support their initiative and continue the struggle for all possible conservation.

In the first quarter of 1981, 300.0 million kW x h of electricity, 152,300 Gcal of heat and 28,600 T of comparison fuel were saved.

At the same time there are shortcomings in the work of the branch. The associations "Stavropol'neftegaz," "Tadzhikneft'" did not fulfill the plan and the adopted socialist commitments for extraction of oil and gas condensate.

The board of the Ministry of the Oil Industry and the presidium of the central committee of the trade union of oil and gas industry workers have examined the results of the all-union socialist competition for the first quarter of 1981. From its results the following were adopted:

1. Acknowledge as winners of the all-union socialist competition for the first quarter of 1981, and award the challenge Red Banners of the ministry of oil and gas industry workers with first monetary prizes to the collectives of the association "Yuganskneftegaz," "Urayneftegaz," "Komineft'," "Udmurtneft'," "Kuybyshevneft'," "Grozneft'," "Ukrneft'," "Nizhnevolzhskneft'." "Saratovneftegaz," Dagneft'," "Gruzneft'," the oil and gas extracting administration "Fedorovskneft'" of the association "Surgutneftegaz of Glavtyumenneftegaz, the oil and gas extracting administration "Al'met'yevneft'" of the association "Tatneft'," the oil and gas extracting administration "Aznakayevskneft'" of the association "Tatneft',", the oil and gas extracting administration "Suleyevneft'" of the association "Tatneft'," the oil and gas extracting administration "Leninogorskneft'" of the association "Tatneft'," the oil and gas extracting administration "Prikamneft'" of the association "Tatneft'," the oil and gas extracting administration "Arlanneft'" of the association "Bashneft'," the oil and gas extracting administration "Krasnokholmskneft'," the oil and gas extracting administration "Tuymazaneft'" of the association "Bashneft'," the oil and gas extracting administration "Krasnokamskneft'" of the association "Permneft'," the oil and gas extracting administration "Polaznaneft'" of the association "Permneft'," the oil and gas extracting administration "Buzulukneft'" of the association "Orenburgneft'," the oil and gas extracting administration "Rechitsaneft' of the association "Belorusneft'"; the Surgut administration of drilling operations No 2 of the association "Surgutneftegaz" of Glavtyumenneftegaz, the Strezhevoy administration of drilling operations of the association "Tomskneft'," Almet'yevsk administration of drilling operations of the association "Tatneft'," Leninogorsk administration of drilling

operations of the association "Tatneft'," the Menzelinsk administration of drilling operations of the trust "Tatneftegazrazvedka" of the association "Tatneft'," the Tuymazy administration of drilling operations of the association "Bashneft'," the Kungur administration of drilling operations of the association "Permneft'," the Svelogor administration of drilling operations of the association "Belorusneft'," the trust "Bashneftegeofizika," the trust "Volgogradneftegeofizika," the trust "Tatneftegeofizika," the Al'met'yev administration to increase output of the oil beds and major repair of wells of the association "Tatneft'," the oil and gas drilling administration "Kul'saryneft'" of the association "Embaneft'" of the trust Tyumenneftestroy" of Glavtyumenneftegaz, the trust "Bashneftedorstroyremont" of the association "Bashneft'," the administration of main oil pipelines "Druzhba" of Glavtransneft', the administration of main oil pipelines of West and Northwest Siberia, the administration of northwest main oil pipelines, the experimental plant for production and repair of geophysical and power engineering equipment "Elektron" of Glavtyumenneftegaz, etc.

2. Award second and third monetary prizes to the collectives of the oil and gas drilling administration "Surgutneft'" of the association "Surgutneftegaz," the oil and gas drilling administration "Aktyubaneft'" of the association "Tatmeft'," the oil and gas drilling administration "Dzhalil'neft'" of the association "Tatneft'," the oil and gas drilling administration "Bavlyneft'" of the association "Tatneft'," the administration for intrafield collection and use of casing head gas "Tatneftegaz" of the association "Tatneft'," the oil and gas drilling administration "Yuzharlanneft'," the oil and gas drilling administration "Chekmagushneft'" of the association "Bashneft'," the oil and gas drilling administration "Khadyzhenneft'" of the association "Krasnodarneftegaz," the oil and gas drilling administration "Abinneft'" of the association "Krasnodarneftegaz," the oil and gas drilling administration "Komsomol'skneft'" of the association "Mangyshlakneft'," the oil and gas drilling administration "Uzenneft'" imeni 23rd CPSU Congress of the association "Mangyshlakneft'," the oil and gas drilling administration imeni 26 Baku Commissars of the association "Azneft'," the oil and gas drilling administration "Ordzhonikidzeneft'" of the association "Azneft'," the oil and gas drilling administration "Chernomorneft'" of the scientific production association "Soyuztermneft'," the Surgut administration of drilling operations of Glavtyumenneftegaz, the Aznakayevo administration of drilling operations, the Belebey administration of drilling operations, the Neftekamsk administration of drilling operations of the association "Bashneft'," the Chernushka administration of drilling operations of the association "Permneft'," the Osinsk administration of drilling operations of the association "Permneft'," the Belorussian administration of drilling operations for drilling oil wells in West Siberia of the association "Belorusneft'," the Maykop administration of drilling operations of the association "Krasnodarneftegaz," the Neftekumsk administration of drilling operations of the association "Stavropol'neftegaz," the Andizhan administration of drilling operations of the association "Uzbekneft'," the Tuymazy geological-exploratation office of the association "Bashneft'," the administration "Zapsibneftegeofizika," etc.

3. The good work of the following collectives was noted: of the association "Krasnodarnneftegaz," of the association "Azneft'," the oil and gas drilling administration "Strezhevoyneft'" imeni 50th Anniversary of the USSR of the association "Tomskneft'," the Oktyabr'skiy administration of drilling operations for drilling oil wells in West Siberia of the association "Bashneft'," the Strezhevoy administration to increase output of the oil beds and major repair of wells of the association "Tomskneft'," the Tamponazh office of the association "Tur'menneft'," the construction-installation administration, repair-construction administration

"Tatnefteremstroy," the Bugul'minskiy administration of automobile roads of the association "Tatneft'," the mobile mechanized column of the association "Bashneft'," the mobile mechanized column No 2 of the association "Mangyshlakneft'," etc.

Guided by the decisions of the 26th CPSU Congress, organizational-mass work should be done to mobilize the collectives to unconditional fulfillment of the planned asssignments and adopted socialist commitments, to direct efforts of the competitors to further increase in production efficiency and work quality, all possible saving of labor, material and fuel and energy resources, strengthening of the labor and production discipline, to systematically analyze the fulfillment of the plan and socialist commitments, to take timely measures to eliminate the causes that interfere with the satisfactory activity of the collectives, to focus more attention on strengthening work to guarantee the corresponding level of industrial hygiene and accident prevention, and to prevent cases of production injury.

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CSO: 1822/224

FUELS

UDC 622.323+550.362

THERMAL METHODS OF WORKING OIL FIELDS

Moscow TEPLOVYYE METODY RAZRABOTKI NEFTYANYKH MESTOROZHDENIY in Russian 1981 (signed to press 6 Feb 81) pp 1-10, 283-288

[Annotation, introduction and table of contents from book "Thermal Methods of Working Oil Fields," by Nikolay Konstantinovich Baybakov and Aleksandr Rubenovich Garushev, Izdatel'stvo "Nedra," 2400 copies, 288 pages]

[Text] The chief and most progressive methods are described for thermal modification of the oil bed and critical well zone. Theoretical foundations are presented for heat- and mass-exchange, and concepts regarding the mechanism for extracting oil during thermal modification of the bed. Recommendations and calculations are made for planning and introducing thermal methods. Results are described from field tests, methods of thermodynamic control and regulation of steam-thermal modification of the bed. The second edition (first edition, 1977) shows the outlook for development of thermal methods both as independent, and in combination with other methods of active modification of the bed to increase the oil output.

This book is for production-technical and scientific workers of the oil industry.

Thirty-seven tables, 118 illustrations, 36 bibliographic entries.

Introduction

The Soviet Union is an industrially developed country which completely supplies its own internal needs for oil and petroleum products, and exports them to other countries.

The volume of oil and gas condensate extraction for 1971-1975 thus was 2.080 billion T, and 2.224 billion T for the 4 years of the 10th Five-Year Plan.

In 1980, over 600 million T of oil and gas condensate were extracted as compared to 352.5 million T in 1970 and 37.9 million T in 1950.

The percentage of oil and gas condensate extraction in the USSR in the total world fund rose from 7.4% in 1950 to 18.4% in 1979.

This intensive increase in the volume of oil extraction became possible not only because of the systematic increase in the explored industrial reserves, but also because of the introduction of advanced systems of working the fields which guarantee high and stable rates of oil recovery for a long period of time, and more complete extraction of it from the depths.

Since the oil reserves are not infinite, starting with the first years of nationalization of the oil industry, our country took measures aimed at perfecting the system of working the oil fields.

Until the middle 1940's, the increase in oil output was mainly due to efficient use of the reserve of the bed's natural energy. Then a new stage of technical progress in working the oil fields began. The base for this stage was the scientific fundamentals developed by the Soviet scientists and practical workers for working oil fields using methods of artificial modification of the beds by perimeter injection of water.

Further progress was mainly governed by perfection of the flooding method. It became possible to significantly intensify this process by contour cutting of the deposits.

Injection of water into the bed is used in all the newly worked major fields, as well as at many fields where working was started earlier. Over 200 oil fields are currently worked by these methods.

One can judge the high national economic efficiency of the flooding method by the fact that about 80% of the entire volume of oil extraction is obtained from flooded beds. In three decades, over 45% of the oil extracted in the USSR has been obtained by this method. In this case, labor productivity rose considerably, and the specific capital investments and operating outlays diminished.

The most important indicator for the effective use of scientific fundamentals for working oil fields with the maintenance of bed pressure through injecting water into the beds is the considerable increase in the coefficient of oil output as a whole for the country. In particular, the planned final coefficient of oil output for all the fields worked in the USSR is 0.46, while in the United States where flooding is done on a smaller scale, it does not exceed 0.33.

Despite the high technical and economic indicators obtained in working the fields using the flooding method, however, the problem of attaining more complete oil output has not been resolved. It is especially difficult to work beds which are characterized by complicated geological conditions and which contain oils of increased viscosity.

Theory and practice have shown that the greatest final coefficient of oil output during flooding (to 50-60%) is reached in comparatively uniform beds which contain oil with viscosity to 3 cP. With high values of oil viscosity, the effectiveness of flooding drops, and with viscosity over 25-30 cP, this method of modifying the bed is practically ineffective and is difficult to implement. In this case the final oil output does not exceed 20-25%.

Consequently, with the modern technology of working oil fields maintaining bed pressure by injecting water into the bed, complete extraction of the geological oil reserves is not guaranteed. As a consequence, over 50% of the geological reserves remains in the depths, and up to 80-85% remains in the beds with highly viscous oil.

Because the number of fields where working begins with complicated mining and geological conditions and with highly viscous oil is increasing all the time, a trend is noted towards reduction in the average coefficient of oil output in the sector.

Thus, from 1961 to 1980, the planned oil output dropped from 51 to 46%. This trend will be maintained if more advanced working methods are not introduced.

It is common knowledge that in order to guarantee high rates of development of the oil industry, new production facilities are created every year in the country. However, a considerable number of them are used to compensate for the drop in oil extraction on the worked fields, especially with low coefficient of oil output of the beds.

It should be stressed that this percentage of oil will not rise in the subsequent period. At the same time, new, more advanced methods of modifying the beds and the critical oil well zones in order to increase the oil output and reduce the rates of decline in oil output are now being implemented on limited scales.

This is first of all explained by the fact that extraction of difficult-to-extract oils requires great capital investments and operating expenditures. This significantly raises the net cost of the oil. However,taking into consideration all the rising prices for oil and the change in the structure of the reserves, introduction of new methods is undoubtedly economically expedient.

The national ecnomic importance of raising the oil output of the beds is confirmed by the conservation of capital investments, material and labor resources. If, for example, we are faced with the task of additional extraction on the worked fields in a long-term period (to 1990) by increasing oil output of 1 billion T of oil, or roughly 70 million T per year, then the saving from implementing this measure can be estimated as many hundreds of millions of rubles of capital investments, and a considerable reduction in outlays of material and labor resources.

The most important task of the scientists and specialists of the country's oil industry is to develop a complex program for development of this sector. A significant place must be occupied by broad scale introduction of measures to increase the coefficient of oil output of the beds. One should take into consideration that the rise in oil output if only by 1% will yield many tens of millions of tons per year in additional oil at the already created facilities with relatively small capital investments and expenditures of production. This is equivalent to the discovery and working of many large oil fields. Therefore, the "Main Directions of Economic and Social Development of the USSR for 1981-1985 and for the Period to 1990" sets before the country's oil industry the task of "expanding the use of new methods of modifying the oil beds and increasing the extraction of oil from the depths by this means."

It is especially important to force work to increase oil output of the beds in the fields of our country's European sector, and primarily, in the Caucasus and Azerbaijan, where considerable material and financial resources are being invested in the development of the fuel and energy branches. In this case a considerable number of the oil and gas fields entered the period of declining oil extraction. Many fields of the Ural-Volga region also entered this period. Therefore even now a considerable quantity of oil and gas has to be transported from the eastern regions of the country to the west. This requires great capital investments, material and technical resources and labor outlays.

Questions of improved efficient use of the oil fields in the European sector of the USSR are of primary importance also because amost all the fields with low coefficient of bed output which are in the late stage of working are located here, as well as the main oil fields of the Ural-Volga region. Although they are worked with higher coefficients of oil output, they still do not correspond to the modern requirements of technical progress.

It should be noted that in the oldest oil regions, Baku, Groznenskiy and Krasnodar where the fields have been worked for over 100 years, the oil output does not exceed 30-35%, and this means that in the depths of these regions alone, many hundreds of millions of tons of oil remain unextracted.

In order to improve oil recovery from the worked and newly worked fields, it is necessary to thoroughly study their characteristics and select new methods for modifying the bed, and work out new technical solutions to guarantee intensification of oil recovery.

In the last decade, a number of new methods have been formulated in our country and abroad which help to attain more complete oil output than with standard flooding. However, not all of them have been sufficiently studied, tested, and most important, not all are applicable from an economic viewpoint. The majority of methods require considerable capital investments for additional oil extraction.

Studies show that the coefficient of oil output can be significantly increased by changing the physical and physical-chemical properties of the displacing agent, by using hydrocarbon solvents, carbon dioxide, micellar solutions, surface-active substances, polymer solutions and other agents, and finally, by changing the temperature regime of the process of oil displacement from the bed.

By introducing these methods of increasing oil output, the United States extracted almost 30 million T of oil in 1980. This is about 6.4% of the total extraction. About 70% (12.8 million T) of the oil was obtained with the use of thermal methods.

Greater preference will be given to thermal methods in the near future. In particular, in 1990 the United States plans to extract about 45 million T of oil, or about 80% of the toal extraction by using thermal methods.

New methods are being introduced on a limited scale in the Soviet Union. In 1979, additional extraction of oil through the use of the new methods was slightly more than 3 million T or about 0.5% of the total extraction of oil together with gas condensate throughout the country. In this case, thermal methods were responsible for over 70% of the additional oil extraction. The trend for more intensive introduction of thermal methods as compared to other new methods will be maintained in the future.

The special place of thermal methods of modifying the bed is governed by the fact that widely accessible agents are used to realize them, water and air (oxidizer), and the scales of introduction of these methods do not depend on the possibility of obtaining large quantities of chemical reagents necessary for the introduction of physical-chemical methods of increasing the bed oil output.

Another important advantage of the thermal methods over the majority of physical-chemical methods is the possibility of attaining higher oil output with different physical-geological conditions of the oil fields. Thermal methods are often used when oil has not been successfully extracted from the bed by any other method.

Thermal methods of modifying the bed are based on a drastic reduction in the viscosity of oil during heating, i.e., on an increase in its mobility under bed conditions.

Therefore the fields with highly viscous oil are the primary objects for thermal methods. These objects include the fields of Karazhanbas and Kenkiyak (West Kazakhstan), Usinskiy (Komi ASSR), Russkiy (West Siberia), a number of fields of the Ural-Volga region, North Caucasus, Azerbaijan, Sakhalin and others.

However, the effectiveness of the thermal methods is manifest most completely in the fields not only with highly viscous oil, but also with paraffin-base oil, since modification of beds with paraffin-base oil (for example, the Uzen' field) with a cold agent results in precipitation of the paraffin from the oil directly in the porous medium. These beds are also among the primary objects for thermal methods.

During thermal modification of the bed, practically all known mechanisms of oil displacement which are accompanied by diverse phase transitions are manifest. Therefore it is no accident that interest is shown in the thermal methods in defining the future additional working of the deposits of low-viscous oil that have been in operation for a long time with the use of water injection.

Consequently, the area of application of active thermal modification in working oil fields is fairly broad, and this predetermines its high national economic importance and the need for the most rapid and universal, where expedient, application in industrial conditions.

Thermal modification makes it possible not only to improve the effectiveness of working, but also to include many fields in active working that are being conserved.

The oil extracting enterprises of our country are using thermal modification of the bed in three main modifications:

heating of the critical well zone with steam, different heating agents and heat released during artificially created chemical reactions;

cyclic or constant injection into the bed of different volumes of heat carriers (high-temperature water, steam or hot gases);

creation of intrabed combustion (IC), as well as wet combustion by injecting water into the bed in order to create a heat carrier directly in the bed in the combustion zone.

Each of the indicated modifications can be used together with other methods of bed modification. In this case it is the most promising to create thermal margins that can be moved by the unheated water.

According to the data of theoretical and laboratory studies, injection into the bed of water heated to 90°C instead of cold can increase the oil output by 5-10%.

Preparation of large volumes of hot water, as shown by the experience of working the Uzen' field, can be effectively done under certain conditions in different water-heating units. Natural thermal waters (for example, the thermal waters of the Senoman deposits in West Siberia) are also used as the working agent. It is more expedient, however, to inject into the bed more active heat carriers capable of significantly increasing the temperature.

It has been established that these effective working agents include: superheated steam, steam-gas mixtures and high-temperature water (heated to 250°C and more) that can be used in thermal methods of working, depending on the depth of occurrence of the beds and the pressures in them.

Calculations show that during steam-thermal modification of the bed, higher oil output (by 15-20% and more) is possible than with flooding the bed with hot water.

Successful work to inject steam is underway in the Kenkiyak (Embaneft'), Okha (Sakhalin Island) fields and in a number of other regions.

Experimental-field work on steam-thermal treatment of wells and block-cyclic steam-thermal modification of the bed which were done at the Zybza field in the Krasnodarskiy Kray made it possible to extract about an additional 200,000 T of oil with considerable economic results.

One of the promising (from the viewpoint of guaranteeing the possibility of the most complete recovery of oil from the collectors) among the known methods, is creation of intrabed combustion (IC).

Under certain conditions, intrabed combustion can result in essentially almost complete oil output of the bed. In this case, 10-15% of the oil reserves are consumed to maintain combustion. Under real conditions, the expected oil output of the collectors is 50-80%.

Experimental work to create intrabed combustion in the Pavlova Gora field in the Krasnodarskiy Kray has been successfully underway since 1966. In this case the net cost of the oil was close to the general field net cost. By the middle of the 1970's, work was started for west intrabed combustion on the Khorasany field in Azerbaijan.

Oil extraction from the old fields (especially with low coefficient of oil output of the bed) can also be increased significantly by the shaft method in combination with thermal methods. According to forecasting estimates of the specialists, the bed oil output is significantly increased. The process is being successfully implemented.

For example, the Yarega field in the Komi ASSR with anomalously high oil viscosity was prepared from the very beginning for working by the shaft method, since the use of other methods would have been inefficient. Working of this field by the shaft method with subsequent use of thermal methods permitted a considerable increase in the bed oil output. Currently the oil output on the modified sections has reached over 40% versus 6% in the period when the field was worked on a natural regime.

Many old fields with depth of oil bed occurrence to 1200 m are suitable for shaft working. The fields of the Apsheron Peninsula, Emba and Maykop regions with shallow depths of occurrence of the oil beds must be the primary objects for this working.

Construction of an oil shaft with annual output of about 200,000 T of oil has currently been started in the region of Khorasany on the Apsheron Peninsula.

Laboratory-experimental and field work has been done to search for methods of effective working of bitumen deposits using heat carriers in Tatariya.

The peculiarity of the conducted experimental-industrial work on thermal methods of oil extraction is that it has mainly been done on exhausted oil deposits using an old well fund not designed for high temperature loads. One should also note the limited scales of introduction of thermal methods both in coverage of the reserves, and in level of oil extraction which do not meet the rising demands for development of the oil-extracting industry.

Radical changes in the introduction of thermal methods of oil extraction are only possible if a set of complicated scientific and technical problems are solved which are aimed at creating the scientific fundamentals for working fields, as well as fundamentally new production equipment and control instruments necessary for effective management of extraction of oil by thermal methods. Questions of creating powerful sources of generating a heat carrier, which could be, in particular, atomic boilers and plasma units, etc. deserve special attention.

This monograph is based on the works of Soviet scientists and on the practical results of major experimental-industrial work on thermal methods of working done in our country. In this case the conclusions and assumptions are mainly illustrated in the example of working the fields of the Krasnodarskiy Kray since practically all the currently known modifications of thermal modification of the bed have been systematically and purposefully tested right in this region.

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The authors will be grateful to all readers for opinions and wishes.

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the oil separation systems. Automatic control and regulation of the technological parameters of the separation units are also described.

This book is designed for engineering-technical and scientific workers of the oil extracting industry, as well as students of oil VUZ's and departments.

Molchanov, A. G. "Gidravlicheskiy privod shtangovykh skvazhinnykh nasosov" [Hydraulic Drive of Sucker Rod Well Pumps], 16 pages, 1 ruble 20 kopecks.

The main theoretical assumptions are presented for the operating principle of the sucker rod hydraulic drive for a pumping unit using a column of pumping-compressor pipes as the counterbalance. Main trends are defined for the development of this drive for ShGNU [expansion unknown] and the long-term trend of creating and improving it. The arrangement of the main assemblies and parts of this drive and methods of establishing the optimal stroke and operating mode are described. The main results are shown from operating the hydraulic drive units, the features of their maintenance, and underground repairs. The economic effectiveness of using hydraulic drive is analyzed.

It is designed for engineering-technical workers of the oil industry. It will be useful for students of oil VUZ's and departments.

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