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USSR Report

ENERGY

(FOUO 12/81)

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ELECTRIC POWER

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DEVELOPMENT OF POWER ENGINEERING IN LIGHT INDUSTRY REVIEWED

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 6, Jun 81 pp 2-4

[Article by M. A. Kochetkov, V. L. Gromova and N. D. Slobodskaya, engineers at the USSR Ministry of Light Industry: "The Development of Power Engineering in Light Industry"]

[Text] In the 10th Five-Year Plan, collectives of enterprises in light industry conducted a great deal of work with regard to fulfilling the established plans for manufacturing products (including consumer goods), expanding their selection and improving their quality. In the years 1976-1980, the average growth of the basic, most energy-intensive types of production (fabric, tricot, etc.) in crude form amounted to 9.5 percent. This increase in production output was achieved due to the technical re-equipping of industry, the construction of new enterprises and the modernization of a portion of the existing enterprises as well as to an increase in labor productivity.

Of the power equipment used at enterprises in light industry, 95 percent is electrical equipment and only 5 percent is thermal and general-purpose plant equipment (steam and water-heating boilers, ventilators, compressors, etc.). However, despite such a ratio, light industry on the whole is a thermal-intensive sector, since 60 percent of the overall consumption of power resources (converted to conventional fuel) is expended in the form of thermal energy, about 32 percent is electric power and 8 percent is production-process fuel (firing and drying of porcelain, drying of raw cotton, singeing of fabrics, etc.). The most energy-intensive are the enterprises of the textile industry which consume about 60 percent of the electric power and more than 50 percent of the thermal power from the overall expenditure of power resources.

The increase in the production output, the re-equipping of enterprises and the introduction of new facilities have required an increase in the consumption of fuel and power resources as well as an expansion and modernization of the power industry.

For the 10th Five-Year Plan, the consumption of thermal power increased by 17.5 percent, electric power by 13.5 percent and fuel by 10.2 percent. The overall consumption of power resources converted to conventional fuel grew by 12.8 percent.

Below is shown the structure of the consumption of electric and thermal power in the overall consumption of power resources in the industry:

Consumption of electric power, %:	
to derive production and auxiliary equipment	78.2
including ventilation	13.8
for electrical production processes	6.2
for lighting	13.5
for other needs	2.1
Consumption of thermal power, %:	
for production needs	71.5
for ventilation and heating	27
for other needs	1.5

In the period from 1975 to 1980, the extent of electrification of labor has increased considerably: by 13.5 percent throughout the ministry as a whole, by 9 percent in the textile industry.

The enterprises' need for electric power is practically totally provided for by Minenergo's systems (internal power production comprises less than 0.2 percent) while two-thirds of the requirement for thermal power is covered using internal boiler plants.

The technical re-equipping of enterprises in light industry has been accomplished by introducing advanced technology, automated lines in place of individual machines and new types of production equipment with increased speeds and productivity; by the mechanization of labor-intensive operations as well as by the implementation of measures to improve working conditions for the laborers (improved lighting in the work areas and increased output of ventilation units).

New, higher-output production equipment has been introduced whose operation requires a lesser expenditure of labor. Basically, however, this equipment is more energy-intensive, since the requirement for reduced consumption of power resources was not considered when the equipment was built. This was a result of the insignificant share of power resources in the cost of production (1 to 2 percent). The rise in the power consumption of the equipment brought about an increase in the output of ventilation units as a result of the increased heat released into the surroundings. This has required an additional expenditure of energy. For example, the replacement of ring-spinning machines with higher-output hydraulic spinning machines in the same work area (taking into consideration the increase in ventilation-system output) brought about an increase in the consumption of electric power by a factor of 2 to 2.5. An increase in the consumption of power is also necessitated by the replacement of AT-100 automatic looms with operator-less ATPR looms.

In connection with the technical re-equipping of industry, changes have also taken place in the composition of power equipment: the number of electric motors has increased by 25 percent, while their average individual output has risen by 12 percent; the number of steam boilers has increased by 2 percent, while their average output has increased by 14 percent; the number of power transformers has risen by 25 percent, their output by 16 percent. The great increase in the number of electric motors in comparison with their average output has been dictated by the introduction of multimotor equipment (lines, etc.) with comparatively small individual outputs. On the other hand, the average output of steam boilers has increased more, since obsolete boilers have been replaced with more powerful ones.

The increase in the enterprises' power consumption has likewise brought about a rise in the standardized and actual rates of consumption of thermal and electric power per unit of raw product. The greatest influence on the growth of energy resource consumption rates has been exerted by the technical re-equipping and modernization of operating enterprises and the introduction of new power-intensive installations (as a result of great mechanization, better lighting and ventilation).

In order to insure normal operation and an increase in production output, the ministry developed in the 10th Five-Year Plan a long-range plan for raising the technical level and increasing the modernization of the enterprises' power-production facilities. Over a period of five years, 60 enterprises with shut-down low-output boiler plants have been supplied with central heat (from Minenergo TETs's); 86 boiler plants have been converted to gas; 780 boilers have been replaced with more powerful units; 321 boilers have been automated; 170 chemical water-purification installations have been put into operation; 100 enterprises have been converted to an increased electric power-supply voltage; transformer substations have been modernized at 195 enterprises.

In addition to this work being done on modernizing and renovating the power-generating units, the enterprises have yearly implemented additional measures for conserving fuel and power, among which one can name the following: improved fuel-storage conditions at depots and reduced transportation losses; an increased degree of utilization of the heat contained in exhaust gases; improved boiler hydrolycity; increased condensate recovery ratios; reduced losses of heat to the environment in boiler and fuel-burning installations; the introduction of modern, less energy-intensive production processes; the modernization and replacement of obsolete power-consuming equipment and the regulation of its operation; the renovation of heat-supply systems; the optimization of electrical installations (including lighting); the change-over of production-shop heating from steam to water and air; an improvement in the quality of repair work and equipment relubrication schedules.

During the 10th Five-Year Plan, enterprises of light industry conserved 630,000 t of conventional fuel, 9.4 million GCal of thermal power and 3.31 billion kWh of electric power.

In addition, testing has shown that, despite implementation of measures to conserve fuel and improve the condition and operation of power installations, there still exist deficiencies at enterprises which bring about inefficient consumption and losses of power resources. For example, about one-third of the steam boilers are operating without economizers; the production and release of thermal energy is not taken into consideration at 50 percent of the boiler plants; a portion of the boilers are operated without operational charts; at many enterprises there is a lack of consideration given to the consumption of power resources in the shops, which interferes with the engineers' participation in the battle to conserve energy. The recovery of condensate and the utilization of power resources is insufficient; optimum load schedules for power transformers are lacking; schedules for preventive maintenance and lubrication of the equipment are violated; many enterprises use a total lighting system which does not allow a portion of the lights to be disconnected when an equipment line is shut down.

A serious deficiency at certain enterprises is the insufficient number of power service personnel as well as the lack of personnel in the power bureau whose primary mission is the daily control over the efficient use and conservation of utilities.

At the present time, the efficient and economical consumption of fuel and power resources is acquiring ever greater significance. In connection with this, the ministry is adopting measures to eliminate deficiencies in the utilization of fuel and power and the mobilization of the enterprises' collectives in the search for reserves incorporated in the future development of industry (and in the application of energy-conserving technology and the utilization of internal power reserves).

Much systematic work on the conservation of power resources is being conducted by the Khersonskiy cotton combine whose experience in the utilization of internal power reserves through the introduction of a water reflux in the finishing industry has been disseminated (through order of the USSR Minlegprom) to other enterprises. This measure provides for a great saving of heat and water. At this same combine work has begun on the utilization of the low-potential heat of waste dye solutions. However, as a result of the high degree of contamination of the waste solutions, it is necessary to organize the production of special heat exchangers at machine-construction plants.

At the Ternopol' and Riga porcelain plants, the waste-gas heat from the firing kilns is used to dry the formed crocks.

Great attention is being devoted to questions regarding the conservation of power resources at the Orekhovo-Zuevka cotton combine, at the spinning and weaving plant imeni F. E. Dzerzhinskiy and the Krasnaya Talka textile-finishing plant in Ivanovo, at the Krengol'mskaya Manufaktura and Baltiyskaya Manufaktura combines, at the Darnitskiy silk and Minsk worsted plants and elsewhere.

The "Basic Directions for the Economic and Social Development of the USSR for the Years 1981-1985 and the Period to 1990," approved by the 26th CPSU Congress, provide for the further re-equipping of the enterprises of light industry based on the more extensive introduction of high-output machines and composite mechanized lines in various subsectors and on continuous-production processes for finishing fabric and knitwear; for the increase in the volume of production by 18 to 20 percent with particular attention being devoted to expanding the selection and improving the quality of the product.

In its long-range plan for conserving power resources for the 11th Five-Year Plan, the ministry has provided for improving the economy's position by introducing abbreviated, up-to-date production processes and new equipment: mercerizing lines with boiling treatment and an accelerated method of boiling and bleaching cottons and other fabrics; fulling and washing machines in the silk industry; lines for fulling and relaxing; bleaching and drying machines for knit linen; pressure apparatus operating at elevated steam temperatures to intensify the finishing, etc.

Great significance is attached to creating and introducing automated production-process control systems at enterprises and the introduction of automated enterprises.

The major tasks in the development of power engineering in light industry during the 11th Five-Year Plan are:

the implementation of measures that provide for a long-range plan to increase the technical level of the enterprises' power systems (the central heating of 85 enterprises with the shut-down of their small-scale internal boiler installations; the gasification of 115 boiler plants; the replacement of 870 obsolete boilers; the automation of 501 boilers; the installation of 287 economizers; the introduction of 184 chemical purification units and 150 deaerators; the transition of 223 enterprises to higher voltages; the renovation of transformer substations at 279 enterprises);

the development and introduction at enterprises of efficient systems for accounting for the consumption of utilities; the generation and output of heat energy in internal boiler rooms as well as the shop-wide accounting of power expenditures;

the improvement of heat and power-supply systems in order to reduce energy losses;

the improvement of utility consumption schedules (by hour and by day of the week) and the development of efficient operating conditions for production equipment in order to optimize loads on power transformers and boilers;

the development and implementation of measures to improve the recovery and utilization of condensate;

the determination of the volume and feasibility of using internal power reserves on hand at enterprises, including low-potential reserves, the heat from solutions used in the finishing process in textile and knit-good enterprises, ventilation exhaust from dryer air, etc.; the development of a long-range plan based on these materials with a determination of the requirement for the number and types of necessary equipment and materials;

the development and introduction (at large enterprises, first of all) of automated control systems for controlling the operation of the primary power equipment (ASUenergo);

the consolidation of the enterprises' power services and the creation of power bureaus or power-control groups within them.

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FUELS

CALL FOR DEVELOPMENT OF FUELS INDUSTRY REVIEWED

Moscow GEOLOGIYA NEFTI I GAZA in Russian No 5, May 81 pp 1-8

/Editorial: "The Decisions of the 26th CPSU Congress -- We Will Carry Them Out!"/

/Text/ The 26th CPSU Congress made decisions that are determining the present and future of our Motherland. In the report given by CC CPSU General Secretary Comrade L.I. Brezhnev, he summarized the results of the CPSU's multifaceted activities and the heroic labor of the Soviet people during the Ninth Five-Year Plan, presented an extensive program for the further building of communism in the USSR, conducted a thorough and truly scientific analysis of this country's internal life, the international situation and the worldwide revolutionary process, and developed the general party line for the 1980's.

The 26th CPSU Congress unanimously approved the "Basic Directions for the Economic and Social Development of the USSR for 1981-1985 and the Period to 1990." A comprehensive analysis of our economic and social structure in the 1970's and the last five-year plan was given at the congress. As Comrade L.I. Brezhnev emphasized in his report, the results of the development of our national economy confirm convincingly the correctness of the economic strategy that the party worked out at the 24th and 25th CPSU Congresses. The country has moved forward substantially in all areas of the creation of communism's material and technical base.

A special feature of the last decade was large alterations in the disposition of our productive forces. In accordance with the decisions of the 25th Party Congress, the formation of territorial production complexes is taking place in many economic regions. The last decade was a period of steady growth in heavy industry. The output of capital goods was maintained at the same rates as in the preceding 20 years. In comparison with the 1960's, electricity production increased by a factor of two. Oil extraction (including gas condensate) reached 603 million t in 1980, while gas extraction reached 435 billion m^3. "In northwestern Siberia," as Comrade L.I. Brezhnev mentioned in his report, "in 1970 oil extraction (including gas condensate) was at a level of 31 million t, while in 1980 it exceeded 312 million; gas extraction during this period increased from 9.5 to 156 billion m^3. The Orenburg gas workers now produce more than 48 billion m^3. The miners of the Pavlodar-Ekibastuz complex dug about 67 million t of coal in 1980, almost 3 times as much as in 1970."

During the 10th Five-Year Plan, oil extraction in Tyumenskaya Oblast increased by 165 million t, while for gas the figure was 122 billion m^3. The new region now

supplies considerably more gas and oil than were extracted in the entire country on the eve of the 23d CPSU Congress.

The gas industry was developed at a very rapid rate in the 10th Five-Year Plan, in full accordance with the decisions of the 25th Party Congress. The level of gas extraction stipulated for the end of the five-year plan (400 billion m^3) was exceeded in 1979 and reached 435 billion m^3 in 1980. In this 5-year period the highest increase in gas extraction--146 billion m^3--was secured. The national economy received 20 billion m^3 more gas than planned.

Turkmengazprom /Turkmen All-Union Industrial Association/ began working 14 deposits in the 10th Five-Year Plan and increased gas extraction by a factor of 1.4, while the collective of gas workers fulfilled their 5-year assignment in October 1980 and succeeded in producing another 15 billion m^3 beyond that.

As the result of work done in Western Siberia, the surveying of a number of oil (Var'yeganskoye, Severo-Var'yeganskoye, Kholmogorskoye and others) and gas (Yuzhno-Russkoye, the Cenomanian Urengoyskoye and Yamburgskoye fields and others) deposits was completed. A new gas extraction base was created on the Yamal Peninsula, where preparations are being made to work the Kharasaveyskoye deposit and survey a number of others. New fields have been opened in the Central Priob'ye and the northern part of Tyumenskaya Oblast (Muravlenkovskoye, Novogodneye, Kharampurskoye, Kruzenshternskoye and others).

The surveying of a number of deposits (Vozeyskoye, Vasilkovskoye, Vaneyvisskoye and others) has been completed in the Timano-Pechorskaya Province and the goal for the increase in oil reserves in the Udmurt ASSR has been exceeded.

In the Pre-Caspian Depression there has been a significant increase in the reserves of the Astrakhanskoye deposit's gas and promising new deposits of oil, gas and condensate (Karachaganak, Zhanazhol and others) have been discovered in the part of the depression that is in Kazakhstan. Preparations have been made to work the oil deposit on the Buzachi Peninsula. Surveying has been completed in the Zevardinskoye, Shurtanskoye and other deposits in the Uzbek SSR, and the new Dauletabadsko-Donmezskoye gas deposit has been discovered in the Turkmen SSR.

The oil workers of Tatneft' /Tatar Petroleum Association/ are doing a great deal of work on increasing the oil yield factor by creating fundamentally new methods for acting on the beds. They have drawn up 19 production plans for working deposits by new methods that provide for the introduction of different methods of acting on productive beds. Among them, the one most widely used is intrabed desulfurization of the oil. In the 10th Five-Year Plan, about 6,000 t of surface-active substances were pumped into the bowels of the earth. The experimental use of intrabed combustion, high pressure steam, polymers and other reagents was begun. As a result, an additional 2.6 million tons of oil (almost quadruple what was achieved during the Ninth Five-Year Plan) was extracted in the Tatar ASSR. However, far from all their reserves have been put to use. They are concealed primarily in improving the interrelationships between science and production, the oil workers and other departments.

A unified gas supply system has taken shape for this country, and in the last two five-year plans the length of the main gas pipelines has increased by 64,000 km, or by a factor of 2.

The main oil and gas lines are an important component part of this country's transportation complex. The total length of our pipelines is now such that they could circle the globe at the equator five times. The scales and rates of their construction are determining the rapid growth of the oil and gas extraction industry in the regions of Siberia, Central Asia and Kazakhstan. Underground mains reliably connect the industrial center with these regions.

In the 10th Five-Year Plan alone, 50,000 km of pipeline was laid. Among them were the multibranch gas system from northern Western Siberia to Ukhta-Torzhok-Minsk-Ivatsevichi-Dolina and Urengoy-Tyumen'-Chelyabinsk-Petrovsk and the Kuybyshev-Lisichansk-Kremenchug and Omsk-Pavlodar oil lines. In addition, more than 300 powerful transfer and compressor stations were built. Pipeline transportation is one of the most economical methods. It makes the transfer of gas and oil over long distances considerably cheaper and also makes it possible to insure the rhythmic delivery of fuel, combustibles and chemical raw materials to consumers.

In 1979 the gigantic "Soyuz" gas pipeline, which was constructed jointly with the European member nations of CEMA, went into operation. Every year these countries can receive 15.5 billion m^3 of Orenburg gas through this pipeline. The realization of such large-scale programs on a collective basis made it possible to supply our fraternal nations with power, fuel and raw materials.

For their remarkable production achievements and fulfillment of 10th Five-Year Plan assignments and socialist obligations ahead of schedule, as well as the prowess in labor they manifested, the Presidium of the USSR Supreme Soviet conferred the title of Hero of Socialist Labor on 13 of the foremost labor collectives in the gas and oil industry and organizations for the construction of gas and oil industry enterprises.

Orenburggazprom /All-Union Orenburg Scientific Production Association/, the Nizhnevartovskneft' NGDU /Petroleum and Gas Extraction Association/ imeni V.I. Lenin and Glavsibtruboprovodstroy /Main Administration for Construction of Pipelines in Siberia/ were awarded the Order of Lenin. The Order of the Labor Red Banner was awarded to the Al'met'yevsk UBR /Drilling Operations Administration/, Tatneft' imeni V.D. Shashin, the Arlanneft' NGDU, Bashneft' /Bashkir Petroleum Association/ and the Nadym and Shatlyk Gas Extraction Associations. The "Badge of Honor" order was given to the Tyumen' Association for the Transportation and Delivery of Gas.

For their successes in fulfilling 10th Five-Year Plan assignments for increasing reserves and extracting oil and gas, the Presidium of the USSR Supreme Soviet conferred medals and orders on the most distinguished workers, engineering and technical personnel and employees of enterprises and organizations belonging to the USSR Mingeo /Ministry of Geology/, Mingazprom /Ministry of the Gas Industry/ and Minnefteprom /Ministry of the Petroleum Industry/.

In evaluating the results of the work done during the 10th Five-Year Plan, delegates to the congresses of the Communist Parties of Turkmeniya and Azerbaijan discovered many unused production reserves and noted that a significant number of enterprises did not achieve the planned production volumes and efficiency. For instance, Turkmenneft' /Turkmen Petroleum Association/ systematically did not fulfill its planned quotas for the 10th Five-Year Plan: its enterprises underproduced more

than 14 million t of oil and condensate during the five-year plan, as well as a large amount of by-product gas. Many shortcomings in the use of their well assets, in drilling, in setting up fields and in introducing new areas were also not eliminated.

Azneft' /Azerbaijan Petroleum Association/ also lagged seriously behind and underproduced hundreds of thousands of tons of oil during the 10th Five-Year Plan.

Some gas and oil surveying organizations did not fulfill their 5-year assignments for increasing surveyed reserves of gas and oil and confirming them with the USSR GKZ /State Commission on Mineral Resources/, and also did not carry out the planned amount of deep drilling.

The scientific research institutes still have not achieved a substantial improvement in the reliability of local predictions of the existence of gas and oil deposits. Scientific developments are still being introduced into practical use rather slowly. A number of important economic problems have not been solved, and not all scientific research has been aimed at the final results of geological surveying work.

In the 1980's the CPSU will consistently continue to realize its economic strategy, the final goal of which is a steady rise in the material and cultural level of the life of its citizens and the creation of better conditions for the comprehensive development of the individual on the basis of a further improvement in the effectiveness of all public production, an increase in the productivity of labor, and an intensification of the social and labor activities of the Soviet people.

The main goal of the 11th Five-Year Plan is to insure a further improvement in the welfare of the Soviet people on the basis of the steady, progressive development of the national economy, the acceleration of scientific and technical progress and the conversion of the economic system to an intensive path of development, the more rational utilization of the country's productive potential, and the savings of all types of resources and an improvement in the quality of work in all ways possible. In order to realize this main goal, it is intended to implement a system of measures for the consistent improvement of the nation's welfare; to insure steady economic growth and improve the structure of public production; to persistently improve the efficiency of public production on the basis of comprehensive intensification and improve the quality of production and services in all branches; to insure a further acceleration of scientific and technical progress; to strengthen the protection of the environment; to improve the administration and raise the level of management in all branches of the economy and to strengthen the orientation on the achievement of the best final national economic results; to improve the effectiveness of external economic relationships. In order to achieve these goals, it is stipulated that the oil industry will insure the extraction of 620-645 million t of oil (with gas condensate) in 1985; will develop at increased rates the oil extraction industry in Western Siberia, the Kazakh SSR and the northern section of the European part of the country and introduce new oil deposits for industrial development more quickly; will expand the use of new methods of acting on oil beds and with their help increase the extraction of oil from the earth; will improve the technology for the extraction of high-viscosity and bituminous oils; will improve the technical and economic indicators of drilling work through accelerated technical re-equipping and a further improvement in its technology and organization.

The gas industry's most important assignment is to implement a program for the forced development of gas extraction. It is proposed that the volume of gas extracted be raised to 600-640 billion m^3 in 1985; that conditions be created for the further accelerated development of the branch; that there be an expansion of the capacities for integrated processing of casing-head and natural gas, with ethane, sulfur and other associated components being extracted from them; that the extraction of gas condensate be increased and that it be utilized more fully; that high-capacity main gas pipelines with a high degree of automation and operational reliability be constructed; that the efficiency and operational reliability of the country's unified gas supply system be improved; that underground gas reservoirs in the basic fuel-consuming regions continue to be built; that the productivity of labor be increased by 33-35 percent.

In the coal industry, it will be necessary to mine 770-800 million t of coal in 1985.

The following extraction figures have been set for the RSFSR in 1985: oil (including gas condensate) -- 560-580 million t; gas -- 420-460 billion m^3. That includes the following figures for Western Siberia: oil with condensate -- 385-395 million t (of which 375-380 million t will come from Tyumenskaya Oblast); gas -- 330-370 billion m^3. In this five-year plan it will be necessary to produce as much oil as was produced in the last 15 years, while for gas the figure will be double that amount. The acceleration of prospecting for and surveying gas and oil deposits in Tyumenskaya Oblast, in order to increase its output in 1990, is a matter of particular importance. The formation of the Timano-Pechorskiy territorial production complex, on the basis of the fuel and energy resources of the Komi ASSR and the Nenetskiy Autonomous Okrug, will continue. For the Povolzh'ye, it is stipulated that measures will be implemented to maintain the level of gas and oil extraction and that an industrial complex will be formed for the extraction and processing of gas and condensate, as well as the production of sulfur (on the basis of the Astrakhanskoye gas condensate deposit). Geological prospecting for gas and oil will be expanded in the western part of the Kazakh SSR, while on the Buzachi Peninsula the exploitation of the oil deposits will be accelerated.

The most important goals of our industry are the more nearly complete satisfaction of the national economy's requirements for production facilities and the populace's need for goods for popular consumption, as well as an improvement in the quality of our output on the basis of the utilization of the achievements of scientific and technical progress in every way possible. In order to achieve these goals it is necessary to improve the utilization of fuel and energy resources, reduce the consumption of oil and petroleum products as boiler and furnace fuel, and develop atomic power engineering as rapidly as possible. It is also necessary to construct, on an accelerated basis, thermal electric power stations to use coal from the Ekibastuz and Kansk-Achinsk basins and natural and by-product gas from the deposits in Western Siberia.

In his report at the 26th CPSU Congress, Comrade L.I. Brezhnev said: "It is necessary to reduce the proportion of oil used as fuel, replace it with gas and coal, and develop atomic power engineering -- including breeder reactors--more rapidly. Finally, life demands that we continue the search for fundamentally new energy sources, including the creation of the foundations of thermonuclear power engineering.

"I consider it necessary to single out a rapid increase in the extraction of Siberian gas as a task of primary economic and political importance. The deposits in the Western Siberian region are unique. Urengoyskoye, the largest of them, is notable for such gigantic reserves that the country's internal needs can be taken care of for many years and we can still export gas, even to the capitalist countries. The extraction of gas and oil in Western Siberia and their transportation to the European part of the country will become extremely important links in the energy program of the 11th and even the 12th Five-Year Plan."

From the data that have been presented it is obvious that while the extraction of oil (including gas condensate) will increase by 3-7 percent in the 1981-1985 period and that of coal by 7-12 percent, gas extraction will increase by 38-47 percent.

In the report given by the Chairman of the USSR Council of Ministers, Comrade N.A. Tikhonov, the following was noted: "The development of our country's economic potential is largely determined by the state of our mineral raw material resources. In the new five-year plan, geological prospecting work will be conducted more persistently and on an even broader scale. Our duty, no matter how great are our reserves of natural resources, is to search constantly for more rational ways of extracting them and using them economically."

In order to solve these problems, it is necessary to insure the rapid development of work on the geological study of this country's territory and enlarge the surveyed reserves of mineral raw material resources, with special emphasis on fuel and energy resources. It is necessary to implement measures to discover gas and oil deposits in Western and Eastern Siberia, the European part of the USSR, Central Asia and the Kazakh SSR, as well as on the continental shelf.

It is necessary to develop progressive forms of geophysical and geochemical investigations of the depths of the earth more rapidly, make wide use in geology of the capabilities of high-altitude aerial and space facilities for studying the earth's natural resources, and develop and use methods for the accelerated geological-economic evaluation of useful mineral deposits. It is also necessary to provide for the further technical re-equipping of geological surveying organizations and to provide them with highly efficient equipment, technology and transportation facilities.

The 26th CPSU Congress's decisions defined future paths for improving the pipeline system and increasing its basic production assets. It is necessary to improve the efficiency and reliability of the country's unified gas supply system. In order to do this it will be necessary to build large underground reservoirs in the basic fuel-consuming regions. Pipeline transport will be developed at accelerated rates during the 11th Five-Year Plan, particularly in Western Siberia. The scientists and specialists will be faced with the problem of creating and introducing the technology for the year-round construction of underground lines in remote regions. This will increase the work tempo sharply and make it possible to develop new gas and oil deposits more rapidly.

The construction of high-capacity main pipelines with a high degree of automation and operational reliability is of particular importance. This can be done by the widespread introduction into practice of the plant method of manufacturing oil transfer and compressor stations and the use of multilayer, large-diameter pipes.

In the 11th Five-Year Plan the development of science and technology must be subordinated to an even greater degree to the solution of the economic and social problems of the Soviet society, the acceleration of the changeover of the economy to a path of intensive development, and an improvement in the effectiveness of public production. Starting from this, it is necessary to improve the effectiveness of scientific research; reduce significantly the amount of time it takes to introduce the achievements of science and technology into the production process; improve the coordination of the activities of scientific establishments; insure the rapid development of basic research and improve the effectiveness of applied research; strengthen the material and technical base of scientific research, investigative planning and design organizations and higher educational institutions.

It is necessary to strengthen the mutual ties between science and production; increase the responsibility of ministries and departments for the level of research in scientific establishments and use the results of finished scientific developments and inventions in the production process; increase the production of instruments, equipment, automation facilities, reagents and preparations for conducting scientific research; determine and change, on a timely basis, the direction of research and development and the organizational structure of scientific establishments in accordance with the requirements of the scientific and technical revolution. It is necessary to improve the effectiveness of the utilization of the higher educational institutions' scientific potential for the solution of national economic problems; improve the training and raise the level of qualification and certification of scientific and scientific-pedagogical personnel. We need to improve the scientific and technical information system and patent and licensing work; assist in the further development of massive creativity on the part of inventors and rationalizers in every way possible; strengthen the role of scientific and technical societies in improving the production process. On the basis of utilization of the achievements of science and technology it is intended, in particular, to insure the creation and widespread use of technical facilities and technology for the integrated and more nearly complete extraction of useful minerals and the development of poor and complex deposits; study the structure, composition and evolution of the earth, the biosphere, the climate and the world ocean (including the shelf) for the purpose of the rational utilization of their resources and improving the effectiveness of measures in the field of protecting the environment.

A thorough scientific approach to the life of society and the prospects for improving it is the basis of planning not only for the next 5 years, as was previously the case, but with a simultaneous study of the prospects for the next decade. While planning new boundaries for the growth of this country's productive forces, at the same time we are determining to what degree this will be achieved because of scientific and technical progress. Today, science encompasses all aspects of life in our country. The complex assignments formulated for it by the 26th CPSU Congress raise to a new and higher level the demands that a developed socialist society makes on the scientists and engineering and technical personnel in all the research collectives in the struggle for our country's tomorrow and for the acceleration of our movement toward a communist future. The honorable duty of Soviet scientists is to meet these demands with new successes in the investigations of the laws governing the development of nature and new efforts aimed at the most rapid possible introduction of the achievements of science and technology into life.

For the last 10 years there has been a tendency to draw into surveying and industrial development ever more remote and hard to reach gas and oil deposits in the

northern and eastern parts of our country. There has been a significant increase in the depth to which surveying and geophysical investigations extend. The depth of gas and oil wells on land and the ocean shelf has reached 6 km. The probability of discovering new deposits that will be highly efficient to exploit in the developed regions of this country, such as the Romashkinskoye, Samotlorskoye, Urengoyskoye, Orenburgskoye and other deposits, has been reduced considerably.

Consequently, increasing the surveyed reserves of gas and oil is a complicated economic, scientific and technical problem, and its solution is one of the most important conditions for the further economic and social development of the USSR. The preparation of surveyed resources of fuel and energy raw material from 1981 to 1985 and for the period up to 1990 will require a significant increase in the amount of geological surveying work done (including deep exploratory drilling) in comparison with the 10th Five-Year Plan. An important reserve for reducing the cost and shortening the surveying time, as well as accelerating the beginning of exploitation of new deposits is optimization of the drilling network and the more extensive utilization in the surveying process of advanced exploitation-evaluation wells.

As far as geological prospects are concerned, our country has the capabilities of enlarging its surveyed resources of gas and oil as well as increasing their extraction. At the same time, we should expect a further reduction in the proportion of gigantic and large deposits in the total number of discovered gas and oil deposits and, consequently, an increase in the monetary and material expenditures necessary for their surveying and the extraction process. In connection with this, there will be more stringent requirements for improving the methods used to search for and survey gas and oil deposits and increasing the effectiveness of scientific predictions of the presence of gas and oil. A great deal of attention should be devoted to improving the resolution of seismic surveying, which is the basic form of geophysical work during the preparation of an area for deep drilling.

The fuel and energy complex always was and still is the heart of our economic system. In 1981, 1.385 billion kWh of electricity will be generated and 610 million t of oil and gas condensate will be extracted, along with 458 billion m^3 of gas and 738 million t of coal.

As was previously the case, thermal and hydroelectric power stations will be constructed in the eastern regions of the USSR, while atomic power engineering will be expanded in the European part of the country.

This strategy for the development of power engineering is related to the fact that our main fuel bases -- Western Siberia, the Kuzbass /Kuznetsk Coal Basin/, Ekibastuz, the Kansk-Achinsk basin -- are concentrated in the east. These regions will also supply the basic increase in the extraction of gas, oil and coal.

As the extraction of gas and oil increases, so will the number of enterprises engaged in processing them, and pipeline construction will be expanded. The Urengoy-Petrovsk and Punta-Ukhta-Gryazovets-Torzhok main pipelines (and branches from them) will be constructed.

At the same time, in the older gas- and oil-producing regions of the European part of the USSR (the Trans-Caucasus and Northern Caucasus, Uralo-Povolzh'ye, the Ukraine), where the gas- and oil-bearing territories have been very well surveyed,

we cannot count on significant increases in the gas and oil reserves, so it is possible there will be a gradual decline in the level of extraction. In these territories it is assumed that there are new deposits at depths of greater than 4 km, and in the coming decade geological surveying work will be done there that will make it possible to slow down the rate of decline and possibly stabilize the level of gas and oil extraction.

From the first days of Soviet power, socialist competition has been a powerful accelerating force for all matters concerning the Soviet people. In the precongress period and after the completion of the 26th CPSU Congress's work, throughout the entire country and in all collectives, socialist competitions were organized to increase the productivity of labor, to improve the quality and efficiency of the work done in all sectors and at all working places, and to fulfill the national economic plans of the first year of the 11th Five-Year Plan ahead of schedule.

For example, the collective at Glavtyumenneftegaz's /Main Administration for Petroleum and Gas for the Tyumen' Region/ Yuganskneftegaz association took upon itself as its socialist obligation for 1981 to fulfill its annual plan for the extraction of oil ahead of schedule, on 29 December. Through the acceleration of the introduction into exploitation of new oil deposits, a further improvement in techniques, technology and the organization of production, and a more efficient utilization of production capacities, they propose: to increase oil extraction in 1981 to 50.2 million t; to extract 310,000 t of oil above their annual plan; to drill 25,000 m of oil wells more than assigned; to implement measures for the fuller utilization of their wells; to reduce labor expenses for the maintenance of a single well by 4.6 percent in comparison with 1980; to increase the level of oil extraction by complexly automated enterprises to 90 percent and to improve the oil well exploitation factor.

This association's collective has called on all oil workers throughout the country to develop a socialist competition for the fulfillment of the assignments for the first year of the 11th Five-Year Plan ahead of schedule.

The oil workers of the Azerbaijan SSR have vowed to extract 208 million m^3 of gas and produce 30,000 t of fuel above plan in 1981.

The oil workers of the Kazakh SSR have sworn to extract an additional 115,000 t of oil and 27.2 million m^3 of gas in 1981.

The gas field workers of the Uzbek SSR have assumed an obligation to exceed their plan by 105 million m^3 of gas in 1981.

For 1981, the gas and oil workers of the Turkmen SSR have obligated themselves to extract 43,200 t of oil and 320 million m^3 of gas above plan.

The oil workers of the Tajik SSR are determined to extract an additional 2,000 t of oil and 8 million m^3 of natural gas.

The gas field workers of the Ukrainian SSR have vowed to extract 820 million m^3 of gas more than was planned.

The gas and oil workers of the RSFSR have sworn to extract 2.8 million t of oil and 1.7 billion m^3 of gas more than was assigned.

For 1981, the collectives of the organizations and enterprises of USSR Mingeo have assumed the following socialist obligations: through improving the organization and techniques of geological surveying work, the introduction of achievements of scientific and technical progress and progressive experience, to provide an increase in reserves per ruble of expenditure and to overfulfill, without enlarging allocations, the plan for the increase in oil and condensate reserves by 3 percent and natural gas by 4 percent; to discover 11 new gas and oil deposits in 1981; to prepare and hand over for industrial development the Dauletabad-Donmezskoye natural gas deposit in the Turkmen SSR.

The Megionneftegazgeologiya association's collective has assumed high obligations for 1981 by deciding to overfulfill its annual plan for the increase in surveyed oil reserves by 9 percent and to reduce the planned cost for the preparation of 1 t of oil reserves by 8 percent.

For the purpose of accelerating scientific and technical progress, improving technical and economic indicators, and increasing the quality and efficiency of their work, USSR Mingeo's collectives have sworn to fulfill ahead of schedule (on 25 December 1981) all their planned assignments for solving the most important scientific and scientific-technical problems and the introduction of progressive techniques and technology into practical geological surveying work; to finish ahead of schedule, by 7 December 1981, the formulation of integrated and purposeful programs for the geological and geophysical investigation of gas and oil deposits in the northern part of Tyumenskaya Oblast; to develop suggestions on the optimum technique for conducting geological and geophysical work with respect to gas and oil in Eastern Siberia.

The 26th CPSU Congress emphasized that the realization of the extensive program for this country's economic and social development in the new five-year plan is the most important economic and political assignment for all party, Soviet, professional trade union, Komsomol and managerial organizations. The congress expressed its confidence that the workers in all branches of the national economy, under the leadership of the Leninist Communist Party, will develop socialist competition even further and apply their creative efforts, knowledge and experience for the successful solution of the problems involved in building communism. There is no doubt that the collectives of the working organizations and enterprises of USSR Mingeo, Mingazprom and Minnefteprom will carry out the decisions of the 26th CPSU Congress successfully, as well as the State Plan for Social and Economic Development and their socialist obligations for 1981, the first year of the 11th Five-Year Plan, and will make a significant contribution to a further increase in our gas and oil resources, the accelerated development of gas extraction, and an increase in the volume of oil extracted.

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FUTURE ECONOMIC DEVELOPMENT OF OIL INDUSTRY OUTLINED

Moscow NEFTYANAYA PROMYSHLENNOST': SERIYA EKONOMIKA in Russian No 4, Apr 81 pp 2-4

/Editorial: "Basic Directions for the Branch's Economic Work in the 11th Five-Year Plan"/

/Text/ As did many other branches of industry, the oil industry greeted the 26th CPSU Congress with labor successes. A considerable volume of the gas and oil that were extracted was obtained because of an increase in the productivity of labor, and profitability was increased in many oil-producing regions. Oil and gas condensate production in 1980 was 603 million t.

Many large programs were realized in the branch during the 10th Five-Year Plan. In accordance with the decisions of the 25th CPSU Congress, development of the country's main oil-producing base -- the Western Siberian gas and oil complex -- was continued. The amount of oil extracted in this region more than doubled in the last 5 years.

A substantial contribution to the total amount of oil extracted was made by the Uralo-Volzhskaya gas and oil province, primarily by such regions in it as the Tatar and Bashkir ASSR's and Kuybyshevskaya and Permskaya Oblasts.

In the "Basic Directions for the Economic and Social Development of the USSR for 1981-1985 and the Period to 1990," it is said that in 1985 the level of oil (with gas condensate) extraction must be 620-645 million t. Great importance is attached to the accelerated introduction into industrial development of new oil deposits on the basis of the extensive use of industrial methods of construction and new methods for acting on oil beds. In 1985 the proportion of oil extracted by complex automated enterprises will reach 85-90 percent, while the labor expenses for the maintenance of a single well will be reduced by 15-18 percent.

Considerable attention is being devoted to the problem of enlarging the role of planning, which is the central link in the administration of the branch.

Work on improving planning in the branch was intensified considerably after the issuance of a decree by the CC CPSU and USSR Council of Ministers on 12 July 1979. The "Methodological Propositions for Branch Planning of Oil Extraction" were confirmed in 1980. The principle that is the basis of this document makes it possible to combine centralized branch planning with planning in the oil-producing regions. Thus, the technical and economic substantiation of the extraction plan's indicators

can now be according to a unified methodological plan based on engineering calculations for technological and economic planning. The planning calculations substantiate not only the projected levels of oil extraction, but also the amounts of drilling work, capital investments and material and technical resources needed to achieve them.

The development of mathematical methods for evaluating the intensity of oil extraction plans contributes to a decreased risk of their underfulfillment in each oil region. The introduction into operation of the first stage of an automated branch system for planning calculations makes it possible to improve the stability, uniform intensity and effectiveness of plans.

Branch planning now has at its disposal rigorous methods substantiated by both the theory of the development of oil deposits and statistical analysis.

The further development and introduction of guidance and methodological documents will make it possible to determine an order for the compilation of prospective 5-year and annual plans in all subbranches. The critical assignment of the oil industry's economic services in carrying out the 26th Congress's decisions is to organize the performance of work to improve the economic effectiveness of the conduct of oil extraction and drilling work by all structural units of enterprises and all collectives and workers. It is necessary to improve the technical and economic indicators of drilling work by accelerated technical re-equipping and a further improvement in the organization of drilling work.

In the period 1981-1985, an important place will be given to the development of prospective planning techniques.

During the 11th Five-Year Plan we will work on introducing methods for the optimum control of the development of oil deposits, with due consideration for the effect of natural geological conditions on the technical and economic indicators of deposit exploitation. For this purpose we will develop criteria regulating the utilization of the earth's oil resources: reserves will be categorized as "balance" and "transbalance"; economically justified limits of expenditures for the preparation of industrial oil reserves will be established; the feasibility and sequence of the introduction of deposits into development will be determined; the development variant will be chosen and methods for increasing the oil yield will be substantiated; the limits of the exploitation of wells, deposits and fields will be determined.

The solution of problems related to the optimization of the fuel and energy balance will occupy an important place. The special mathematical models developed for this purpose include all links of the oil complex's production cycle: preparation of reserves, development of deposits, oil transportation, its processing at NPZ's /petroleum-processing plant/, and the system for the distribution of petroleum products to the consumption bases.

These are the goals and strategy for the development of the oil industry in the long-term perspective. In connection with this, the problem of optimizing the oil complex is viewed not only within the framework of the fuel and energy complex, but also with due consideration for satsifying the national economy's structural requirement for motor vehicle fuel and raw materials for petrochemistry.

Further research in this area will make it possible to work out specific suggestions for the rational utilization of oil because of its more thorough processing, the use of alternative energy sources and the economical utilization of our fuel and energy resources. In order to satisfy the national economy's requirement for special-purpose petroleum products and provide export supplies, projects are being formulated for a more reliable substantiation of the size of our oil reserves and production capacities for the extraction, transportation and processing of oil.

The branch's economic services have done a considerable amount of work on carrying out the CC CPSU's and USSR Council of Ministers' decree "On Improving the Planning and Intensifying the Effect of the Economic Mechanism on Improving Production Efficiency and Work Quality."

The development and introduction of an interconnected system of planning and evaluation indicators for the branch and its associations, enterprises, shops and work crews make it possible to insure the unity of the economic interests of all subunits in the oil-extraction complex, which will promote a significant improvement in production efficiency. The main feature of the new system is that fund allotment and the awarding of bonuses to all the subunits of an association have been placed in direct relationship to and dependence on the interests of the branch as a whole. Such an integrated evaluation creates the economic conditions necessary for insuring the fulfillment of assignments for both oil extraction and the increase of reserves.

The experience gained in using the new system of planning and evaluation indicators in the Bashneft' /Bashkir Petroleum Association/ and Tatneft' /Tatar Petroleum Association/ organizations demonstrated its effectiveness. The results of these associations' production and economic activities improved significantly. The plan for 1981-1985 provides for the introduction of this system in all oil-producing regions.

An important place is occupied by work to improve the effectiveness of drilling production by financing work for wells where construction has been completed, which presumes the coverage of expenses for uncompleted construction through bank credit until it is completed. This makes it possible to use the drilling organizations' fixed capital better and to shorten the duration of the construction process.

A collective of branch specialists is working on the compilation of a new SUSN /Handbook of Consolidated Estimate Norms/ and PPR's /work plan/ for the construction of gas and oil wells. The conversion of the branch to the new well construction financing conditions at the beginning of the 11th Five-Year Plan will insure a significant reduction in the length of the construction period.

Great and important work is being done in the branch in the area of pricesetting. At the present time new wholesale prices for gas and oil have been worked out and approved; these prices will insure the profitable operation of all associations. In order to increase production efficiency in the branch, plans are being made to develop proposals on the order of utilization of charges, profits, deductions, rents and fees for funds.

The branch's economic work on improving planning and the economic mechanism also provides for the development and introduction methodological proposals for the

compilation of the technical, industrial and financial plan for a gas-extracting association and its enterprises, as well as geophysical and gas-processing enterprises and main line transportation organizations.

The wage and bonus systems need further improvement.

It is necessary to do considerable work in the branch in order to improve the economic methods of controlling scientific and technical progress. Much has already been done in this area in connection with the conversion of the branch and its scientific research, design, planning and production organizations to the autonomous financing system for creating, mastering and introducing new technology.

For the branch it is necessary to solve problems related to the planning of oil production on the basis of purposeful programs of scientific and technical progress. In the 11th Five-Year Plan they will be solved with due consideration for the requirements for the technical and economic indicators of equipment and processes, as well as the optimum location of equipment and materials among the regions.

The realization of this work will facilitate the achievement of high final branch results.

Work in the area of capital construction is extremely complicated and important. We are faced with developing a system for capital construction in the oil industry for the period up to 1990. In it, capital construction is regarded as a purposeful system that provides for the development of the entire complex and the subsystems in it as an integrated whole that is correlated with all indicators. The program will provide for the entire construction cycle, from the moment a decision is made about the creation of an object until it is liquidated.

In recent years a great deal of work has been done on the development of a series of guidance documents defining the legal and methodological basis and the rules for the reception of initial information for the planning of construction projects. Documents are being prepared for the basic indicators of scientific and technical progress.

In order to improve the planning of capital investments, great importance is attached to the development and introduction of guidance documents on the current and 5-year planning of capital investments, allowing for the construction reserves at the association and branch level.

We are faced with the performance of a great deal of work to improve the system for controlling scientific research and development. As a result of this work, guidance documents for selecting the directions of scientific research and experimental design work and the rational utilization of scientific potential will be introduced into the branch. The creation of a purposeful program for controlling scientific research and development and its realization will result in a significant improvement in the effectiveness of science and production in the oil industry.

Within the framework of the program for improving the economic development and arrangement of the oil industry, there will be an analysis of the branch's development in the 11th Five-Year Plan and proposals will be developed for realizing production reserves.

The goals placed before the economic subdivisions of this branch by the Directives of the 26th CPSU Congress are extraordinarily important and in order to achieve them it is necessary to combine the efforts of all collectives in the branch.

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USE OF MAXIMUM PRICE TO STIMULATE INNOVATION DESCRIBED

Moscow NEFTYANAYA PROMYSHLENNOST': SERIYA EKONOMIKA in Russian No 4, Apr 81 pp 12-14

/Article by M.A. Aleksandrov and I.Ye. Rudavskiy, All-Union Scientific Research Institute for Drilling Techniques: "Using the Maximum Price to Stimulate the Creation of Progressive Drilling Equipment"/

/Text/ The enterprises of the Ministry of the Petroleum Industry act as the customer (basic consumer) of new equipment (products) used in the branch.

In accordance with the requirements of GOST /All-Union State Standard/ 15.001.73, "Development and Delivery of Products for Production Purposes," the developer receives from the customer the basic requirements for the product that is to be developed, including the maximum price and its substantiation.

In the "Instructions Concerning the Order for Coordinate Development, Approval and Implementation of Specifications and Prices for Machine Building Products for Technical and Production Purposes" (RDI 79-76), it is pointed out that the economic substantiation for the creation of a new article in the development stage must be presented in the form of a maximum price (based on the customer's application), a projected price (based on the projected cost) and the economic effect.

In connection with this, the maximum price remains unchanged throughout all stages of the development process, with the exception of cases of a change in the original properties of the article being developed as required by or by agreement with the customer.

Price-setting agencies do not handle materials concerning the approval of wholesale prices in the absence of a maximum price agreed upon between the customer and the manufacturer.

From what has been said it follows that the maximum price is one of the basic economic criteria in evaluating the effectiveness of planning decisions for developing examples of new articles, making decisions about the presentation of a new product for production, and determining the wholesale price levels for it.

The maximum price of a new article characterizes that highest price that, given the new article's technical and economic properties, guarantees the user a benefit that is sufficient enough so that he will be interested in changing over to the new product.

The highest (maximum) price is a means directed at mobilizing planners (designers) and technologists for the creation and introduction of the most progressive and efficient equipment used in the drilling of gas and oil wells. If, as the result of planning, it turns out that the production cost of a new article exceeds the maximum price or that the difference between the manufacturing cost and the maximum price is so small as not to insure the necessary level of production profitability, this serves as evidence of the economic ineffectiveness and low level of planning of the new product, whereas when the production cost is considerably lower than the maximum price, this is indicative of the new article's progressive nature.

At the planning stage, maximum prices enable the designers to turn down economically unprofitable projects and force them to look for and find more economically substantiated solutions to technical problems and create only that new equipment that will contribute to a reduction in expenditures of human and embodied labor.

Maximum prices for equipment for drilling enterprises are determined according to the "Techniques for Determining the Highest (Maximum) Price for New Drilling Equipment," which were developed by VNIIBT /All-Union Scientific Research Institute for Drilling Techniques/ and VNIIOENG /All-Union Scientific Research Institute for the Organization and Economics of Petroleum and Gas/, with due consideration for the specific conditions encountered when drilling gas and oil wells.

It is very important to establish the factors that are used to evaluate the level of the maximum price.

The first factor that is subject to evaluation for the consumer is the price of the basic article ($Ц_б$). He then evaluates the qualitative aspect of the new article (higher equipment productivity, operating time and so forth), which is determined by the replaceability factor of a previously used article by the new one, as far as technical and economic parameters are concerned, as well as for labor resources by the change in service life (T). Finally, the last factor is the savings in current expenditures achieved by the customer (consumer) as the result of the use of the new equipment.

Allowing for the factors that have been listed, the highest price is determined with the following formulas:
for articles with an extended (more than 1 year) service life:

$$Ц_{vp} = Ц_б \cdot \frac{П_н}{П_б} \cdot \frac{\frac{1}{T_б} + E_н}{\frac{1}{T_н} + E_н} + \frac{И_б - И_н}{\frac{1}{T_н} + E_н} \pm \Delta K; \quad (1)$$

for labor articles:

$$Ц_{vp} = Ц \cdot \frac{У_б}{У_н} + \frac{И_б - И_н}{У_н} \pm \frac{E_н \cdot \Delta K}{У_н} \quad (2)$$

where $Ц_{vp}$ = upper limit of the price of the new equipment (article), in rubles; $Ц_б$ = cost of the basic article, in rubles; $П/П_б$ = replaceability factor; ($П_н$ and $П_б$ = annual output volumes, given in units of the new and basic article, respectively); $T_б$ and $T_н$ = service lives of the basic and new equipment, in years;

E_n = normative coefficient of comparative effectiveness of capital investments = 0.15; $И_n$ and $И_b$ = consumer's operating (current) expenses for production output when using the new and basic articles, in rubles; ΔK = change in the consumer's capital investments in connection with the use of the new article instead of the basic one, in rubles; Y_b/Y = replaceability factor (Y_b and Y_n = specific consumption of the basic and new articles, respectively, per unit of production output on the part of the consumer).

These formulas indicate that the new article's price can be higher than that of the one being replaced, but that because of improvements in the technical and economic factors it will be equally profitable.

However, the upper limit may not be the maximum price. The fact of the matter is that equal profitability of the new equipment and that being replaced gives the advantage to the basic equipment, both for the manufacturer (as being an article already in production) and for the consumer (tested and familiar).

Therefore, the price for a new product must guarantee not equal profitability, but an increased profit in comparison with the product being replaced. The maximum price for a new article must be cheaper than the equally profitable price, to a certain degree. If this degree of cheapness for the consumer is designated as σ, which is less than unity, we then have the following formula for the new article's maximum price ($Ц_m$):

$$Ц_m = Ц_{упр}\,\sigma. \qquad (3)$$

On the basis of factual data on the annual reduction in the production cost of a new product during the years in which it is being assimilated (2-3 years), in the oil industry this coefficient is taken to be 0.9.

Below we present two examples of the calculation of the maximum prices for both equipment and labor articles.

Example 1. The calculations are made for D2-172M screw-type face motors for the conditions under which drilling is performed by Permneft' /Perm' Petroleum Association/. As the basis for comparison, we use the drilling indicators obtained when using 3TSSh1-172 turbodrills in exploitation drilling with an electric drive at depths of 939-2,159 m (drilling with an interval H = 1,220 m). Because of the increase in cutting per bit from 15.09 m to 45.20 m, with some lessening of the drilling rate from 6.38 m/h (V_b) to 4.47 m/h (V_n), the drilling time changed from 682.08 (T_{bas}) to 436.55 (T_{new}) hours. Bit consumption was reduced from 81 (n_b) to 27 (n_n), with the price for a Type III 215.9T-TsV-3 bit (allowing for the increase in the supply ($Ц_d$) price) being 112.52 rubles. The estimated cost per hour for drilling rig operation, without overhead expenses, expenditures for amortization of the face motors, and corrected for face motor maintenance, the overhaul period and the commercial drilling rate, was 44.52 rubles for the 3TSSh-172 (C_{hb}) and 46.66 rubles for the D2-172M (C_{hn}).

In this case, the operating expenses per meter of drilling are:

$$З_b = \frac{C_{hb}T_b + n_b Ц_d}{H} = \frac{44.52\ 682.08 + 81\ 112.52}{1220} = 32.36 \text{ rubles/m};$$

$$З_п = \frac{C_{hn} T_n + n_n Ц_d}{H} = \frac{46,66 \cdot 436,55 + 27 \cdot 112,52}{1220} = 19,19 \text{ rubles/m.}$$

For a guaranteed 3TSSh1-172 operating time (t_{sb}) of 800 h, while that of the D2-172M (t_{sn}) is 250 h, and given service lifes for the former (T_b) and latter (T_n) of 3 and 1.5 years, respectively, the annual drilling volume (П) is:
for the 3TSSh1-172:

$$П_b = \frac{V_b t_{sb}}{T_b} = \frac{6,38 \cdot 800 \cdot 0,85}{3} = 1446 \text{ m;}$$

for the D2-172M:

$$П_n = \frac{V_n t_{sn}}{T_n} = \frac{4,47 \cdot 250 \cdot 0,85}{1,5} = 633 \text{ m}$$

(0.85 is a factor allowing for the work of the face motor in mechanical drilling).

The operating expenses for the annual drilling volume using the new face motor are:

$$И_b = З_b \times П_n = 32,36 \times 633 = 20483,88 \text{ rubles;}$$
$$И_n = З_n \times П_n = 19,19 \times 633 = 12147 \text{ rubles.}$$

The price of a 3TSSh1-172 turbodrill ($Ц_b$) is 4,200 rubles.

Since the D2-172M screw-type face motor is labor means, and also considering the fact that when it is used there arises no need for a change in capital investments ($\Delta K = 0$), the upper limit of its price is:

$$Ц_{vp} = Ц_b \cdot \frac{П_n}{П_b} \cdot \frac{\frac{1}{T_b} + E_n}{\frac{1}{T_n} + E_n} + \frac{И_b - И_n}{\frac{1}{T_n} + E_n} = 4200 \cdot \frac{633}{1446} \cdot \frac{\frac{1}{3} + 0,15}{\frac{1}{1,5} + 0,15} +$$

$$+ \frac{20483,88 - 12147,27}{\frac{1}{1,5} + 0,15} = 11290,88 \text{ rubles;}$$

The maximum price is: $Ц_m = Ц_{vp} \times 0.9 = 11,290.88 \times 0.9 = 10,161.7$ rubles.

Example 2. The calculations are made for a Type III 269.9 S-GNU bit, which is used in the low-speed drilling method. As a basis for comparison we use the operating indicators of Type III 269.9 S-GN bits, as supplied by Ukrneft' /Ukrainian Petroleum Association/, for rotary drilling with an electric drive in exploration drilling in the depth interval 2,728-3,232 m (drilling with an interval H = 504 m). Because of the increase in cutting per bit from 32.47 m (h_b) to 42.50 m (h_n) and the drilling rate from 1.77 to 2.15 m/h, the drilling time was reduced from 424.43 (T_b') to 339.18 (T_n') hours. The estimated cost per hour of drilling rig operation for expenses that are a function of time but without overhead expenses, and corrected for the commercial rate, were (C_h) was 39.35 rubles. The price of a Type III 269.9 S-GN bit ($Ц_b$) is 288 rubles.

The operating costs per meter of drilling for mechanical drilling, raising and lowering operations, preparatory and concluding operations and auxiliary work, without overhead expenses and the cost of the bit, are:

$$И_b = \frac{C_ч T_b}{H} = \frac{39,35 \cdot 424,43}{504} = 33,14 \text{ rubles};$$

$$И_n = \frac{C_ч T_n}{H} = \frac{39,35 \cdot 339,18}{504} = 26,48 \text{ rubles}.$$

The specific bit consumption per meter of drilling was:

$$У_b = \frac{1}{h_b} = \frac{1}{32,47} = 0,0308;$$

$$У_n = \frac{1}{h_n} = \frac{1}{42,5} = 0,0235.$$

Keeping in mind that in connection with the use of the new bit, for the consumer there arises no need to change the capital investments ($\Delta K = 0$), and also the fact that the bit is a labor means, the upper limit of the price is determined by the formula:

$$Ц_{vp} = Ц_b \cdot \frac{У_b}{У_n} + \frac{И_b - И_n}{У_n} = 288 \cdot \frac{0,0308}{0,0235} + \frac{33,14 - 26,48}{0,0235} = 660,88 \text{ rubles}.$$

The maximum price is: $Ц_m = Ц_{vp}$ x 0.9 = 660.88 x 0.9 = 594.79 rubles.

Thus, by being oriented on the maximum national economic effect, maximum prices thereby exercise control over the effectiveness of new equipment and create the economic conditions needed to interest manufacturers in producing and systematically improving new products and to interest consumers in introducing them.

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GENERAL

TERMINOLOGY RELATED TO POWER SYSTEMS RELIABILITY

Moscow NEFTYANAYA PROMYSHLENNOST': SERIYA TRANSPORT I KHRANENIYE NEFTI I NEFTEPRODUKTOV in Russian No 4,1981 (signed to press 20 Apr 81) pp 31-37

[Article in the reference handbook in the "Petroleum and Petroleum Product Storage and Transportation" series, Ministry of the Petroleum Industry and the All-Union Scientific Research Institute for the Organization, Management and Economics of the Petroleum and Gas Industry: "Power Systems Reliability (Terminology)."]

[Text] A collection of recommended terms for "Power Systems Reliability" has been published by the Committee for Scientific and Engineering Terminology of the USSR Academy of Sciences. Specialists from all sectors of power engineering, including the Ministry of Energy, Ministry of the Electrical Power Equipment Industry, Ministry of the Petroleum Industry, Ministry of the Gas Industry and the Ministry of the Construction of Petroleum and Gas Industry Enterprises of the USSR participated in the development and discussion of the collection.

The utilization of the recommended terminology, which is thus of an intersectorial nature, should aid in a better understanding of the problem area of reliability by the scientific and engineering community. Considering the increasing volume of publications in the field of petroleum supply system reliability and the importance of terminological unity with the operation of the "Neft'-2" automated system for scientific and technical information, the editorial staff of the reference scientific and technical collection "Petroleum and Petroleum Products Storage and Transportation" decided to bring the complete complement of the 114 recommended terms to their readers. The editorial staff thereby hopes to turn the attention of readers to the increased responsibility of trunk petroleum pipeline transport for the reliability of the petroleum supply system and to the necessity of utilizing unambiguous terminology for reliability in this regard in the scientific and technical information sector.

I. Power Facilities and Their Operational Characteristics

1. Система энергетика. Система. Power System. System. An open man-machine system intended for the extraction (generation, derivation), reprocessing (conversion), transmission, storage and distribution of the corresponding product and the supply of this product to the consumers.

Notes:

1. Power systems, depending on their hierarchical level and output product, are treated as follows: the overall power system, encompassing the major components and links in the fuel and power complex of the nation; an electrical power system (for the simultaneous generation, conversion, transmission, storage and distribution of electrical and thermal power); an electrical system (for the generation, conversion, transmission and distribution of solely electrical power); a heat supply system (for the generation, conversion, transmission, storage and distribution of solely thermal energy); a gas supply system (for the extraction and derivation, reprocessing, transmission, storage and distribution of gas and gas condensate); a petroleum supply system (for the extraction and derivation, refining, transmission, storage and distribution of oil and petroleum products); a water supply system (for the extraction, reprocessing, transmission, storage and distribution of water.

2. A power system product (output) is understood to be the kind of energy, energy carrier, as well as water, compressed air, etc.

3. Any power system or component of it is a power facility (object).

2. Пропускная способность. Carrying capacity. The maximum long term value of the power (productivity) which can be assured under the given operational conditions for the system.

3. Номинальная мощность. Номинальная производительность. Nominal capacity. Nominal productivity. The maximum long term permissible power (productivity) level of a facility under its design (planned) operational conditions.

4. Установленная мощность. Установленная производительность. Installed capacity. Installed productivity. The sum of the nominal capacities (productivities) of the aggregate of facility components under consideration.

5. Располагаемая мощность. Располагаемая производительность. Available capacity. Available productivity. The installed capacity (productivity) of a facility reduced because of the mismatch of the capacities (productivities) of its series connected components.

6. Рабочая мощность. Рабочая производительность. Working capacity. Working productivity. The available capacity (productivity) of a facility minus the value of the available capacity (productivity) of its components which are undergoing preventive maintenance or emergency repairs (32, 33) or are subjected to an emergency or dependent shutdown (34, 35).

7. Включенная мощность. Действующая производительность. Connected capacity. On-line productivity. The working capacity (productivity) of a facility minus the amount of the available capacity (productivity) of its components which are on unloaded standby.

8. Структура системы энергетики. Структура системы. Power system structure. System structure. The composition of power system components, their interrelationship and the relationship of the kinds of products, energy carrier stores,

capacities (productivities) and carrying capacities of its components in the extraction (production, derivation), reprocessing (conversion), transmission, storage and distribution chain for the corresponding product.

9. Система энергетики с сильными связями. Система с сильными связями. Power system with strong links. System with strong links. A power system, the network for which in normal and repair modes (36, 38) does not limit the use of the available capacity (productivity) of the generation centers for the feed to the consumption centers.

10. Система энергетики со слабыми связями. Система со слабыми связями. Power system with weak links. System with weak links. A power system, the network for which in normal or repair modes limits the utilization of the available capacity (productivity) of generation centers for the feed to consumption centers.

II. Properties Characterizing the Reliability of Power Facilities

11. Reliability. The property of a facility of performing the specified functions in the specified amount under definite operational conditions.

Notes:

1. As applied to power systems, included in the specified functions are the uninterrupted supply of the appropriate product with the requisite quality to consumers and not allowing situations which are dangerous to people and the environment.

2. Reliability is a comprehensive property which, depending on the function of a facility and its operational condition, can include a number of properties (individually or in certain combinations). The major properties are the following: failure-free service, durability, repair suitability, storability, stability, mode controllability, survivability and safety.

12. Безотказность*. Failure-free Service. The property of a facility of continuously maintaining its operability for a certain time or a certain non-failure operating time (86).

13. Долговечность*. Durability*. The property of a facility of maintaining its operability until the onset of the ultimate state for an established system of preventive maintenance and repairs.

14. Ремонтопригодность*. Repair suitability. The property of a facility which consists in its adaptability to the prevention and detection of the reasons for the occurrence of its failures (54), damage and the elimination of their consequences by means of preventive maintenance and repairs.

15. Сохраняемость. Storability. The property of a facility of continuously maintaining a good operating or just operable status (20) during and after storage and (or) transportation.

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* In accordance with the State Standards which are in force.

16. Устойчивоспособность. Stability. The property of a facility of continuously preserving stability for a certain period of time.

17. Режимная управляемость. Управляемость. Mode Controllability. Controllability. The property of a facility of maintaining a normal operating mode by means of control.

18. Живучесть. Survivability. The property of a facility of standing up to perturbations and not allowing for their stage by stage spread with a massive disruption of power to consumers.

19. Безопасность. The property of a facility of not allowing situations which are dangerous to people and the environment.

III. States Characterizing the Reliability of Power Facilities.

20. Работоспособное состояние. Работоспособность. Operable Status. Operability. The state of a facility in which it is capable of performing all or part of the specified functions, either fully or partially.

21. Полностью работоспособное состояние. Полная работоспособность. Fully operational status. Fully operable. The operational state of a facility in which it is capable of fully performing all of the specified functions.

22. Частично работоспособное состояние. Частичная работоспособность. Partially operational status. Partially operable. The operational state of a facility in which it is capable of performing a portion of the specified functions, either fully or partially, or all of the specified functions, but where even only one of them is partially carried out.

23. Неработоспособное состояние. Неработоспособность. Inoperable status. Inoperability. The state of a facility in which it is incapable of performing all of the specified functions.

24. Рабочее состояние. Working Status. The state of a facility in which it performs all or part of the specified functions, either fully or partially.

25. Полностью рабочее состояние. Full Working Status. The working state of a facility in which it completely performs all of the specified functions.

26. Частично рабочее состояние. Partially Working Status. The working state of a facility in which in performs a portion of the specified functions, either fully or partially, or all of the specified functions, but in this case even if only one of them is partially carried out.

27. Неробочее состояние. Nonworking Status. The state of a facility in which it does not perform all of the specified functions.

28. Предельное состояние. Ultimate Status. The state of a facility in which its further operation should be terminated because of a violation of safety requirements which cannot be eliminated, or a reduction in the level of operability (41) which cannot be eliminated, or an impermissible reduction in operating efficiency.

29. Резервное состояние. Standby Status. The working state of a facility in which it is the back-up (61) for other facilities.

30. Состояние нагруженного резерва. Состояние включенного резерва. Loaded Standby Status. Actuated Standby Status. The standby state of a facility in which it is in operation.

31. Состояние ненагруженного резерва. Состояние невключенного резерва. Unloaded Standby Status. De-activated Standby Status. The standby state of a facility in which it is not in operation.

32. Состояние предупредительного ремонта. Preventive Maintenance Status. The nonworking state of a facility in which work is underway to ascertain, prevent and eliminate defects in it which could lead to the failure of the facility.

33. Состояние аварийного ремонта. Emergency Repair Status. The nonworking state of a facility in which work is underway to restore its operability, disrupted as a result of component failure in the facility.

34. Аварийный простой. Emergency Shutdown. The nonworking state of a facility in which work is not underway to restore its operability, disrupted as a result of component failure in the facility.

35. Зависимый простой. Dependent Shutdown. The nonworking state of a facility which arises as a consequence of the disconnection of other facilities, or the performance of work on them which requires the disconnection of the given facility, the operability of which is not disrupted in this case.

36. Нормальный режим. Normal mode. The working state of a facility in which the values of the specified operating mode parameters and the backup are kept within the established limits.

37. Утяжеленный режим. Operation without Backup [literally: 'more weighted mode']. The working state of a facility in which, regardless of the values of the specified operational parameters, no backup is provided within the set limits.

38. Ремонтный режим. Repair Mode. The working state of a facility in which part of its components is undergoing preventive maintenance or emergency repair.

39. Аварийный режим. Emergency Mode. The working state of a facility in which it is found as a result of a failure of its components, from the moment of failure occurrence until the fault is contained.

40. Послеаварийный режим. Postemergency Mode. The working state of a facility in which it is found as a result of a failure of its components following the containment of the fault until the specified operating conditions are established.

IV. Events Characterizing the Reliability of Power Facilities.

41. Отказ работоспособности. Operational Failure. The event which consists in the transition of a facility from one level of operability to another, lower level.

Note: The operability level is defined by a specified listing and specified volume of functions which the facility is capable of performing.

42. Польный отказ работоспособности. Total Operational Failure. An operational failure which places a facility in an inoperable state.

43. Частичный отказ работоспособности. Partial Operational Failure. A loss of operability which places a facility in a partially operable state.

44. Внезапный отказ работоспособности. Sudden Operational Failure. A loss of operability characterized by a sudden reduction in the level of facility operability.

45. Постепенный отказ работоспособности. Gradual Operational Failure. A loss of operability characterized by a gradual reduction in the level of facility operability.

46. Независимый отказ работоспособности. Independent Operational Failure. A loss of operability of a facility which is not due to failures of other facilities.

47. Зависимый отказ работоспособности. Dependent Operational Failure. A loss of operability of a facility due to the failures of other facilities.

48. Устойчивый отказ работоспособности. Persistent Operational Failure. A loss of operability, the restoration of which requires the repair of the facility.

49. Неустойчивый отказ работоспособности. Intermittent Operational Failure. A loss of operability, the restoration of which requires only the disconnection or a change in the operational mode of the facility, without repairing it.

50. Отказ функционирования. Functional Failure. The event which consists in the transition of the facility from one relative functional level to another lower level.

Notes:

1. The functional level is defined by the listing and scope of function which the facility performs.
2. The relative functional level is understood to be the ratio of its actual value to the requisite value at a given point in time.

51. Польный отказ функционирования. Total Functional Failure. A loss of function which places the facility in a nonworking state.

52. Частичный отказ функционирования. Partial Functional Failure. A loss of function which places the facility in a partially working state.

53. Внезапный отказ функционирования. Sudden Functional Failure. A loss of function characterized by a sudden drop in the relative functional level of a facility.

54. Постепенный отказ функциорования. Gradual Functional Failure. A loss of function characterized by a gradual reduction in the relative functional level of a facility.

Note for Terms 41-54: In cases where the possibility of incorrect interpretation is precluded, the use of the term failure is permitted in place of the terms operational failure and functional failure.

55. Отказ срабатывания. Actuation Failure. A functional failure which consists in the failure of a facility to perform a necessary action.

56. Излишнее срабатывание. Excessive Actuation. A functional failure which consists in the actuation of the facility when it is required that other facilities react and there is no requirement for the actuation of the given facility.

57. Ложное срабатывание. False Actuation. A functional failure which consists in the actuation of the facility in the absence of any requirement for the actuation of the given facility and other facilities.

58. Авария. Breakdown. The event which consists in the transition of a facility from one level of operability or relative functional level to another substantially lower one, with a great disruption of the operational mode of the facility.

Note: A breakdown can lead to either partial or total destruction of a facility, a massive interruption of power to consumers, and the creation of conditions dangerous to man and the environment. The attributes of a breakdown are stipulated in the technical standard setting documentation.

59. Локализация отказа функционирования. Localization of a Functional Failure. The event which consists in limiting the consequences of the functional failure of a facility.

60. Восстановление. Restoration. The event which consists in increasing the level of operability of a facility or its relative functional level.

V. Means of Assuring the Reliability of Power Facilities. Providing Back-Up.

61. Резервирование. Providing Back-Up. Increasing the reliability of a facility through the introduction of redundancy.

Note: Redundancy is the additional means and capabilities above the minimum necessary requirements for the performance of the specified functions by the facility.

62. Структурное резервирование. Structural Redundancy. Redundancy which provides for the use of redundant structural elements of a facility.

63. функциональное резервирование. Functional Redundancy. Redundancy which provides for the use of the capability of components of performing additional functions.

64. Временное резервирование. Time Redundancy. Redundancy which provides for the use of surplus time.

65. Информационное резервирование. Information Redundancy. Redundancy which provides for the use of excess information.

66. Общее резервирование. Redundancy in which a backup is provided for a facility as a whole.

67. Раздельное резервирование. Individual Redundancy. Redundancy in which backups are provided for individual components of a facility or groups of them.

68. Постоянное резервирование. Permanent Redundancy. Redundancy in which the back-up components participate in the functioning of a facility on an equal basis with the main components.

69. Резервирование замещением. Substitution Redundancy. Redundancy in which the functions of a main component are transferred to the backup only after the failure of the main component.

70. Скользящее резервирование. Fluttering Redundancy. Substitution redundancy in which the functions of a group of main components of a facility can be performed by one or several backup components, each of which can replace any failed main component in the given group.

71. Фиксированное резервирование. Fixed Redundancy. Substitution redundancy in which the functions of a group of main components of a facility can be performed by one or more backup components, each of which can replace only a definite failed main component in the given group.

72. Резерв мощности, резерв производительности. Capacity Reserve, Productivity Reserve. The difference between the available capacity (productivity) of a facility and its load at a given point in time for the case of permissible values of its operational mode and product quality indicators.

73. Ремонтный резерв. Repair Reserve. The portion of reserve capacity (productivity) of a facility intended to compensate for losses in its capacity (productivity) due to preventive maintenance.

74. Оперативный резерв. Operational Reserve. The portion of reserve capacity (productivity) of a facility intended to compensate for the imbalance between the product output and consumption, caused by failures of facility components, as well as random and unforeseen increases in output product consumption.

75. Аварийный резерв. Emergency Reserve. The portion of the operational reserve of a facility, intended to compensate for losses in its capacity (productivity) caused by failures by facility components.

76. Нагрузочный резерв. Load Reserve. The portion of the operational reserve of a facility intended to compensate for random and unforeseen increases in output product consumption.

77. Эксплуатационный резерв. Operating Reserve. The difference between the working capacity (productivity) of a facility and its load at a given point in time at the permissible values of its operational mode parameters and output product quality indicators.

78. Резерв продукции. Запас продукции. Output Product Reserve. Output Product Margin. The amount of the output product accumulated above that necessary for a definite time interval.

79. Народнохозяственный резерв. National Economic Reserve. The reserve capacity (productivity) or reserve product output intended to compensate for a disruption of the balance occurring as a consequence of the advanced development of related sectors of the national economy.

80. Технологический резерв. Production Process Reserve. The reserve capacity (productivity) and/or reserve product output of a consumer which can be used to prevent a disruption, a reduction in the scope of a disruption or assure the nonemergency termination of a production process of a consumer in case his supply is cut off.

VI. Reliability Indicators for Power Facilities

1. General Concepts

81. Показатель надежности. Reliability Indicator. A quantitative characteristic of one or more properties which comprise the reliability of a facility.

82. Критерий надежности. Reliability Criterion. The stipulations, in accordance with which decisions are made concerning the reliability of a facility.

83. Единичный показатель надежности. Unit Reliability Indicator. A reliability indicator applying to one of the properties comprising facility reliability.

84. Комплексный показатель надежности. Comprehensive Reliability Indicator. A reliability indicator applying to several properties comprising facility reliability.

85. Нормируемый показатель надежности. Standardized Reliability Indicator. A reliability indicator, the value of which is established by the technical standards setting documentation.

86. Наработка. Nonfailure Operation. The duration or volume of operation of a facility.

87. Время восстановления. Restoration Time. The period of time from the moment of a reduction in the level of operability or the relative functional level until the moment of restoration of the requisite operability level or relative functional level.

88. Технический ресурс. Ресурс. Technical Service Life. Service Life. The nonfailure operating time from the start of operation of a facility or its renewal following preventive maintenance until the onset of the ultimate state of this facility.

89. Срок службы. Useful Operating Life. The calendar duration of operation of a facility from its beginning of its renewal following preventive maintenance until the onset of the ultimate state of this facility.

90. Ущерб от ненадежности. Losses Due to Nonreliability. National economic losses caused by the lack of reliability of a power facility, as well as the ecological disturbances related to it.

2. Unit Indicators

Nonfailure Operation Indicators

91. Вероятность безотказности работы. Probability of Nonfailure Operation. The probability that a failure will not occur within the limits of the specified nonfailure operating time.

92. Интенсивность отказов. Failure Rate. The limit of the ratio of the conditional probability of facility failure in a time interval or nonfailure operating time immediately after the given point in time with the condition that there was no failure of the facility prior to this point in time to the duration of this interval, as it tends to become infinitely small.

93. Параметр потока отказов. Failure Flow Parameter. The limit of the ration of the facility failure probability in a time interval or nonfailure operating time immediately after the given point in time, to the duration of this interval, as it tends to become infinitely small.

94. Средний параметр потока отказов. Average Failure Flow Parameter. The ratio of the mean value of the number of facility failures over a specified time interval or the nonfailure operating time to the length of this time interval.

95. Средняя наработка до отказа. Mean Time Before Failure. The mean value of the nonfailure operating time of a facility until the first failure.

96. Наработка на отказ. Time Between Failures. The ratio of the operating time of a restorable facility to the mean value of its number of failures during this operating time.

Note for Terms 91-96: The terms are also applicable to concepts characterizing both operational failures and functional failures of a facility.

Operating Life Indicators

97. Гамма-процентный ресурс. Gamma Percentage Service Life. The nonfailure operating time, during which there is a specified percentage probability that the facility will not achieve the ultimate state.

98. Средний ресурс. Average Service Life. The mathematical mean value of the service life.

99. Назначенный ресурс. Designated Service Life. The accumulated operating time, which when reached, the operation of a facility should be terminated, regardless of its status.

100. Средний срок службы. Mean Operational Life. Mathematical mean value of the operational life.

Repair Suitability Indicators

101. Вероятность восстановления. Restoration Probability. The probability that the time for facility restoration will not exceed the specified value.

102. Интенсивность восстановления. Restoration Rate. The limit of the ratio of the conditional probability of facility restoration in the interval of time immediately following the given point in time with the condition that prior to this point in time there had as yet been no restoration, to the duration of this time interval as it tends to become infinitely small.

103. Среднее время восстановления. Mean Restoration Time. The mathematical mean value of the restoration time of a facility.

Note: Terms applicable to the duration of a state in which a facility is found can be constructed in a similar fashion, for example, the mean emergency repair time.

Operational Controllability Indicators

104. Коэффициент противоаварийной управляемости. The Counter-emergency Controllability Coefficient. The ratio of the mean value of the difference between the number of effective actuations of the control system in the case of emergency modes, and the number of its superfluous and false actuations, to the mean value of the number of its actuation demands over a specified time.

105. Среднее время локализации отказа функционирования. Mean Time for Functional Failure Containment. The mathematical mean value of the period of time from the moment of functional failure to the moment of localization of a facility functional failure.

3. Comprehensive Indicators

Nonfailure Operation, Longevity and Repair Suitability Indicators

106. Вероятность работоспособного состояния. Operable Status Probability. The probability that a facility will be in an operable state at an arbitrary point in time.

Note: Terms for the probability characteristic and other kinds of states can be constructed in a similar fashion, for example, emergency repair status probability.

107. Коэффициент готовности. Readiness Coefficient. The probability that a facility will prove to be operable at an arbitrary point in time, when it is required that it be used for its function.

108. Коэффициент технического использования. Technical Utilization Coefficient. The ratio of the mean value of the time that a facility is in the working state over a certain operational period to the length of this period.

109. Коэффициент оперативной готовности. Operational Readiness Coefficient. The probability that a facility, in a standby mode, will prove to be operable at any point in time, and starting with this point in time, will operate without failing for a specified time interval.

110. Средний недоотпуск продукции. Average Output Product Shortfall. The mean value of the quantity of output product by which consumers were deficient over a specified period of time.

111. Коэффициент обеспеченности продукцией. Output Product Delivery Coefficient. The ratio of the mean value of the amount of product delivered to consumers over a specified period of time, to the amount of it required over this same time period.

112. Коэффициент использования мощности. Коэффициент использования производительности. Capacity Utilization Coefficient. Productivity Utilization Coefficient. The ratio of the mean value of the working capacity (productivity) of a facility to its installed capacity (productivity) over a specified period of time.

Indicators Expressed in Terms of Cost

113. Средний ущерб на один отказ. Average Losses per Failure. The mean value of the losses incurred per failure of a power facility.

114. Удельный ущерб. Specific Losses. The loss, referenced to a unit of output product shortfall or to a unit of limited capacity (productivity), or to a unit of time.

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