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USSR Report

ENERGY

(FOUO 11/81)

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ELECTRIC POWER

ELECTRIFICATION AND ECONOMIC GROWTH

Moscow VOPROSY EKONOMIKI in Russian No 4, Apr 81 pp 58-68

[Article by A. Beschinskiy and Yu. Kogan in the section devoted to "Urgent Problems of the 11th Five-Year Plan"]

[Text] December of 1980 marked 60 years since the approval by the Seventh All-Russian Congress of Soviets of the State Plan for the Electrification of Russia, GOELRO, which V.I. Lenin called the second program of the party.

Considerable importance is attributed to the electrification of the nation in the Leninist concept of the construction of the material and technical base of communism. The Leninist teaching on electrification generalized the most advanced trends in scientific and engineering thought.

Even in the initial developmental stage of electrical power engineering, V.I. Lenin saw a powerful lever in electrification for the construction of the material and technical base of the new society, as well as the basis for social transformations in the USSR; he saw an energy carrier in electrical power which met the developmental requirements and scales for national production in the 20th Century to the greatest extent. V.I. Lenin linked the future development of national production to the wide use of electrical power to increase labor productivity. He noted the special properties of electrical power as an energy vehicle (the capability of concentration, divisibility, mobility, hygienic quality, etc.), because of which, electricity is the most effective form of incorporating an ever increasing number of various kinds of energy resources in the production process. The mobility of electrical power and the capability of concentrating it allow for the delivery of a practically unlimited electrical potential to any point, consequently, create powerful, highly productive plants in industry. The efficiency of the conversion of electrical energy to other kinds of energy makes it the basis for the modern large machine industry and is responsible for the possibility of realizing new technologies based on the utilization of electrophysical and electrochemical processes.

Thus, V.I. Lenin treated the electrification of the national economy as the technical basis for progress in national production during the historical period of the transition from capitalism to socialism. Along with this, centralized concentrated production of electrical power played the part in the Leninist concept of a moving force for the socialist collectivization of production, both in power

engineering itself and in all other sectors of the national economy. V.I. Lenin saw in the dialectical unity of these two aspects the significance of electrification for the creation of a new social order. "Large machine industry which is also capable of reorganizing agriculture can be the only material basis for socialism. But we cannot limit ourselves to this general statement. It must be made more specific. The large industry capable of reorganizing agriculture and which corresponds to the level of the newest technology is the electrification of the entire nation".[1] These Leninist ideas were embodied in the state plan for the electrification of Russia: the GOELRO plan.

Along with the tasks of developing industry, transportation and agriculture, a provision was made in the GOELRO plan for the creation of 30 new regional electric power stations over the course of 10 to 15 years with an overall capacity of 1,750,000 MW as well as 20 thermal electric power stations and 10 hydroelectric power stations. The scales of the GOELRO plan seem modest now. Suffice it to say that in 1979, the USSR brought about 11 million MW of electrical power capacity on line: almost 7 times more than outlined in the GOELRO plan for 10 to 15 years. Nonetheless, the methodological principles embodied in it have not lost their importance.

One of the major principles of the GOELRO plan was the development of power engineering and electrification in a close interrelationship with the rise of the technical level of the national economy, its structure and geographical arrangement. For this reason, it was a program for the comprehensive development of the entire national economy based on electrification. The increasingly deeper penetration of electrical power into production and the growth of electrical power consumption are tied in the closest possible manner to the major trends in scientific and engineering progress, which form the basis for the growth of national labor productivity.

A distinctive feature of the GOELRO plan was also the fact that the power engineering sector was treated as a comprehensive system in which electrical power engineering was studied and planned in close coordination with all other components of power engineering, such as the fuel balance, the utilization of water resources, the structure of the consumers, etc. Also embodied in the GOELRO plan was that which today is called a systems approach, in which the efficiency of power engineering (in particular, its impact on technical progress and the growth of labor productivity in the national economy) is tied to structural changes within the energy sector, primarily, to the advanced development of electrical power engineering.

The role of electrification in the reconstruction of the nation's fuel and energy balance which was defined in the GOELRO plan was characteristic in this regard. Soviet Russia inherited a destroyed industrial fuel base, which prior to the revolution had entirely depended on Donetsk and imported coals and Baku oil. The War and intervention undermined an already weakened fuel sector. The only way out of the fuel crisis under these conditions was a deep transformation of

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1 V.I. Lenin, "Polnoye sobraniye sochineniy" ["Complete Collected Works"], Vol. 44, p 9.

the fuel balance based on the wide utilization of local fuel and hydroelectric power resources. The mastery of these resources and electrification were treated in the GOELRO plan as two inseparably linked problems. Along with this, electrification also performed another important function. By utilizing decentralized local energy resources, electrical power stations combined them into large centralized power generation and formed power systems, promoting an increase in the efficiency of the entire energy sector.

The systemic approach was reflected in the interrelated treatment of the ongoing and future task. The importance of long term planning was underscored in the GOELRO plan as the basis for the correct solution of current tasks. The authors of the plan noted: "We are increasingly threatened by the danger while overcoming the routine difficulties of getting off the main track and for the sake of temporary interests, sacrificing the major, significant and essential interest of the overall plan for our economic work."[1]

In practice, the GOELRO plan was the first successfully executed long term plan, which encompassed the development of the nation's economy as a whole for a long period. V.I. Lenin called the GOELRO plan a great economic plan[2]. In a letter to G.M. Krzhizhanovskiy (of 14 March, 1921), he characterized the major features of the systemic approach to the determination of the efficiency of national economic outlays: the broad variants in economic analysis; individual facilities are not compared, but rather national economic structures with differing values of the electrical power engineering component; expenses and the results in a comparative analysis are traced throughout the entire energy sector cycle, taking into account the consumer effect, i.e., the entire national economy is treated (and not just the expenditures and impact of power engineering).

In the GOELRO plan, the problem of the mutual measurement of one-time and current expenditures was posed on the basis of these principles, as well as the problem of estimating the effectiveness of comprehensive measures in water management and an analysis was made of the effectiveness of the interconnection between electrification and a growth in labor productivity. The plan also contained a number of other stipulations which reflect the objective laws governing the further development of Soviet power engineering: the uniform locating to the extent possible of regional electric power stations over the nation's territory as the basis for the development of economic regions and establishing their specialization; the widescale utilization of renewable water resources through the construction of hydraulic developments for comprehensive functions; the harmonic combination of thermal and hydroelectric power stations into large power systems; and a faster pace of development for electrical power engineering as compared to other sectors of the fuel and energy complex, as well as the economy as a whole.

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[1] "Plan GOELRO" ["The GOELRO Plan"], Gospolitizdat, 1955, p 44.

[2] See V.I. Lenin, "Polnoye sobraniye sochineniy", Vol 42, p 158.

V.I. Lenin set up all of the work on the composition and realization of the GOELRO plan as a nationwide and political effort, in the course of which, the concept of electrification mastered the masses and became a true material force in the construction of a new society. Just 10 years after the approval of the GOELRO plan, its major tasks had been performed. As early as five years later, the figures of the GOELRO plan were exceeded: by a factor of three times for electrical power generation, by a factor of almost two times for coal extraction, by a factor of two times for oil extraction and by a factor of three for industrial output. In line with the Leninist principles for systemic planning, the development of electrical power engineering and electrification was realized in a mutual linkage to the growth of the entire nation's fuel and energy base.

The period from the approval of the GOELRO plan to the middle of the 1950's was the stage of increasing value of coal fuel, the percentage of which in the nation's fuel balance increased up to 60 percent. The increase in the role of coal was promoted by its widescale utilization for electrical power and heat generation at electric power stations. At the same time as the discovery and planned preparation for the mastery of industrial resources of oil and natural gas, there occurred a restructuring of the energy consumption structure because of the increase in motorization and an improvement in the fuel utilization efficiency in transportation and industrial technologies. A new stage of deep restructuring of the fuel balance started in the 1950's in the direction of a rapid rise in the production and consumption of oil and gas fuel, the specific share of which increased from 35 percent in 1960 up to 68 percent in 1979. The specific share of oil and gas in the boiler and furnace fuel balance at TETs's as well as in boiler plants and industrial technologies increased. The utilization of petroleum products in transportation had a considerable impact because of its changeover to diesel and electric locomotives.

Along with this, the increase in the fraction of oil and gas fuel was not accompanied, as in capitalist nations, by a reduction in coal extraction. In 1978, coal extraction increased by 42 percent as compared to 1960, while open pit mining increased by a factor of 2.5. This was one of the factors which balanced out the entire nation's fuel and energy complex.

At the present time, our nation possesses a large capacity, well developed fuel and power complex. Almost one-fifth of the world's production of fuel and energy resources is its share. The Soviet Union is the only large industrially developed nation which is completely provided with its own fuel and energy resources. The USSR maintains leadership in the volume of coal mined and centralized power generation; it occupies first place in the world in oil extraction, including gas condensate (603 million tons in 1980) and second place in terms of natural gas extraction (435 billion cubic meters) and electrical power generation.

The installed capacity of USSR electric power stations amounted to 270 million KW in 1980. The Soviet Union occupies first place in the world in a number of technological areas: the concentration of capacity in thermal and hydroelectric power stations, the development of district heating, the rates of growth in nuclear power engineering, the level of the voltages used for high voltage electric power transmission lines and the capacities of integrated power grids (the highest form of which is the unified power system of the USSR).

Table 1. Electrical Power Engineering Development Indicators as Compared to Indicators for National Economic Growth and the Fuel-Power Complex of the USSR (1940 = 100)

	1960	1970	1975	1979
Growth Indices:				
Electrical power engineering*	678	1,848	2,600	3,200
Electrical power output**	608	1,524	2,137	2,549
Fuel industry*	353	636	846	960
Fuel extraction**	291	513	660	777
National income	435	867	1,142	1,362
Gross industrial production	521	1,183	1,694	2,033
Labor productivity in industry	296	492	657	749
Electric power to worker ratio in industry	300	520	660	730
Power to worker ratio in industry	230	500	630	700

* In terms of the total output cost

** In terms of the real physical indicators (fuel in tons of conventional fuel).

Thus, electrical power output increased by a factor of 32 times from 1940 to 1979 while the product output of the fuel sectors increased by 9.6 times and the volume of industrial production by a factor of 20. In this case, the national income increased by a factor of 13.6. There was a rise of 0.77 percent in the fuel resources and a 1.3 percent increase in electrical power output per one percent of rise in the national income. The advanced growth of electrical power engineering made it possible to significantly expand the scales of electrification of the national economy. The demand for electrical power, figured on a per capita basis, approached 5,000 KWH as compared to 2,200 KWH in 1965. About 12 KW of electric motor, instrument and equipment capacities went for each worker in industry, something which is equivalent to a 200-fold increase in the manpower of a worker. Electrical power consumption in agriculture increased in 1979 by a factor of five as compared to 1965, and reached 102 billion KWH. The length of electrified railroads increased in 1979 by a factor of 1.7 relative to 1965 and amounted to 42,400 km, while the specific share of electrified railroads in the overall cargo turnover of rail transport increased over this period from 39.5 to 53.6 percent respectively.

The upcoming period will be characterized by a substantial change in the tasks and the approaches to the development of electrification of the USSR. Its interrelationship with the fuel and power complex and other sectors of the national economy is becoming more complicated and is also being strengthened. The further development of electrification is closely tied to the tasks of increasing production efficiency, a growth in labor productivity, an improvement in product quality as well as savings in material resources, especially fuels. Its development will be governed to a significant extent by the new conditions for the nation's energy supply and shifts in the fuel and power complex.

The concept of USSR economic growth is based on the requirements of the major economic law of socialism and takes into account a continuous increase in personal and public demands, and the necessity of maintaining stable rates of growth in

Table 2. Indicators for the Electrification of the National Economy

	Measurement Units	1965	1970	1975	1978	1979
Electrical power generated in the USSR	Billions of KWH	507	741	1,039	1,202	1,238
Electrical power consumption in industry	Billions of KWH	349	488	657	737	751
Electric power to worker ratio in industry	Percent	100	127	161	173	178
Electrical power consumption in agriculture (for production)	Billions of KWH	12.4	25.6	53.9	71.0	76.5
The same, per 1 hectare of plowed land	KWH	55	114	240	314	335
Electric power to worker ratio in agriculture	Thousands of KWH per worker	0.4	0.8	1.7	2.4	2.5
Electrical power consumption in transportation	Billions of KWH	37.1	54.4	74.2	92.6	96.2
Length of the electrified railroads	Thousands of km	24.9	33.9	38.9	41	42.4
In percent, referenced to the overall length of the railroads	%	19	25	28	29	30
Fraction of cargo turnover handled by electric locomotives as a percentage of total cargo turnover of railroad transport	%	39.5	48.7	51.7	53.6	53.6
Electrical power consumption in households and the services sector	Billions of KWH	59.3	94	138.9	166.2	173.3
Specific electrical power consumption in households and the services sector	KWH per resident	255	390	550	640	660

national production. Along with this, the further expansion of the nation's economy will take place under conditions of reduced increases in labor resources, increasing costs for traditional sources of energy and raw materials and limitations of an environmental protection nature. For this reason, it is essential to provide for a transition to a resource sparing approach to the development of the national economy and to master fundamentally new efficient technologies for the production of material goods and services.

One of the objective conditions for stepping up production is the refinement of the structure of the energy carriers being used. The fraction of electrical power as an energy vehicle possessing the best consumer qualities and which meets the new technical and economic requirements should be increased.

The product output of the fuel and power complex, and especially electrical power engineering, is being increasingly directed towards satisfying social needs. It serves for the creation of the optimum conditions for production, improving work conditions as well as lifestyle comfort, and for a growth in the standard of living of the workers. The requirements placed on the "cleanness" of the energy carriers, the methods and sources for the derivation of energy and their correspondence to the tasks of environmental and public health protection are increasing. The development of the fuel and power complex, and electrification is acquiring a multipurpose character, while its results are being increasingly evaluated based on economic and social criteria.

Under modern conditions, the significance of electrification is being strengthened substantially. L.I. Brezhnev pointed out in his address to power engineering workers, machine builders and workers in the fuel sector in the Soviet Union on the occasion of the 60th anniversary of the day of approval of the GOELRO plan that just as before, the pre-eminent role in the resolution of the greatest economic, social and political problems belongs to electrification. The most economical sources of primary energy in the future can be incorporated in the national economic turnover by means of electrification: nuclear fuel, low grade coal, and in the future - solar and thermonuclear energy. The "raw materials" base for electrification is being expanded at the same time. Thus, the efficacy of the principles of the GOELRO plan is being revealed in all its completeness.

It will become technically possible in the near future with the mastery of new electrical technologies to replace about 40 percent of the fuel used directly in the national economy and about 70 percent of the steam and hot water with electric power. The extent of the practical realization of this substitution depends on the economic indicators and the social efficiency of electric power utilization. The continuous rise in the cost of replacing the work force, the increase in the cost of raw materials and high grade fuel are responsible for the increasing importance of electrification, since it is transformed into the most resource sparing component which is capable of saving manpower, materials and fuel, and at times even capital investments. The implementation of the great creative program of the party set forth in the "Main Trends for USSR Economic and Social Development during 1981-1985 and the Period up to 1990" adopted by the 26th CPSU Congress is inseparably tied to the further development of electrification and its material base: electrical power engineering.

A priority task for electrification is the resolution of the task set in the "Main Trends" of mechanizing labor intensive processes, primarily those involving heavy manual labor. The electrification of loading-unloading, transportation and repair work provides a savings of 100 to 1,000 man-hours of manpower figured per 1,000 KWH. Electrical mechanization within economically justified limits for manual, heavy and labor intensive work in industry, agriculture, construction and transportation would be able to provide right now for the conditional freeing of about 12 million workers with an annual wage fund of 20 to 25 billion rubles. Annual expenditures for

electrical mechanization would amount to 12 to 14 billion rubles, while the additional electrical power consumption would amount to a total of 30 to 40 billion KWH annually. The savings in labor expenditures, figured only with respect to the wage fund for the conditionally freed workers, would be equal to 6 to 11 billion rubles annually.

Electrification promotes the efficient concentration and generalization of production. The productivity of many kinds of equipment (electrical steel making, blast and cement furnaces, ammonia synthesis plants, metal rolling machine tools, etc.) has increased by a factor of 2 to 2.5 over the last 10 to 15 years. In 1975, more than 52 percent of all product output was from large and the very largest plants and factories, which comprise only 4.2 percent of the overall number of USSR industrial enterprises. The labor productivity in this group was higher than for the industry average by a factor of 1.6 times, the electrical power to worker ratio was 1.84 times higher, while the electrical equipment capital to labor ratio was higher by a factor of 1.26. The remaining 95.8 percent of the enterprises are characterized by lower indicators as compared to the industrial average. Consequently, it is specifically the large, most electrically outfitted enterprises which in the final analysis shape the economic indicators for industry as a whole.

Table 3. Material and Electric Power Input Requirement Indicators for Machine Building

	1960	1970	1975	1980	Growth Factor
Product output in 1975 prices (in billions of rubles)	27.7	86.6	121.2	178.5	6.44
Metal consumption (in millions of tons)	28.0	57.0	72.7	78.3	2.80
Electrical power consumption (in billions of KWH)	31.45	65.6	90.3	108.6	3.45
Material consumption relative to product output (in kg/ruble)	1.011	0.658	0.6	0.439	0.43
Electric power consumption per unit of metal (in KWH/ton)	1.123	1.15	1.242	1.387	1.24
Electric power consumption relative to product output (in KWH/ruble)	1.133	0.757	0.745	0.608	0.54

The problem of boosting the output of progressive structural materials, the derivation of which is based on electrolytic and electrothermal processes, is also being solved based on the widescale use of electric power. This includes aluminum, the melt output of which is planned to be increased in the 11th Five-Year Plan by 15 to 20 percent, as well as titanium, magnesium, nickel and steel made in electric furnaces, the production of which should increase by 60 percent in 1981-1985, and others.

The value of electrification in reducing the material input requirements of production is determined by the capability of electrical technologies of providing for a

greater yield of product from the same quantity of raw material, as well as less stringent selectivity in terms of the quality of the raw materials as compared to alternative technologies. Only on the basis of electrical technologies can wastes (in particular, ferrous metal scrap), spent material and other low grade raw materials be efficiently utilized and all of the valuable by-product components of a complex raw material be more completely utilized. By virtue of the fact that the cost of objects of labor continually increases during their processing, the application of electrical technologies is especially effective in the final stages of production. Since the processing of materials entails energy use, the indicators for the energy and electric power input requirements of production depend to a large extent on its material input requirements. The dynamics of the electric power input requirements as a whole for industry and its sectors manifest as the result of two opposing trends: a reduction in the material input requirements (in physical terms) and a growth in the electric power consumption per unit of material. This can be seen in the example of machine building.

While the electric power consumption per unit of materials used in machine building increased by 24 percent over the period from 1961 to 1980, the material input requirements fell off by a factor of almost 2.5, as a result of which, the electric power to product output ratio was cut almost in half. Thus, a reduction in the materials input requirement is one of the most important factors in saving fuel and energy resources. The major directions planned for the 11th Five-Year Plan involve the further advanced growth in electric power generation. Its annual output will grow by 20 to 24 percent and reach 1,550 to 1,600 billion KWH in 1985 as compared to an 18 to 20 percent growth in national income and an 18 percent growth in the production of fuel and energy resources.

An important role belongs to electrification in carrying out the tasks of industrialization and increasing the efficiency in USSR agricultural production, in the realization of the food program proposed by the party. An increase in the electric power to worker ratio in agricultural production by a factor of 1.4 to 1.5 was planned by the 26th CPSU Congress. The use of electric power for irrigation and providing other water to land, the creation of a microclimate in animal husbandry facilities and refrigeration operations will be increased. The significance of electrification in improving the living conditions of the people will rise. Special environmental protection electrical technologies are being designed, because of which, electric power consumption in industry may rise to 15 to 20 percent.

The increase in the role of electrification is likewise conditioned by the substantial change in the energy supply conditions for the national economy in the long term. The production of high grade fuel, primarily petroleum, is becoming more expensive. This is related to the gradual exhaustion of petroleum and gas resources in the European area of the USSR and the further shifting of the major extraction centers to the northern regions of Siberia. The fraction of investments going to replace out-of-service capacities of the overall capital investments in the fuel and power complex is increasing. The distances of oil and gas transportation as well as the amount of fuel and energy incoming to the European area of the USSR and the Urals are also increasing. As a result of the combined effect of these factors, the cost of high grade fuel in the major regions of its utilization is rising substantially.

With the rise in the cost of work force replacement and the degradation of mining geology conditions, the production of mined, and especially coking coal is likewise becoming more expensive. The capital to output product ratio for the fuel and power complex, as well as electrical power engineering, will increase by 15 to 20%, while in individual sectors, even more because of the strengthening of the ecological requirements and the implementation of environmental protection measures. In the new energy situation and with the increase in the requirements placed on the scales for the utilization of fuel and energy resources to provide a reliable and economical energy supply for the national economy, it is necessary to solve two mutually complementary problems:

1. Accomplish large structural shifts in the development of the energy sector, which are directed towards the realization of a new developmental strategy for the fuel and power complex, which is an alternative (primarily for stationary power generation) to the widescale utilization of traditional expensive, especially high quality energy sources;

2. The implementation of an effective energy saving policy, which provides for a substantial reduction in the energy input requirements of the national economy.

The major shifts in the fuel and power complex structure are due to the following: the advanced development of nuclear power engineering with its gradual transformation into the leading component of the entire energy sector of the nation, and primarily, for electric power generation; the accelerated growth of coal extraction through open pit mining in the eastern regions of the nation (the development of the Ekibastuz, Kuznetsk and Kansko-Achinsk basins) as well as the mastery of the water power of the rivers of these regions; the efficient utilization of high grade fuel. In this case, gas extraction should be increased, something which promotes a reduction in oil and petroleum product consumption, primarily as a boiler and furnace fuel; the gradual mastery of new sources and new methods of energy production, primarily geothermal, solar power and thermonuclear fusion.

There are favorable natural prerequisites and the necessary production conditions exist in our nation for the execution of these large shifts: various types of nuclear reactors have been mastered, a powerful machine building base has been created for the development of nuclear power engineering, unique resources of inexpensive coal have been prepared for exploitation, which are capable of being extracted by open pit mining and scientific and technical research has been carried out for new sources and methods of obtaining energy. An important positive factor is the favorable structure of the fuel and energy resources of the USSR, which makes it possible to provide for their most efficient combination at each stage of the development of the fuel and power complex. Thus, the accelerated utilization of natural gas in the 11th Five-Year Plan will make it possible to universally prepare for a further widescale development of the coal industry. By 1985, gas extraction will grow to 600 - 640 billion cubic meters, i.e. by 38 to 47 percent as compared to 1980, while the fraction of gas in the overall production of energy resources in the nation will grow from 25 to 30 percent.

The rate of growth of power consumption relative to the rates of growth in the national income have increased significantly in recent years. During 1971 - 1979, the growth in fuel and power consumption per one percent increase in the national income also amounted to about one percent. Moreover, it is technically possible and

economically necessary to reduce the energy input requirements of the national income so that the ratio of the rates of growth in the consumption of fuel and energy resources to the rates of growth of the national income does not exceed 0.7 to 0.8. A gradual reduction in the coefficient of elasticity down to a value of 0.8 would provide for a savings in fuel and energy resources by the end of the 20th Century equal to about 20 percent of the entire annual fuel and power consumption in the nation over 20 years (depending on the ranges of the rates of increase in the national income).

An important factor in reducing the energy input requirements of national production, besides curtailing its material input requirements, is a series of structural shifts which occur in industrial production and which act to increase the fraction of sectors having an energy input requirement below the average for industry. A constant condition for saving energy is the efficient distribution of primary energy resources and finite energy carriers with respect to trends in their utilization and their consumers, so that each of the kinds of energy delivers the maximum effect. In evaluating the role of various measures in reducing the energy input requirement, it must be kept in mind that two-thirds of all energy losses, which now comprise 60 percent of its primary production, occur in the area of energy carrier consumption.

Energy savings in the consumption sector is conditioned by the increase in the efficiency of fuel and energy resources, which can be realized through the application of goal directed measures related to the modernization and the improving of the operational conditions for energy intensive equipment (for example, strengthening accounting and control for power consumption, especially for steam, hot water and petroleum products; refining structural design parameters of existing equipment and that being placed in production, as well as increasing its load; the utilization of secondary energy resources). Along with this, a fundamental specific feature of the future development of the fuel and power complex is the fact that the possibilities for increasing the efficiency of fuel and energy resources in traditional user technologies are being relatively reduced. For this reason, a major direction for the changeover of the economy to an energy saving type of development is a reduction in the useful expenditure of energy based on a change in the structure of the technologies, including a change through the creation of new non-energy-intensive kinds of equipment (the creation of new technologies using the heat of exothermal reactions in the chemical industry, something which will make it possible to curtail energy expenditures for the production of such mass products as ammonia, methanol, etc. by a factor of 5 to 10); strengthening the thermal insulation of industrial and civilian buildings will make it possible to provide a heat savings for heating of no less than 25 to 30 percent.

It is specifically in the area of technological structural measures to save energy that the role of electrification is especially great. In this regard, one can cite the application of new industrial technologies of the laser metal and rock cutting type; the electric spark treatment of soil in agriculture, which simultaneously provides for the synthesis of nitrogen compounds in a soil layer; the application of heat pumps to obtain low temperature heat; the utilization of "electrical delivery devices" in central heating systems, which make it possible by means of flexible individual control of the temperature by the users to provide for a savings of no less than 25 to 30 percent of the heat used for heating buildings. In this case, the electric power consumption does not exceed 10 to 15 percent of the total annual consumption of all energy carriers for heating residential buildings.

Electrification is an important factor in the qualitative refinement of the structure of useable energy resources through the substitution of electrical power for gas and especially oil, as well as for the thermal energy derived from them. A prerequisite for this is the further differentiation of economic estimates: their increase for high grade fuel with the relative stabilization of the final outlays for electric power generated at AES's and thermal electric power stations using coals from open pit mining. In many cases, the substitution of electric power for petroleum products and gas does not lead to a general overexpenditure of primary fuel and energy resources, since the difference between the high efficiency of the electric power consuming equipment and the efficiency of equipment operating on other energy carriers makes it possible to compensate for fuel losses in its conversion to electric power.

The overall volume of the possible replacement of high grade fuel at the present stage already amounts to no less than 40 million tons of conventional fuel, for which about 100 to 105 billion KWH is needed. The impact of this substitution, according to our estimate, is one billion rubles annually with respect to the lumped outlays.

The further accelerated development of electrification in the 11th and 12th Five-Year Plans will be an important and objectively essential condition which assures the execution of all of the key tasks of economic growth. In line with this, the resolution of the tasks confronting the area of electrification depends in many respects on the refinement of the structure and territorial organization of electric power generation and its orientation towards an intense path of development. An extremely important direction for the structural realignment is the transformation of nuclear power engineering, which generates electric power and heat, into the leading component of the energy sector for the regions of the European area of the USSR, where in this regard, the construction of new base load condensation electric power stations using organic fuel should be terminated. As early as 1985, the electric power generated at nuclear electric power stations will increase up to 220 to 225 billion KWH, i.e., will more than triple as compared to 1980, while the generation of hydroelectric power will increase up to 230 to 235 billion KWH. From two-thirds to three-fourths of the entire annual increase in electric power output will be obtained by virtue of these two sources in the 11th and 12th Five-Year Plans. At the same time, it is necessary to exclude fuel oil from the fuel balance of existing power stations and replace it with natural gas.

One of the major tasks in optimizing the structure of power systems in the European region is providing for their flexibility, for which, it is necessary to develop both special peak and semi-peak load electric power stations, as well as increase the control range of the base load electric power stations (KES's, AES's and TETs's).

The development of power engineering in the regions of Siberia will in the future also be based on high capacity thermal (coal) and hydroelectric power stations. The accelerated exploitation of the Ekibastuz coal basin and placing the first stage of the extremely large Berezovskiy cut No. 1 in service in the Kansko-Achinsk basin are planned for the 11th Five-Year Plan. The construction of the Ekibastuz GRES's will be continued. The further development of the large power industry complexes - the Ekibastuz, Kuznetsk, Kansko-Achinsk, Angaro-Yenisey - is an extremely important factor in the shift of the extraction and production of primary energy resources to the nation's eastern regions. The concentration of a

decisive portion of the nation's energy resources here at a cost of five to six times less than in the European region makes it inexpedient to develop nuclear power engineering in Siberia. The scales for the development of AES's are governed by the comparative economic indicators of nuclear electric power stations where they operate in a definite (base load) portion of the the load graph, and consequently, by the size of this zone. Moreover, all of the types of necessary energy carriers are not exhausted with electrical power and low temperature heat, in the form of which nuclear energy can be delivered in the future to the power supply systems. For this reason, along with the forced development of nuclear power engineering, the regions of the European area and the Urals will be in need of an increasing input of energy resources from the eastern regions of the nation. It will likewise be necessary to provide for export deliveries of hydrocarbon fuel. All of this conditions the necessity of developing "east to west" transportation systems based on an optimal combination of various types of transport (railroads, pipelines, high voltage electric power AC and DC transmission lines). Ultrahigh voltage electric power transmission lines - 1,150 KV alternating current and 1,500 to 2,200 KV direct current - will supplement the existing types of electrical links in the nation's Unified Power System, bringing a significant savings of electrical power and promoting an improvement in the reliability and efficiency of the entire energy sector.

The reconstruction and disassembly of obsolete equipment should be important factors in the intensification of power generation and the growth in the efficiency of the energy supply. The refinement of the price setting system, which is called upon to reflect the objective processes of increasing cost of energy resources will stimulate the renewal of equipment. A priority task up until the end of the current century is the development within the requisite timeframes and on the necessary scales of the scientific, planning and trial industrial and production developmental work in power engineering in related fields, which provide for a planned transition to a more distant stage in power engineering development. It is now difficult to design a model for the power engineering of the future which is reliable as regards structure and economic parameters. However, it can be presupposed with a high level of probability that these parameters will be governed by the mass utilization of the energy of fast neutrons, thermonuclear fusion as well as solar and geothermal energy. As L.I. Brezhnev noted at the 26th CPSU Congress: ". . . Life requires the continuation of the search for fundamentally new energy sources, including the creation of the bases for thermonuclear energy." The close tie between electrical power and the techniques for mastering these new energy sources makes it possible to anticipate a further increase in its role among the other forms of converted energy.

8225
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FUELS

CAPITAL CONSTRUCTION OF PETROLEUM INDUSTRY STRUCTURES DISCUSSED

Moscow NEFTYANAYA PROMYSHLENNOST' SERIYA "NEFTEPROMYSLOVOYE STROITEL'STVO" in Russian No 1, 1981 pp 2-6

[Article by Sh. S. Dongaryan, in the Ministry of the Petroleum Industry: "Capital Construction of Petroleum Industry Structures"]

[Text] During the 10th Five-Year Plan the development of the petroleum industry was characterized by high rates of growth in the volumes of petroleum that were extracted which was achieved principally by means of the forced development of petroleum deposits in Western Siberia and an increase in the volumes of capital investments and construction and installation work that were directed toward developing deposits, constructing, reconstructing and technologically reoutfitting enterprises and installations for transporting petroleum and preparing and processing natural gas byproducts, and enterprises for repairing and manufacturing equipment for drilling and extracting petroleum.

In 1980 the volume of capital investments and construction and installation work increased by a factor of 1.6 in comparison with 1976. It became possible to achieve the limits that were set for extracting petroleum and to execute the required volumes of capital investments and construction and installation work as a result of realizing the program for further improving the technology of extracting petroleum and extensively introducing industrialized methods of construction.

The principal trend in the area of industrializing the construction of petroleum industry structures is the completely equipped modular section construction (BKS) method. The use of the advanced method has made it possible to create new technological, spatial planning and structural approaches for the complex of structures at an installation in the form of transportable modular sections having a large unified mass and a high level of automation and factory preparedness that provide a reduction in fuel and energy consumption by 15 to 20 percent, material consumption by 20 to 30 percent and labor resources by a factor of 2 to 2.5, and provide an improvement in the system of designing, manufacturing, delivering equipment, and construction. The concentration of capital investments and material and technological resources and the completely equipped nature of the modular section equipment delivered by the plant has made it possible to significantly reduce the duration of construction and the timeframes for starting up and developing new capacities.

During 1976 to 1980 the production of 17 new types of modular section automated equipment (BAO) was mastered. Approximately 10,000 complete sets of BAO were turned out for the sum of more than 500 million rubles. The first completely equipped modular section installations with a weight of up to 200 tons were made in our country having been given the name super modular sections.

In 1980 almost 4 times as many completely equipped modular section installations were manufactured in comparison with the first year of the 10th Five-Year Plan while the number of workers per 1 million rubles of construction and installation work (SMR) decreased almost by half.

Work was done to create, produce and construct pumping stations for mainline transportation structures using modular section boxes for auxiliary purposes by member-countries of SEV [Council for Mutual Economic Aid] in collaboration with the Ministry of Construction of Petroleum and Gas Industry Enterprises.

Highly productive methods of laying mainline and industrial pipelines have been adopted on the basis of primarily using contact welding, thin layers of casings, basic technology for welding pipe runners and automated methods of controlling the pipelines that are built and by using motor vehicle transportation that is able to pass through areas with more difficult terrain which makes it possible to convey individual pipes and pipe sections to the line.

The adoption of complete sets of prefabricated structural building components and also structural components with lighter weight shapes and inflated casings has been accomplished. During the 10th Five-Year Plan one million square meters of buildings from lighter weight structural components were built. This provided a reduction in the estimated cost of building such structures by 11 to 12 percent.

Modern technological means were used for transporting and assembling structural building components and equipment. Approximately 100 types of new machines and mechanisms were developed which make it possible to increase labor productivity by 15 percent. The use of standardized sets of devices and small size means of mechanization aided in increasing the labor productivity of construction workers by 20 to 40 percent. The technological outfitting of design organizations was done by means of introducing new technology (the EVM [electronic computer], curve plotters and others) within the framework of the SAPR [automated planning system]. The use of computer technology increased the quality of designs for laying out petroleum industry structures and roads, and reduced design time. As a result of carrying out all of these programs higher technological and economic indices were obtained for capital construction. The relative proportion of SMR that was done directly at the construction site in 1980 decreased in comparison with 1976. The level of incomplete construction was reduced. At the end of 1975 the volume of incomplete construction comprised 72 percent of the yearly amount of capital investments while 57 percent was projected at the end of 1980.

Together with this the pace for adopting BKS does not correspond to the growth in capital investments. The relative proportion of the cost of BKNS [expansion unknown] decreased by 5.7 percent for the five-year plan. This was brought about by a lag in the production of modular section equipment relative to sector demand.

Up to the present time the output of auxiliary equipment, inter-modular section and intersite connections in modular section form has not been developed to a full degree in production; the completely equipped delivery of petroleum industry structures to the construction site has not been realized.

The growth in the volumes of capital construction during the 11th Five-Year Plan will require faster rates of construction, an improvement in its efficiency, and an orientation toward the end results for the national economy. The solution to these complicated and crucial problems is related most of all to an improvement in the level of management of the capital construction system that will provide an increase in construction efficiency by means of adopting the achievements of scientific and technological progress and by reducing unproductive losses in designing and construction production.

1. In the field of improving organizational management, work is scheduled to be done in two main directions.

The creation of an optimum management system over all participants in the processes of designing-manufacturing-construction for orienting them toward unified sector results on the basis of eliminating disagreements in the standard legal basis of making decisions. For this aim the principles of Special Purpose Program SKS: XI-XII "Improving Management of the System of Capital Construction for the Petroleum Industry during the 11th and 12th Five-Year Plans" were worked out, the realization of which will make it possible to eliminate unproductive losses of time and resources that arise as a result of a lack of coordination of the activities of the participants that are in various organizational systems. An organizational basis is being formed for realizing this program and documents have been prepared for publication with the criteria and legal basis for Special Purpose Program SKS: XI-XII.

Improving the management of one's own construction organizations. The second direction is closely connected with the first (The Special Purpose Program) and it achieved the greatest development during the experimental perfecting of the "Tatneft'" Association's management of its own construction organizations.

At the present time on the basis of interim results a program for further developing one's own construction organizations and improving management is being worked out in the Ministry of the Petroleum Industry.

In the area of adopting the achievements of scientific and technological progress a "Plan for the Technological Development of Petroleum Industry Construction," which has been worked out by the Ministry of the Petroleum Industry is expected to be realized as well as appropriate programs for mainline transportation, gas processing and other production subsectors. The aim of these programs is to create conditions which will ensure high technological and economic indices for constructing and utilizing structures while accelerating the start up of their operations and increasing labor productivity in construction by a factor of 2 to 2.5. For this, more perfect combined spatial planning and structural approaches to the structures are required which will make it possible to form transportable modular section installations with a single large mass and a high level of automation and factory preparedness. It is necessary to perfect the systems of designing, manufacturing and construction (including

the planning and management by these workers) in order to ensure the completeness of the deliveries of complexes for developing petroleum deposits and also the standard legal basis for realizing the programs for developing scientific and technological progress in construction and for creating a legal basis for the completely equipped modular section construction method.

The plan specifies the formation of industrial production as well: in making completely equipped modular section structures for collecting and transporting products from petroleum boring holes; central points for collecting and preparing petroleum, gas and water; for maintaining pressure in the strata and the industrial water supply; for increasing the petroleum yield from the strata; for exploiting boring holes by an air lift method; for destroying and utilizing the residue that is extracted when treating the strata's waste water. These tasks are being done on a unified methodical basis which encompasses working out standardized technological schemes for structures and complexes; determining the quantitative level of the capacities of the structures and the parametric level of the modular section equipment; working out standardized combined approaches to structures and organizing the working out of deficiencies and the modernization of existing equipment and its industrial manufacturing. Developing completely equipped modular section technological structures will be done on the basis of standardizing the different types of equipment which will make it possible to improve the serial nature of production and significantly increase the volumes of equipment being manufactured by existing production capacities;

buildings and structures for secondary and auxiliary, administrative and management services, shelters for modular section equipment and technological installations and also watch and operation settlements. The formation of new efficient materials and industrialized structural components for buildings plays an important role in this direction. It is suggested that a new system of complete deliveries be formed having in mind the transfer of the functions for completing the equipment to the enterprises that do the prefabrication work and complete equipping and the organization of deliveries of structures and complexes with all the basic and auxiliary equipment including intermodular section and intersite utility lines.

With the aim of providing construction sites with the required types of products and amount of completely equipped modular section installations it is specified that production capacities for turning out equipment be created. When this is done much attention will be given to improving the technological processes for producing equipment and the specialization of the plant-manufacturers.

Considering the fact that the existing capacities of the construction industry's bases are insufficient and also their increasing role in the completely equipped modular section method of construction, comprehensive work is specified by the plan which is aimed at creating and efficiently placing completely equipped modular section production bases for manufacturing large size modular sections. The creation of a new structure and forms for construction organizations and new forms for evaluating their activity will be an important moment in the perfection of the construction industry which is extremely necessary under conditions of adopting the completely equipped and operations-watch method of construction on a mass scale.

Comprehensive work is specified to be done to create methods and technological means for transporting and building structures utilizing completely equipped modular sections. It is necessary to enlist the aid of the organizations of the Ministry of Construction of Petroleum and Gas Industry Enterprises, the Ministry of the Automotive Industry, the Ministry of Construction, Road and Municipal Machine Building, the Ministry of the Aviation Industry and the Ministry of the Shipbuilding Industry to resolve this work.

The plan specifies that methods for evaluating and planning the level and economic effectiveness of the completely equipped modular section method of building structures for developing petroleum deposits be improved. This work will make it possible to determine the optimum level of industrialization for construction, its effect on the technological and economic indices of structures for developing petroleum deposits and regulate problems with pricing completely equipped modular section equipment.

3. An important role in improving capital construction is attributable to technological unification and standardization--the primary links in the system of controlling the technological level and quality in design and construction. At the present time a number of standard technical documents have been worked out that are aimed at improving the quality of design and construction, reducing fuel, energy and material consumption, reducing construction time and developing new capacities. Further improvement in the standard technical documents specifies:

creating a system of standard technical documents encompassing the entire investment process from discovery of the deposit and verification of the reserves to the development of the design capacities;

eliminating existing functional excesses in the standard technical documents that are related to the adoption of the completely equipped modular section method of construct

eliminating existing discrepancies in the standard technical documents;

creating new standard documents that take into consideration the shift of capital construction into regions with difficult natural and climatic conditions and also the development of deposits of petroleum with high levels of viscosity and petroleum containing hydrogen sulfide.

The efforts of all participants in creating and utilizing petroleum industry structures must be directed toward a solution to this direction of work.

4. In the area of further improving the Ministry of the Petroleum Industry's design complex an improvement in planning design and research work is specified as well as in the organization and technology of the design process, the perfection of methods of managing planning and estimate affairs, and the adoption of an overall system of controlling the quality of design and research work. Toward this goal the Ministry of the Petroleum Industry has completed a transfer to a new system of designing (TEO [expansion unknown]--working drawings), and development of phase one of an SAPR for petroleum is being completed, etc. The planned work will make it possible to increase the technological and economical level of the design approaches while improving quality and reducing the time for working out designs.

Large and complicated problems have to be solved for developing the petroleum industry in Western Siberia.

Starting to develop a large number of distant deposits requires unprecedented construction for it, main highways to them and structures for supplying power which must eliminate the seasonal nature of the work of boring and construction organizations and significantly increase the efficiency of their work. This will also make it possible to gradually reduce the projected volumes of material and equipment supplies that change hands.

Together with the construction of main highways in Western Siberia it is necessary to complete construction of motor vehicle access routes to the groups of petroleum boreholes on an extensive scale. Since the beginning of exploiting the Western Siberia deposits such access routes have not been built since there was not sufficient capabilities for building even main highways. But relative to the fact that conditions for exploiting the boring holes are becoming more complicated (the allotment of the available mechanized equipment will comprise more than 70 percent in 1985), the lack of motor vehicle access routes to the groups of boreholes will lead to delays in repair work and consequently to considerable losses of petroleum extracted.

With the aim of eliminating the loss of light grades of petroleum the construction of petroleum settling installations is projected for the forthcoming five-year plan along with the construction of gas processing plants in Western Siberia for utilizing natural gas. This will make it possible to significantly increase the production of a wide range of grades of hydrocarbons and at the same time meet the needs of the petrochemical industry for this valuable raw material. It is necessary to build a system of product pipelines from Western Siberia to Uralo-Povolzh'e for transporting the broad range of grades of hydrocarbons.

Completing such large volumes of work for developing the petroleum industry is possible under conditions where the extremely important program for non-production construction is implemented.

The difficulty in accomplishing this goal is contained not only in the fact of the absolutely large volumes but also in the fact that a large portion of this construction must be done in new cities and settlements. Construction organizations in many republics and oblasts have been enlisted in order to complete the programs for building housing and structures for cultural and everyday purposes in Western Siberia.

Completing such large tasks requires searches for new methods, chiefly organizational. It is desirable to implement the following measures.

1. The decisive factor in expanding the volumes of construction is the formation of a suitable base for construction. At the same time the formation of this base requires that huge material and personnel resources be directed toward its construction which will inflict considerable harm to the construction of petroleum industry structures. On the other hand it is necessary to build a large amount of housing, cultural and everyday structures both for the construction workers of this base and the operating personnel which will also have a harmful effect on providing the workers who are doing the primary operations with housing and everyday conditions.

In this regard it seems expedient to form reinforced concrete and metal structural components plants, large panel housing construction plants, sanitation and pipe billet plants, and plants that do capital repair work on machines, mechanisms and means of transportation within the rayons of Western Siberia where there is petroleum construction. This is expedient even though all of the building materials, raw materials and rolled metal are transported to the northern part of Tyumenskaya oblast from other rayons of the country.

In order to accelerate the realization of this program it would have been expedient to transfer the KPD [Large Panel Housing Construction], reinforced concrete, and metal structural components plants and gravel strip mining operations that are already in operation in other rayons of the country to the construction organizations in the Western Siberia petroleum and gas complex.

2. The organizations of the USSR Ministry of Installation and Special Construction Work as a subcontractor of the Ministry of Construction of Petroleum and Gas Industry Enterprises could have made a large contribution toward forming capacities for the Western Siberia petroleum industry. At the present time the USSR Ministry of Installation and Special Construction Work is participating only in the installation of gas processing plants, gas lifting compressor stations and storage tanks at the main petroleum transferring stations on the main petroleum pipelines.

In order to accelerate the construction of petroleum industry structures in Western Siberia it is expedient to charge the USSR Ministry of Installation and Special Construction Work with executing installation work at all structures.

3. In the interests of the work the fact that the organizational structure of gas extracting enterprises in Western Siberia was changed requires that the organizational structure of construction organizations in the Ministry of Construction of Petroleum and Gas Industry Enterprises also be changed:

to form construction associations in Nizhnevartovsk, Surgut, Nefteyugansk on the basis of general construction and pipe trusts;

to form construction trusts affiliated with new petroleum extracting administrations;

to reserve construction of only structures for the petroleum industry (excluding main petroleum pipelines) for the Main Tyumen Administration for Construction of Petroleum and Gas Industry Enterprises having also placed under its jurisdiction the "Tomskgazstroy" Trust;

to reserve construction of main gas and petroleum pipelines for the Main Siberia Pipeline Construction Administration;

to form a new main administration--the Main Tyumen Gas Construction Administration--for supervising construction in the gas containing areas of the north.

4. In order to build almost all industrial structures, bases near groups of boreholes and highways, and to erect cities and settlements in Western Siberia it is necessary to cover the construction site with sandy soil. The total demand for sandy soil will

exceed 100 million cubic meters annually and will increase. Almost all ministries are preparing the ground by a hydromechanical method. It would have been expedient to form a Special "Hydromechanization" Trust in the Ministry of Transport Construction to prepare sandy soil for all consumers. This will make it possible to better utilize the stock of earth probes, to better locate hydroalluvium stripping operations, to reduce transportation distances and at the same time significantly reduce demand for dump trucks for transporting soil.

9495
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GENERAL

UDC 65.015.1:622.323+622.24

NEED FOR STANDARDIZATION OF OIL-INDUSTRY ENGINEERING PROCESSES STRESSED

Moscow ORGANIZATSIYA I UPRAVLENIYE NEFTYANOY PROMYSHLENNOSTI in Russian No 4, 1981 pp 19-21

[Article by V. S. Ugolev and V. L. Chicherov: "In the Matter of Standardizing Engineering Processes in the Oil Industry"]

[Text] The importance of standardization in the economy is growing ever greater. This is explained by the considerable economic impact obtained as a result of standardization: an improvement in the quality of the workers' labor, an increase in the level of engineering and improvement in the output quality.

Standardization has been extensively introduced in the oil industry, particularly in recent years. Subjects for standardization have been: various machines, mechanisms, equipment, tools, materials, requirements for product quality indicators, terms and definitions, the system of notation for product quality indicators, methods of determining product quality indicators, engineering processes, etc.

It is necessary to dwell separately on the standardization of engineering processes. They can be divided into engineering processes during the manufacture of this or that product. In other words, they can be divided into plant and machine-construction engineering processes and into specific processes for the oil industry (such as the extraction and raw-material sectors) which are applied during the development of oil deposits, the extraction of oil, the operation of wells and their routine and major repairs.

It is these processes that play an important role in the oil industry. The overall number of engineering processes which are subject to standardization in the oil industry is extremely great. This can be explained by many factors, chief among which are the following.

1. An objectively composed situation in which the oil industry is exclusively extractive in nature and is concerned with raw materials.

The major portion of machines, mechanisms and equipment operated in the industry is designed and manufactured in organizations and at enterprises of related ministries and departments. for example, Minkhimash, Mintyazhmash, Minelektrotekhprom, Minpribor (drilling rigs, drilling pumps, deep-well borehole pumps, centrifugal pumps for flooding, immersible electric oil pumps, compressors, equipment for the

preparation, processing and cleaning of the washing fluid; drilling derricks, tackle systems, keys, hoists, cables, various electrical equipment, manometers, other instruments for monitoring and recording, etc.).

Therefore, under the given conditions, standardization of the industrial output is not a major direction for standardization in the oil industry. Such work is covered by the corresponding ministries, departments, developers and manufacturers of this product, while in this regard the oil workers are interested in developing technical specifications for these types of equipment, based on scientific and technical progress.

At the same time, one must not underestimate the role of such work in the industry and pay less attention to the standardization of the products developed and manufactured by the enterprises of Minnefteprom.

2. Engineering processes as a form of activity prevail over other forms of activity in the oil industry. One can say that the oil industry is a "production process" whose product is oil.

The activities of the majority of workers in the oil fields, in the industry's design, planning and scientific research organizations and in the management apparatus is one way or another associated with insuring that the most varied engineering processes are carried out. The ultimate goal of carrying out this whole complex of engineering processes in the development of oil deposits is the guarantee of the planned extraction of oil and the conformity of its physicochemical indicators to standards set in State Standard 9965-76 "Oil. The Degree of Preparation for Oil-Refining Enterprises. Specifications."

It should be noted that many other subjects for standardization in the oil industry, for example, the system of notations for quality indicators for special materials and reagents; values for their indicators, their methods of determination, etc., to one degree or another are likewise associated with the engineering processes in which they are employed.

Moreover, up until recently, insufficient attention had been devoted to the standardization of engineering processes in the industry. This is understandable if one considers that even in the machine-construction industries where standardization has begun its own development, the question of standardization of engineering processes in the manufacturing of products has not been worked out to a sufficient degree. Therefore, in connection with the practically total lack of experience in this area, the oil-industry workers face challenging problems with regard to the development of a methodical approach to the standardization of the engineering processes used in the industry. The creation of such methodical documents, which would establish common requirements for the standardization of engineering processes relating to the development of oil deposits, oil equipment and oil-drilling techniques, would fulfill today's urgent tasks in the oil industry.

The development and introduction of such documents in organizations and at enterprises would contribute to the more intensive conducting of work on standardizing the sector engineering processes as a major subject for standardization in the oil industry.

Thus, Minnefteprom's chief organization for standardization and the basic standardization organizations are faced with the task of coordinating work on standardizing engineering processes used in the oil industry and with the task of developing standardized technical documentation regulating this area of activity on an industry-wide scale.

Work has already begun on standardizing the engineering processes used in the oil industry. As an example, one can refer to the industry standards developed by the All-Union Oil and Gas Scientific Research Institute (VNII): OST 39-082-79 "Periodic Electrothermal Treatment of Oil-Well Boreholes. A Standard Engineering Process" and OST 39-097-79 "Cyclical Steam-Heat Treatment of Oil-Well Boreholes. A Standard Engineering Process".

These standards extend correspondingly to the technology of periodic electrothermal treatment of oil-well boreholes and to the engineering process of cyclical steam-heat treatment of oil-well boreholes. They establish the sequence for executing engineering operations and the requirements for them.

Since these two standards are the first experience for the oil industry, we should dwell in a little more detail on their particular features, considering that, by analogy, an entire group of standards can be developed in the future which will regulate the methods of increasing oil-well borehole productivity.

The standards cited contain the following sections.

The first section--"Items for Application"--establishes the parameters of oil deposits (oil viscosity and the oil's paraffin content) as an item for the application of the corresponding engineering processes. Conditions are presented under which the application of the method is advisable (the depth of occurrence of the reservoir, the degree to which the critic zone's oil permeability is reduced due to paraffin deposits, the thickness of the reservoir, the porosity of the reservoir, the reservoir pressure, water content, etc.). The conditions which must be satisfied by the oil-well borehole subject to this type of effect are controlled (productivity, minimal oil-well borehole output, content of mechanical impurities in the output, conditions with regard to the oil and casing strings, the cement stone and the level of fluid in the borehole).

The second section--"Preparation of the Borehole for Treatment"--establishes requirements for the head fittings, the oil and casing strings, the quality of the steam-drive installation, its heat insulation, the procedure for measuring the output and water content of the oil, the procedure for studying the borehole in order to determine the reservoir temperature, the productivity coefficient, the borehole fluid level, the presence and degree of oil permeability due to paraffin deposits, etc.

The third section--"Conducting Treatment"--establishes the sequence for conducting separate engineering operations making up the engineering process as a whole and the requirements for conducting engineering operations.

The fourth section--"Completing Treatment and Putting the Borehole into Operation"--establishes the sequence and the requirements for conducting final work on the borehole and putting it into operation.

The fifth section--"Methods of Monitoring"--establishes both the method and the frequency of monitoring boreholes during treatment and operation after electric and steam heating.

The sixth section--"Safety Requirements"--establishes specific requirements for the entire complex of measures that insure the safe conduction of operations in accomplishing these engineering processes.

The appendices to these standards likewise present the basic terms mentioned in the standards and their definitions. Lists of documents are presented to which references are made in the texts of the standards.

In analogy with these standards, other industry standards can be developed for standard engineering processes used in the oil industry.

As a result of the preceding, one can make the following conclusions:

1. Engineering processes associated with the development of oil deposits, the equipment and techniques of oil extraction, the drilling of boreholes, the raising of fluid to the surface, the initial preparation of the oil, that is, with the entire complex of works within the sphere of activity of the Ministry of the Oil Industry, are the most important subjects for conducting work on standardization in the oil industry.

2. It is necessary to stimulate work on the standardization of engineering processes used in the oil industry.

3. The stimulation of work on the standardization of engineering processes in the oil industry can be achieved by means of developing standardized technical documentation regulating the procedure for conducting work and the content of the work on the standardization of engineering processes and on the coordination of the activities of industry organizations and enterprises in this direction.

9512
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END