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USSR Report

ENERGY

(FOUO 1/81)

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CONTENTS

ELECTRIC POWER

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DESIGNING NUCLEAR REACTOR BUILDINGS

Moscow ZDANIYA ISSLEDOVATEL'SKIKH REAKTOROV (Buildings for Research Reactors) in Russian 1978 pp 2, 4, 154-155

[Annotation and table of contents from book by V.B. Dubrovskiy, A.S. Zinenko, A.A. Levenshteyn, D.A. Metan'yev and A.Ya. Yakovlev, Izdatel'stvo "Nauka", 155 pages]

[Excerpts] The work is devoted to questions of designing the buildings and radiation shielding for nuclear reactors for research. Questions of selection of a sector for construction of the buildings and reactor complexes, designing a master plan, territorial zoning, building lay-out, selection of materials and design decisions for the buildings and shielding and finishing the rooms are examined.

The book is of interest to scientists and engineers working in the area of designing, construction and operation of buildings for nuclear reactors for research, as well as to students specializing in this area. 30 tables, 85 illus., biblio. with 232 titles.

CONTENTS

9194
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ENERGY CONSERVATION

REVIEW OF, PROSPECTS FOR SOVIET FUEL, ENERGY CONSERVATION

Moscow KHIMIYA I TEKHNOLOGIYA TOPLIV I MASEL in Russian No 11, Nov 80 pp 4-9

[Article by I. Ya. Vayner: "Further Improvement in the Efficient Use and Conservation of Fuel and Energy Resources"]

[Text] The life of modern human society in any manifestation is linked to the use of energy. The role of energy resources has become especially noticeable with the acceleration of technical progress in the second half of the 20th century. In the first 50 years of our century, the consumption of fuel and energy resources (FER) tripled in the world, and in the last 30 years it rose 3.5-fold.

Taking into account the intensive consumption of the energy carriers (oil and gas) that are primary under modern conditions, many countries are concerned about satisfying their energy needs with the current structure and rates of FER consumption. An especially alarming situation has developed in the developed capitalist countries (United States, Japan, FRG and others)where the consumption of energy resources, especially oil and petroleum products,is covered to a significant degree by imports from other countries, in particular from the developing nations. The unreliable dependence of the capitalist countries on oil deliveries, in combination with the financial machinations of the oil monopolies ("seven sisters") have already resulted in an acute energy crisis in these countries.

Inflation that has seized the capitalist world promoted a rise in prices for energy resources, especially for oil and petroleum products, by 10-12-fold in the last 7 years. The countries caught in the energy crisis have formulated dozens of sound, semisound and completely unsound energy programs. Their purpose is to formulate "formulas" for balancing the expenditure and influx of energy resources under the created conditions.

The United States is especially distinguished in this respect. Among the numerous programs there are the programs of the last three presidents, including two of J. Carter. Four points that deserve the most attention should be isolated in these programs: a prudent attitude towards their own natural energy resources, especially oil and gas; reconstruction of the energy balance towards an increase in the percentage of coal (United States, FRG), nuclear and hydraulic power, and after the year 2000, the use of nontraditional types of energy on large scales, mainly, solar; increase in the efficient use of FER and their maximum conservation; regulated consumption of energy resources on the whole, and their components by changing the price formation system.

The countries of the European Economic Community hope to reduce the annual rates of energy consumption to 3%, and in the United States to 2%. On the whole all the capitalist countries plan to decrease the specific energy consumption of the gross national product by 5-10% by 1990 as compared to 1971, with a simultaneous 45-50% rise in electricity consumption.

Considerable allocations are made for the implementation of the energy resource conservation program. It is hoped that they will be covered by a reduction in foreign oil imports. However a sober evaluation indicates that imports of oil and petroleum products to the developed capitalist countries, currently roughly 1 billion T/year, can only increase in the future, and the dependence of the capitalist countries that consume energy resources on their suppliers will not diminish.

Our country has considerable potential fuel and energy resources. It is the only highly developed country that provides for its growing energy needs without outside help, despite the fact that the rates of growth in extraction and production of energy resources in the USSR was double that of the world's in the last 30 years. Depending on the economic stage of a country's development, and on the expanded technical potentialities for preparing and using industrial supplies of different energy carriers,the structure of their production and consumption changes. Thus, coal which occupied the primary place in the country's energy balance in the past (66% in 1950), at a certain stage was replaced by more progressive and efficient types of fuel, oil and gas (68% in the 1980 plan).

Reconstruction of the fuel and energy balance towards an increase in the percentage of oil and gas in it permitted an increase in the rates of electrification, mechanization and motorization of the country. The 1950-1975 period was characterized by the discovery and development of major oil and gas fields, primarily in the European sector of the USSR. The economic efficiency of extracting and transporting them to the consumers as compared to coal by mine extraction was evaluated according to the main economic indicators (labor productivity, net cost, specific capital investments) as roughly 1 to 10 in favor of oil and gas. This provided the national economy with tens of billions of rubles of saving in capital investments and current outlays in 25 years.

The 25th CPSU Congress has named the further perfection and reconstruction of the fuel and energy balance in the country as one of the main tasks defining the economic development of the USSR. Taking into consideration the limited nature of the supplies of oil and gas as compared to coal (there is 93% coal, and 7% oil and gas in the earth's depths), the 25th CPSU Congress stressed the need for primary use of oil and gas in the future as motor fuel and technological raw material, gradually excluding their application as boiler-furnace fuel. Here the Congress had in mind significant changes occurring in the economics of the fuel branches. The primary extraction of oil and gas has shifted to the east, into the regions with difficult climate and other conditions. It remains to develop the even more difficult to reach oil and gas fields in East Siberia, sea and ocean shelves.

This will require great financial and other material outlays to maintain the already attained high level of oil and gas extraction, and for their long-distance hauling to regions of the greatest consumption, the European sector of the USSR. At the same time, the extraction of coal by open-pit method is increasing in the coal

industry. Its economic indicators are 3-5-fold better than mine extraction. The relative outlays for extracting the North Tyumen' oil for 1 T of conventional fuel (c.f.) even now are equal or even higher than the outlays for extracting coal by the open-pit method.

The reconstruction of the country's energy balance is a task for many years to come since the fuel branches, especially the coal, have a large time lag. Nevertheless, in the 10th Five-Year Plan new trends and shifts are already noticeable for a reconstruction of the energy balance. Thus, in 1961-1975 the reduction in the percentage of coal was 22 points, or an average of 7.3 points for the five-year plan, In the 10th Five-Year Plan this drop was slowed down and will be 4-4.5 points. The percentage of oil with gas condensate increased in 1961-1975 by 13.3 points. In the 10th Five-Year Plan it will drop by 1-1.5 points. Such a reconstruction of the fuel and energy balance for the optimal combination in it of coal, oil and gas is only one side to the wise and economic approach to the use of the "storehouses" of our earth. It far from exhausts the rich arsenal of measures for an ever more efficient use of energy resources.

The advantage of converting fuel energy into electricity and heat has long been proven. Our country occupies the leading positions in the world in this respect. The percentage of conversion of primary fuel energy into electricity and heat was already 40.8% in 1960 versus 28% in the developed capitalist countries. In 20 years (1961-1980) in our country, the production of FER tripled, and the production of electricity and centralized heat rose 4.4-fold. The production of electricity and centralized heat occupies 47% of the resources of boiler-furnace fuel. The use of water and nuclear energy offers broad possibilities of replacing the scarce mineral fuel to produce electricity and centralized heat at hydroelectric and nuclear power plants. In 1961-1975 the production of electricity at the hydroelectric power plants rose 2.5-fold, and in the 10th Five-Year Plan will increase by no less than 1.5-fold more.

Twenty-six years have passed from the introduction of the world's first Obninsk AES with power of 5,000 kW (in 1954) to the Beloyarsk AES with power of 600,000 kW and fast neutron breeder reactors that was started up in 1980. During this time the total production of electricity at the AES rose to 70 billion kW-h. Nuclear and hydroelectric power plants in the USSR will produce 20% of all the generated electricity this year. Converted to gas it will replace 73 billion m^3, and converted to coal it will replace over 125 million T. Our country's resources in developing hydraulic power are far from exhausted, and the construction of nuclear power and thermal power plants is continuing successfully.

The president of the USSR Academy of Sciences, Academician A. P. Aleksandrov, in an article published in the newspaper IZVESTIYA (10 April 1979) gave a high evaluation to the potentialities of nuclear power engineering: "...the combination of coal and nuclear power engineering is technically capable of providing for all the areas of energy resource consumption, and in the distant future will entirely free oil and natural gas from use in the sphere of energy consumption." Such trends completely respond to the course of reconstructing the country's energy balance that was taken by the 25th CPSU Congress.

The replacement of mineral fuel by other sources of energy does not only include GES and AES. Broad use of nontraditional energy carriers is planned: geothermal water, wind, sea tides, and finally, solar energy. However these sources of

power are still in the research stage, and do not play a noticeable role in the energy balance of the world and our country. But this is a powerful rear support for power engineering. It is enough to recall that the sun annually sends to the earth 180 trillion T of c.f. Roughly half reaches the earth's surface, but this is 8,500 times greater than the expected consumption of the world's energy resources this year.

The replacement of mineral fuel with other sources of energy, although it yields enormous benefit, under modern conditions and in the next 20-25 years will far from guarantee well-being in energy supply. This is understandable since a sufficient alternative will not be created in this period to completely replace the gas-oil motor fuels, mineral fuels at the already active thermoelectric power plants, and hydrocarbon raw material for production processes. The most important state task arises from here: considerable increase in the efficient use of fuel and energy resources and all possible conservation of them.

The practice of using FER that has formed confirms the presence of major reserves here. The percentage of efficient use of energy from its production in the entire world is not even half. Of the four stages of the energy cycle (extraction, enrichment and conversion, transporting, storage and distribution, and use), extraction and final use are the most inefficient stages. They are responsible for 86% of all the energy losses. At the thermal power plants only 30% of the energy of the burned fuel is brought to the consumer. Only 10% of the fuel energy is converted into motion energy in cars. One of the main reasons for the low efficiency in the use of FER is the low efficiency of the machines and the unsatisfactory energy technology of production. Large heat losses occur in industrial and civil buildings. The fuel losses during transporting and storage are still great. Direct losses at the oil refineries during the production of petroleum products are 1.5-2% for the refined oil.

The Communist Party at its congresses, Central Committee plenums and in special decrees mobilizes the workers to fulfill the important program of increasing the efficient use and conservation of energy resources. At the November (1979) Plenum of the CPSU Central Committee, Comrade L. I. Brezhnev stated: "It goes without saying that the planned assignments for fuel conservation must be fulfilled. Not only the econonomic organizations, but all the party and soviet organs from top to bottom are called upon to be concerned about this."

The newspaper PRAVDA on 30 March 1980 published materials from the decree of the CPSU Central Committee "On Work of the Pavlodar Oblast Party Organization to Fulfill the Decree of the CPSU Central Committee on Conservation of Fuel and Energy Resources at the Enterprises and Construction Sites." It states, in particular: "The CPSU Central Committee entrusted the Central Committees of the Communist Parties, Councils of Ministers of the union republics, kray, oblast, city and rayon party committees, and the ispolkoms of the soviets of people's deputies to examine the course of fulfillment of the CPSU Central Committee and USSR Council of Minister decrees on conservation of energy resources and supply of fuel to the national economy, as well as organizational-technical measures developed locally for these questions, and to take additional measures for their realization."

Realization of the program to increase the efficient use and conserve FER yields noticeable results. In 1975 as compared to 1950,900 million T of c.f. were conserved (with regard for "replacement"). In this period major national economic

measures were taken to increase the efficient use of energy resources: the percentage of combined generation of heat and electricity was increased, the parameters of steam in electrical power engineering were raised, the boilers were enlarged, and the steam engines were replaced with diesel and electric engines. These measures alone provided more than half of all the FER conservation in 1951-1975.

In addition, during this period the standards of energy resource consumption were reduced for manufacturing industrial products (this, in particular, saved 370 million T of c.f. in 1975 as compared to 1960) and the production of heat and electricity. The use of secondary energy resources was increased. Measures were taken to control FER losses. As a result the specific energy consumption of the national income dropped by 17.5% in 1975 as compared to 1965. A lot was also done to increase the efficient use of fuel at the stages of its production and extraction. Thus, the introduction of progressive methods for developing the oil fields permitted an increase in the planned degree of extraction of oil from the depths to 45-48%. This is the best indicator in the world.

In accordance with the decisions of the 25th CPSU Congress the total saving of FER in 1980 should surpass 132 million T of c.f. In the current five-year plan the standards of boiler-furnace fuel consumption must be reduced by 3-4%, of gasoline and diesel fuel by 8%, and of electricity and heat by 5%. The replacement of mineral fuel in the generation of electricity at the GES and AES should surpass the level reached in 1975 by 3-4-fold. At the same time, there are still large reserves for increasing the efficient use of FER and conserve them. The mobilization of these reserves, in addition to traditional measures, suggests the use of new major factors: the introduction of new machines and mechanisms with increased efficiency; transition to more advanced energy-conserving technology in industrial production, construction and transportation; intensification of the organizational and technical work at all stages of the energy cycle.

The production enterprises, scientific research institutes, ministries and departments, and planning organizations of the USSR and the union republics are doing a lot of work to further save fuel and energy resources. This work has been significantly activated due to the appeal of the CPSU Central Committee for a worthy meeting of the 26th Communist Party Congress.

The most important trend in the conservation of energy resources, as before, remains the scientifically substantiated decrease in the standards of consumption of fuel, electricity and heat per unit of produced industrial product. In the past 20 years, the fuel consumption standard for production of electricity dropped by almost 40%, and for steam and hot water in the rayon boiler houses by 22%. Further introduction of highly economical power units of high output, increase in the efficiency of the boilers that are made, equipping of the boilers with means of automatic regulation and monitoring, the use of economizers and air-heaters, and elimination of small boiler houses and other meausres will permit a future reduction in the specific standards of fuel consumption to produce electricity and heat.

In the introduction of new power engineering units one should expect a large reduction in the standards of electricity consumption in the production of ammonia gas, methanol, nitric acid, ethylene, divinyl, yellow phosphorus, chlorine and caustic soda. Machine construction and metal-working consume roughly 10% of the

electricity and heat produced in the country. The enterprises of these branches still have large reserves for conserving electricity and heat, including by underloading the electric motors and electric furnaces, and from losses of compressed air, water and heat, and the low collection of condensate. Electrical furnaces still dominate in heat treatment instead of the more economical gas.

A further reduction in the consumption of electricity in machine construction and metal-working is envisaged by increasing the technical level of machining, welding and perfecting founding, increasing the loading of equipment, expanding the assortment of rolled metal products, replacing the metal castings with plastic, etc.

Preliminary calculations show that the implementation of these measures can save 12-14 million T of c.f. per year in machine construction and metal-working in the next five-year plan, and 20 million T of c.f. per year by the end of the decade.

In 1975 ferrous metallurgy used 12.9% of the country's energy resources (without consideration for the consumption of hydrocarbons as raw material). The saving of energy resources in this branch is planned by perfecting the technology of smelting and heating metals, increasing the loading of the furances, reducing their idle time, introducing new units of continuous teeming of steel, installation of recovery units, the use of more advanced burners, improvement in the thermal insulation of the furnaces, etc. A considerable saving of fuel and energy resources can be obtained with a reduction in losses of electricity in the power transmission circuits. In 1975 these losses almost equalled the annual consumption of electricity in the country in 1950. Measures to reduce losses in the electrical circuits are: selection of the optimal circuit plan, shortening of the repair period for equipment in the electrical circuits, etc. A reduction of losses in the circuits by 1 billion kW-h will save over 300,000 T of c.f.

Transportation is one of the major consumers of fuel and energy resources. In 1975 over 160 million T of c.f. were consumed by all types of transportation. Of them 52% were spent for automobile and 19.8% for railroad transportation. As a result of the major measures taken in the last 20 years on railroad transportation (conversion from steam propulsion to electric and diesel, replacement of biaxial cars by four-axial, etc.) the saving of fuel and energy resources in 1975 as compared to 1960 was about 100 million T of c.f.

The freight turnover in truck transportation in 1961-1975 rose 3.4-fold, the passenger turnover rose fivefold, while the expenditure of fuel for these purposes only tripled. Such shifts are explained by the increase in the efficiency of the internal combustion engines, rise in the load capacity of the trucks, construction of roads with hard surface, and certain other measures. The use of fuel for air transportation was improved. In 1975 as compared to 1960 the weighted average consumption of aviation fuel dropped by 27%, as well as for river and sea transportation.

At the same time all types of transportation have broad possibilities for a further saving of fuel and energy resources. In automobile transportation the trucks will be rapidly converted into diesels. Bringing the diesel conversion to 55-60% with the planned growth in freight turnover will save 30-35 million T of c.f. Besides reduction in fuel consumption, the diesel conversion decreases the toxicity of the exhausts, and diminishes the transportation and storage expenditures. A noticeable reduction in fuel consumption is expected from an inreased

use of trailers and semitrailers. According to the data of the RSFSR Ministry of Automobile Transportation, for 100 trucks there are 25 trailers instead of the 1.5 trailers per one truck required by the standards of truck freight. The construction of roads with hard pavement noticeably influences the reduction in fuel consumption in automobile transportation. There are considerable reserves of fuel conservation in perfected planning of freight hauling and the use of transportation, intensification in control over the consumption and storage of fuel, and improvement in the quality of fuels and oils.

The consumption of gas during its transporting on the main gas pipelines increases significantly each year due to the large percentage of gas-turbine drives at the compressor stations. The planned growth in the percentage of electric drives at the compressor stations of the gas pipelines will free tens of billions of cubic meters of gas.

Intensive mechanization and electrification of agriculture considerably expand the boundaries for use of energy resources in it. According to the formed structure of fuel use, diesel fuel is used the most in agriculture. Its consumption for tractor work alone in agriculture in 1980 will be over 35 million T. The introduction into agriculture of economical machines, advanced technology, new forms of using equipment, perfection in the repair and maintenance of the machine-tractor fleet, improvement in the delivery, storage and fueling of mechanisms, increase in responsibility and improvement in control of the development and observance of fuel and energy resource consumption standards will help to save enormous amounts of fuel and energy in this major section of national economic activity.

The concern of the Communist Party for the growth in the national welfare also influences the increase in energy consumption in daily life. In 1980 as compared to 1965, the consumption of fuel and energy resources in residential-communal services rose 3.4-fold for electricity, and almost 4-fold for centralized heat supply. The main reserves of saving in this sector are associated with the further centralization of the heat supply, and improvement in the efficiency of furnaces and boilers. It is planned to increase the thermal insulation of residential and public buildings, equip the central heating with valves of double regulation and instruments for automatic temperature regulation for the heat carrier, and improve the metering of consumption of water, gas and electricity in the apartments. This will significantly increase the saving of energy resources in the communal-general sector. The active assistance of the population in saving electricity and heat, water and gas in the residential and public buildings will be a worthy contribution to the conservation of energy resources.

A lot of work has been done to save energy in the oil refining and petrochemical industries where, as is known, the rise in volumes and extent of oil refining, broadening of the assortment and increase in the quality of products are objectively accompanied by an increase in FER consumption. In 1966-1975 at the enterprises of the USSR Ministry of the Petrochemical Industry the fuel consumption increased 1.8-fold, heat 1.9-fold with a rise in the production of industrial products twofold. The consumption of FER could be even greater if measures were not taken in the branch to conserve them. As a result of the measures taken in 1975, as compared to 1970, the consumption of fuel, heat and electricity dropped by 15.5% per 1 T of refined oil. Work is being completed to save FER in the 10th Five-Year

Plan which will further reduce the outlays for 1 T of refined raw material. The work to save energy will be continued. The USSR Ministry of the Petrochemical Industry and its scientific research institutes are generalizing the experience of work to save FER and plan new tasks in this direction.

In the program being formulated to improve the efficient use and save FER in the oil refining and petrochemical industry, everything is important, starting with the timely and systematic exporting of the product (delays in exporting result in operation on a circulation pattern at a number of enterprises with additional consumption of energy resources) and ending with the use of unified energy systems to produce electricity and steam in gas turbines with recovery of the heat from exhausts.

Reduction of irreversible losses of oil and petroleum products is very important for saving FER in the oil refining and petrochemical industry. For this purpose it is necessary to organize the collection and compressing of the refinery gases, to equip the tanks with pontoons and nonfreezing valves, to replace the immersion coolers with air coolers, to enlarge the production devices into blocks and build combined units, and to introduce more widely low-temperature chemical methods of desulfurization of oil and petroleum products.

With a reduction in the irreversible losses to 1.1-1% for the refined oil one can expect a saving of oil and petroleum products of 3-4 million T/year. The reduction in standards of irreversible losses should be linked to regulated metering of the losses, development and introduction of an advanced method of metering. Not all the oil refineries make complete accounting of the incoming products from the outside, for example, in the form of residues from steam-curing of tanks used for fuel, losses of fuel during burning up of coke from catalyzers, etc.

An increase in the percentage of use of secondary energy resources (SER) in the oil refining and petrochemical industry is one of the major sources of energy conservation. In this branch a source of heat SER is the heat of flue gases from the furnaces of production units, pyrolytic contact gases, gases of catalyzer regeneration, heated product streams, spent steam, etc. With proper attention to the use of thermal and fuel SER the saving of FER can be doubled as a result, i.e., brought to 12-15 million T of c.f. per year. Special equipment and devices are need to recover the SER. One should also bear in mind that the specific capital investments into recovery of secondary energy resources as converted into conventional fuel is 10-12-fold lower than for extraction of 1 T of c.f. The measures noted above and others have the final goal of reducing the specific consumption of fuel and energy resources per unit of manufactured industrial product.

In the national economy, in particular in the oil refining and petrochemical industry, roughly 75% of the FER is used in the form of boiler-furnace fuel, heat and electricity. In the past decade the standards of boiler-furnace fuel and heat consumption in the oil refining industry dropped, while those of electricity were stabilized. At the same time, in this branch due to the intensification of oil refining, factors will appear more and more that promote an increase in the fuel, heat and electricity consumption standards. Thus, in 1975 as compared to the primary refining of oil, the actual specific consumption of fuel was higher: in catalytic cracking by 1.9-fold; in thermal cracking by 1.7-fold; in coking by 2.2-fold; in catalytic reforming by 2.9-fold; and in pyrolysis by 3.5-fold.

The circumstantce that have been formed required important additional measures that are capable of reducing to a certain measure the influence of negative factors on the growth in consumption of fuel and energy resources in the oil refining industry. Such measures include first of all: further concentration of production, enlarging the unit output of units, combining the complex technological processes, converting the equipment to direct feeding of raw material, transfer of the hot petroleum products without intermediate cooling, use of more efficient catalyzers, and the maximum replacement of furnace mazut with plant gases.

There are all grounds to expect that the collectives of the oil refining and petrochemical plants with the active cooperation of the scientific research institutes in the branch and the USSR Ministry of the Petrochemical Industry will make a worthy contribution to the improvement in the efficient use and saving of fuel and energy resources of our country.

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ENERGY CONSERVATION

RSFSR PETROLEUM INSPECTION CONTROLS CONSERVATION, CONSUMPTION OF FUELS

Moscow KHIMIYA I TEKHNOLOGIYA TOPLIV I MASEL in Russian No 11, Nov 80 pp 10-12

[Article by T. Z. Khuramshin, chairman of the RSFSR Goskomnefteprodukt: "Conservation of Petroleum Products in the RSFSR National Economy"]

[Text] The entire world attributes great importance to an efficient and economical consumption of fuel and energy resources (FER). A strengthening of the energy conservation policy in the national economy is an indispensable condition for the further success of the Soviet economy. Its development is accompanied by an intensive growth in production and consumption of oil and petroleum products, gas, coal and other primary sources of energy. In 1980 the USSR plans to extract 606 million T of oil (including gas condensate), 435 billion m^3 of gas,and 745 million T of coal.

With the modern scales of FER production, a reduction in the consumption only by 1% in 1980 will save about 20 million T of conventional fuel (c.f.). Therefore, in order to guarantee an efficient and economical use of FER target complex scientific and technical, economic and social programs are created that cover all the branches of the national economy.

In particular, an increase in the efficient use of liquid fuels is determined by the degree of their use to operate the fuel-consuming equipment, reduction in the energy-consumption of the production processes, improvement in the standardization and metering, and perfection of the production operations for reception, storage and distribution of fuel at the bases and warehouses of the oil supply agencies and the consumers.

The large amount of attention that the party and government, planning and economic organizations give to saving and efficient use of FER promotes the development of socialist competition to conserve all types of fuel and energy. In addition to the development of organizational and technical measures that are the basis for an efficient and economical consumption of petroleum products, it is very important to use scientifically substantiated standards of consumption for fuel and lubricants, to review them in time in accordance with the perfection of equipment and technology of production, and to organize control over the observance of these standards. Their correctly organized metering during storage and consumption occupies a significant place in reducing the losses of motor fuels and lubricants.

Each industry should use approved specific and operating standards of motor fuel consumption for all types of equipment that consume petroleum products. For each

automobile, tractor and other equipment travel and accounting sheets should be filled out. In addition to other indicators they should reflect the results of fuel consumption. These primary documents that were approved by the USSR Ministry of Finances and the USSR Central Statistical Administration, are mandatory for all enterprises and organizations who use the automobile and tractor fleet. The efficient use of fuel and lubricants, and their quantitative and qualitative preservation depend a lot on the technical equipping and condition of the warehouses for storage of the petroleum products, and care of the employed equipment.

Automobile engines use over half of the energy resources consumed by all types of transportation. However the specific consumption of energy resources in automobile transporation is 19 plus times higher than in railroad, and 14 times higher than in river. Cars are one of the main consumers of automobile gasolines and diesel fuels. Due to the continuous growth of the automobile fleet,the demand for these fuels is rising. Therefore all the measures directed towards saving engine fuels are very urgent (careful consideration of the consumption of petroleum products, systematic analysis of the actual consumption according to types of work, regulation of the storage of fuel, mechanized filling of cars and mechanisms, high-quality maintenance, etc.). Agriculture is one of the largest consumers of petroleum products in the country. A decrease in the losses of fuel in this branch by 1% alone will save 20-30 million rubles and decrease the consumption of lubricants by 2.5 million rubles per year.

The struggle against losses of petroleum products has not only technical and economic, but also social importance. The petroleum products that are lost during the operation of equipment, as well as in transportation, storage and distribution do not disappear without a trace, but pollute the environment. Therefore all the measures that prevent losses of these products are directed towards improving working conditions,guaranteeing cleanliness and efficiency of production, and protecting the environment.

The work of the RSFSR Petroleum Inspection plays a large role in improving the efficient use of fuel and energy resources in the national economy. Besides fulfillment of the main functions (planning and control over the supply of the national economy), the system of oil supply has been given control over the efficient and economical consumption of petroleum products at the enterprises of industry, transportation, in the construction organizations and agriculture. The RSFSR Petroleum Inspection with inspections in the petroleum marketing administrations was set up to implement these functions in the RSFSR State Committee for Provision of Petroleum Products.

In accordance with the decision of the RSFSR Council of Ministers the RSFSR Petroleum Inspection has the right to obtain from the ministries, departments, enterprises, institutions and organizations the necessary planning and accounting documents on questions in its competence, data on the consuming units and standards of consumption of petroleum products, plans of measures for their saving, to freely visit and examine all sites and facilities where petroleum products are stored distributed and consumed, and to give instructions on elimination of the detected violations that are mandatory for all organizations. The main task of the RSFSR Petroleum Inspection is to control the efficient and economical consumption of petroleum products and the turning in of used oils.

Work is done in close contact with the agencies of people's control. In 1979 the RSFSR Petroleum Inspection checked about 9000 enterprises and organizations of 13 branches of the national economy in all oblasts, krays and autonomous republics. At the same time the workers of the Petroleum Inspection, bulk plant and administrations of the RSFSR Goskomnefteprodukt [State Committee to Supply Petroleum Products] gave practical assistance to 1800 kolkhozes, sovkhozes, enterprises and organizations to develop and implement measures for conservation of fuel and lubricants, improvement in the organization of petroleum storage, publication of resources of graphic agitation, etc. In order to propagandize the leading methods of conservation and to analyze the shortcomings in the use of petroleum products, the staff and nonstaff inspectors of the Petroleum Inspection appear in the press, on radio and television (in 1979--550 appearances).

The RSFSR Petroleum Inspection analyzes the materials from checks to determine the condition of use of the petroleum products in the RSFSR national economy, in each branch, autonomous republic, kray and oblast. The appropriate ministries, departments and local organizations are informed of the results of the analysis. They take measures to improve the use of the fuel and energy resources. The local party and soviet organs are informed of the detected shortcomings. Materials on gross violations in the use of petroleum products that result in material damage are sent to the procurator's office. In 1979 810 materials were sent, and specific decisions were made on 530 of them.

Guided by the decree of the USSR Gossnab the RSFSR Petroleum Inspection is making broader use of the right to apply fine sanctions to the consumers who transfer petroleum products in violation of the order set by this decree. The fulfillment of the instructions of the RSFSR Petroleum Inspection and the introduction by the consumers of the suggestions of the inspectors that are directed towards saving petroleum products annually save a total of 3-6 million rubles in resources, depending on the volume of petroleum products consumed. As a result of the measures taken the use of lubricants is improved, their specific consumption is reduced and losses are curtailed.

At the same time in many industries fuels and oils are consumed inefficiently. The reserves for reducing their consumption are not used to a full measure. In the RSFSR agriculture overconsumption of automobile gasoline as compared to the allocated funds is allowed. In the first 6 months of 1980, according to the data of the RSFSR Central Statistical Administration, the kolkhozes and sovkhozes of the 50 autonomous republics, krays and oblasts of the RSFSR overconsumed several tens of thousands of tons of automobile gasoline.

Considerable quantities of fuel and oil are lost due to their use not for their direct purpose. Despite the fact that it is impermissible to burn diesel fuel in boilers, and to use fuels and oils of one brand instead of another, such facts are fairly common in the industries and in the enterprises of the Russian Federation. In 70% of the checked kolkhozes and sovkhozes diesel fuel is used to heat residential-general rooms and to wash parts, and lubricants are sold to enterprises and organizations that are not associated with agricultural work.

The sale of fuel on the side reaches 5% in certain industries of the Saratovskaya oblast, while over 10% of the diesel fuel is used for heating. In the agriculture of the Tambovskaya oblast in 1979 thousands of tons of diesel fuel that were allocated for the operation of agricultural machines were burned in boiler houses.

In the sovkhoz "Sarinskiy" of the Orenburgskaya oblast 27 T of diesel fuel were sold, 4485 l of gasoline were given away free, 400 T of diesel fuel were burned in the boiler house and bath, while 100 T of this amount was written off for operation of equipment. The checks revealed the sale of petroleum products to outside organizations by the kolkhozes and sovkhozes of the Bryanskaya, Kurganskaya, Orlovskaya, Tyumenskaya and Yaroslavskaya oblasts in 1980.

Violations of the fund discipline for the use of motor fuels occurred at the enterprises of other branches of the national economy. According to the data of the RSFSR Central Statistical Administration, in 1979 only 9 ministries and departments sold over 20,000 T of fuel to other organizations. They included: RSFSR Ministry of the River Fleet--8,300, RSFSR Ministray of Automobile Transportation--4,300, RSFSR Ministry of Agricultural Construction--2,300, RSFSR Ministry of the Gas Industry 2,200, and RSFSR Ministry of Water Management--1,500. Individual organizations of the Rospotrebsoyuz [RSFSR Union of Consumer Societies]use up to 40% of the lamp kerosene intended for the population, not for its direct purpose, including burning it in boilers and selling it on the side.

Shortcomings in standardization and accounting of the petroleum products and volumes of work were revealed at the enterprises of the RSFSR Ministry of Residential and Communal Services and the RSFSR Ministry of Forestry. In 70% of the enterprises of these ministries that were checked, the automobiles are used with inoperative speedometers. This promotes additions of work volumes and illegal writing off of fuel. In the majority of enterprises fo the RSFSR Ministry of the Gas Industry, RSFSR Ministry of Water Management and RSFSR Ministry of the Fuel Industry that were checked, maintenance and repair of the machine-tractor fleet are not done in time and not completely. For this reason up to 2% of additional fuel is lost.

There is an unfortunate situation in the use of petroleum products in the organizations of the RSFSR Ministry of General Servicing of the Population. For example, over 2,000 T of petroleum products are consumed in the Tula oblast administration of this Ministry. However the lack of proper control over their use and neglect of accounting do not permit determination of the quantity of conserved or overconsumed fuels and lubricants. Storage of the liquid fuel has been poorly organized. The oil warehouses are in unsatisfactory condition. No fuel consumption limit has been set for each automobile. The coupons for fuels and lubricants are issued to the drivers immediately for the month.

Analysis of the checks on the industries, as well as the republic, kray and oblast organizations showed that the shortocmings in the use of fuels and lubricants are a consequence of the poor organization of work to conserve them. It is the direct obligation of the officials who are responsible for the use of petroleum products to eliminate these shortcomings. As a rule, the overwhelming majority of violations can be eliminated in a short time without any outlays. The ministries and departments should focus more attention on conservation of fuels and lubricants, guarantee the development of measures for conservation of petroleum products for each sovkhoz, kolkhoz, enterprise and organization, and strictly follow their fulfillment. One should establish constant and active control over the efficient use of fuels and oils in the subdepartmental enterprises and organizations.

The struggle for conservation of material resources is a multifaceted process. It requires not only economic and organizational measures, not only the use of

ideal equipment and the leading technology, but also the purposeful educational work at all levels of economic leadership. Strict accounting for each kilogram of fuel, a principle of economical and efficient management, must become mandatory for all enterprises of industry, transportation, construction organizations and agricultural production.

The following will promote a further increase in the efficient use of petroleum products and an all possible intensification of the saving pattern:

guarantee that the ministries, departments and other organizations of the state administration see that the fund discipline in consumption of petroleum products is observed by each subdepartmental association, enterprise and organization;

development and introduction of scientifically substantiated consumption standards that stimulate the control over economical use of liquid fuel; implementation of measures to reduce the specific consumption of fuel to produce a unit of product;

intensification of supervision over the observance of the order of consuming petroleum products by the controlling agencies;

increase in responsibility of the enterprises, institutions, organizations and officials for inefficient or wasteful use of petroleum products;

development of a network of filling stations for general use that promote the most favorable conditions for operation of automobile transportation. Here it no longer becomes necessary to build small, unprofitable filling stations and petroleum warehouses at the enterprises and organizations.

9035
CSO: 1822

ENERGY CONSERVATION

UDC 658.26:665.63/64:66.013.6

ENERGY CONSERVATION MEASURES OUTLINED FOR OIL REFINING, PETROCHEMICAL INDUSTRY

Moscow KHIMIYA I TEKHNOLOGIYA TOPLIV I MASEL in Russian No 11, Nov 80 pp 13-16

[Article by G. M. Yermolov in the column "Efficient Use of Energy in Oil Refining": "Conservation of Fuel and Energy Resources in Oil Refining and Petrochemical Industries"]

[Text] The economic development of a country depends to a decisive measure on its supply of fuel and energy resources. The USSR now extracts over 2 billion T of conventional fuel per year. This is one-fifth of the entire world consumption. We could not get along without oil, gas, coal and electricity in practically any sphere of life: at the enterprises, fields and farms, in daily life. However it is important not only to increase to the maximum the volumes of production of all types of fuel and electricity, but also to guarantee a more efficient and prudent use of them.

The party and government are focusing unremitting attention on the further strengthening and development of the fuel and energy base of the Soviet economy, and the maximum saving of fuel, heat and electricity. The decree of the CPSU Central Committee on this question obliges the leaders of the ministries, departments, associations and enterprises to head the struggle for an economical and efficient consumption of everything that our country's economy has, to strengthen the planned and executive discipline at all sections of economic construction, and to strictly fulfill the assignments for an increase in the resources of fuel, heat, electricity, and petroleum products, and their prudent consumption. The struggle for the strictest conservation of fuel, heat and electricity is not a short-term campaign, but a great political matter and it should be conducted with all persistence.

Reduction in the energy expenditures in the oil refining and petrochemical industry is the traditional task of perfecting industrial production, and is directed both towards a decrease in its costs, and conservation of fuel and energy. This is dictated by the fact that oil refining and petrochemistry are not only the producers, but also major consumers of energy. In 1979 7% of the volume of refined oil was spend in the form of fuel, heat and electricity for refining oil and producing petroleum products. Here direct fuel accounted for 57.3%, heat and electricity respectively accounted for 33.0 and 9.7%. Thus, a reduction in the energy intensity of production in oil refining is directly linked to an increase in the output of commercial product, since a reduction in the consumption of fuel and energy will permit production of an additional quantity of petroleum products.

The enterprises of the oilrefining and petrochemical industry are systematically developing and implementing plans of organizational and technical measures for conservation of fuel, heat and electricity, and the maximum use of the available secondary energy resources. The main directions of conservation of fuel and energy include:

introduction of modern, highly productive combined production units (ELOU-AVT-6, LK-6u, L-35-11/1000, EP-300, and others) and industries (monomers, synthetic rubber, ammonia, and others) with lower specific expenditures, and the transfer of the production units from operation on a successive plan of refining petroleum products to operation on a "rigid plan" for feeding raw material. This excludes excess operations for pumping, cooling and subsequent heating (this can result in a decrease in the consumption of conventional fuel of 1 million T, 21,800 TJ of heat and 1.5 billion kW-h of electricity in the branch in 1985 as compared to 1980);

reconstruction of the active production units and industries with an increase in their technical and economic indicators by using more ideal equipment and apparatus, highly efficient catalyzers and modern production plans;

creation at the large oil refineries and petrochemical enterprises of an intra-plant system for industrial central heating with the maximum use of secondary energy resources and reduction in the consumption of central heating water from the TETs and boiler houses;

increase in the efficiency of furnaces by improving control over the combustion pattern of fuel and their equipping with recovery equipment (boiler-recovery units, air heaters, water economizers);

use at the plants of technical grade carbon of chemical heat from low-calorie exhaust gas to generate steam in the boiler-recovery units, as well as the physical heat of the technical-grade carbon gas mixture to heat the raw material, air and central heating water;

switching of heating the industrial and administrative buildings and warming of the pipelines that transport viscous and easily-frozen products from steam to hot water;

increase in the efficient use of secondary energy resources (heat of contact gases and gases of regeneration in the production of synthetic rubber, gas-liquid streams in oil refining and petrochemistry, steam of secondary boiling of condensate, etc.);

reduction in the losses of energy in the plant heat and electrical networks, introduction of alternate-group self-start-up of important electric motors, etc.

As a result of implementing the measures to conserve fuel and energy at the enterprises of the oil refining and petrochemical industry 2% conventional fuel from the total production consumption was saved in 1976-1979. Below are the data for conservation of fuel and energy resources versus the planned standards set for a unit of processed raw material or produced product, in %:

	1976	1977	1978	1979
Fuel	1.38	1.36	2.08	1.65
Heat	2.30	2.77	2.64	2.07
Electricity	2.03	2.80	2.95	2.22

Systematic work is underway in oil refining and petrochemistry to expand the use of the available secondary energy resources. There are currently hundreds of boiler-recovery units operating at the enterprises of the branch. This permits the use of physical heat of the outgoing furnace flue gases, contact gases and gases of regeneration that are formed in the production of synthetic rubber and pyrogas obtained during the production of ethylene.

A lot of work is being done to recover heat of the warmed product streams, steam heat of secondary boiling of condensate, spent heat after steam turbines and piston pumps. Thanks to the increased attention to questions of using secondary energy resources, 10.9% of the total needs of the branch enterprises for heat were guaranteed by generation of heat in the recovery units. This included 20.2% at the synthetic rubber plants.

The greatest success in using secondary energy resources was attained by the Mozyr' oil refinery, the production association "Nizhnekamskneftekhim," the Novokuybyshev petrochemical kombinat, the Tol'yatti production association "Sintez-kauchuk," Kremenchug oil refinery and Sterlitamak synthetic rubber plant. This was attained by using secondary resources to supply their needs for heat respectively by 30.8, 29.9, 25.4, 21.5, 21.4 and 21.2%.

A lot of work has been done by the Yaroslav branch of the institute "Rezinoproyekt," the production association "Tekhenergokhimprom," the G. M. Krzhizhanovskiy Power Engineering Institute, the Belgorod boiler construction plant and the enterprises of the all-union production association "Soyuztekhuglerod" in creating and introducing recovery equipment for burning low-calorie (1680-3360 kJ/m^3) exhaust gas from producing technical grade carbon that has a content of over 40% moisture. In 1979 547,000 T of conventional fuel were saved by burning this gas. Work has been well organized for recovery of the exhaust gas at the Volgograd, Syzran' and Kremenchug technical grade carbon plants.

The all-union competitions for the best suggestion to save heat and electricity conducted by the All-Union Council of Scientific and Technical Societies and the Gosenergonadzor [State Energy Inspection] of the USSR Ministry of Power and Electrification, as well as the public inspections of the efficient use of raw materials, materials and fuel and energy resources conducted by the USSR Ministry of the Petrochemical Industry and the central committee of the trade union of workers in the chemical and petrochemical industry promote the increase in efficient use of fuel, heat and electricity a great deal. In the public inspection of 1979 over 220,000 people participated. They made 60,330 efficiency expert's suggestions. During the inspection over 48,700 suggestions were realized that permitted a saving of material-raw material and fuel-energy resources of 64.8 million rubles. According to the results of the public inspection the 25th CPSU Congress Novopolotsk Oil Refinery was awarded first prize with presentation of a diploma and the challenge Red Banner of the AUCCTU, Komsomol Central Committee and the USSR Gossnab. Diplomas of the AUCCTU, Komsomol Central Committee and the USSR Gossnab were awarded to the Mozyr' Oil Refinery, the M. V. Frunze Ufa Plant of Rubber Technical Items, the Berdyansk Experimental Petroleum and Oil

Plant, the Omsk Synthetic Rubber Plant, the Kirov Tire Plant and the Volgograd Technical Grade Carbon Plant.

Intrabranch inspections are also made for the best organization of work to save fuel and electricity. During the 1979 inspection made by the all-union production association "Soyuznefteorgsintez," 1290 suggestions were introduced that permitted a saving of 341,000 T of conventional fuel, 7543 TJ of heat and 290 million kW-h of electricity. The Syrzan', Novopolotsk and Mozyr' oil refineries were acknowledged as the best among the enterprises of the all-union production association "Soyuznefteorgsintez."

The analysis of the use of energy by the most energy-intensive industries and technological processes made by the power-mechanical section of the Scientific and Technical Council of the USSR Ministry of the Petrochemical Industry, and the periodically held seminars to exchange experience on the running of enterprises for the economical use of fuel, heat and electricity, and increase in the efficient use of secondary energy resources render significant help to an economical and prudent attitude towards consumption of all types of fuel and energy.

The energy service of the engineering and production trust (IPT) "Orgneftekhimzavody" renders significant help in perfecting the energy management of the enterprises. It starts up and adjusts boiler units, production furnaces and heat networks, adjusts the water-chemical operating pattern of power plants, industrial boilers and boiler-recovery units, as well as the electrical services of the enterprises.

The Kuybyshev EPNB (energy start-up and adjustment brigade) of the IPT "Orgneftekhimzavody" successfully adjusts the operating pattern of the heat networks and renders technical assistance in switching the heating from steam to hot water. As a result of switching the users of the I and II phase of the Kuybyshev oil refinery from steam to hot water, the conditions of heat supply were considerably improved. This saved 29.4 TJ/year of heat.

The Ryazan' EPNB developed a device of alternate-group self-start-up of electric motors. Its production was developed by the Ryazan' Experimental Industrial Plan of the scientific production association "Neftekhimavtomatika." This device prevents violations of the production pattern in units of primary oil refining during short-term interruptions in the electrical supply. Such devices have been introduced at the Ryazan', Kremenchug, Krasnovod and Novopolotsk oil refineries. The calculations show that the annual economic effect from using the self-start-up devices on the AVT-6 units will exceed 115,000 rubles.

At the oil refining enterprises work is being done with the participation of the VNIPIneft' [All-Union Scientific Research and Planning Institute of the Oil Refining and Petrochemical Industry] to increase the degree of usage of heat on the AVT and AT units by selecting the optimal velocities of the heat carriers and increasing the average temperature pressures in each heat exchanger. The VNIPIneft' has developed a program to compute the heat exchange plans with the help of a computer for the AVT-3.5 unit. As a result of the reconnection of the active heat-exchange apparatus the oil temperature before the K-1 column was successfully raised by 40-45°C. This reduced the consumption of fuel by 14,000 T, disengaged eight apparatus of air cooling with total rated power of the electric motors of 560 kW, and in addition, improved the output of the unit by unloading the "hot jet" furnace of column K-1.

The Giprokauchuk [State Scientific Research and Planning Institute of the Synthetic Rubber Industry] is focusing a lot of attention on the efficient use of secondary energy resources. The institute is constantly working on perfecting the production plans, and use of more efficient and economical technical designs. Its plans make broad use of absorption bromide-lithium cooling units type ABKhA-5000 that are designed to cool water to a temperature of 7°C. The heat carrier in these units is secondary energy resources, hot water with 90 and 95°C temperature obtained in the dehydration shops. Such units are currently operating in the production association "Nizhnekamskneftekhim" and at the Sterlitamak plant of synthetic rubber. The economic effect from introducing one unit is 80,000 rubles per year. In 1980-1982 it is planned to introduce another 12 ABKhA-5000 units.

The production association "Nizhnekamskneftekhim" has introduced plans for using heat of the desorption solvent cooled from 160 to 61°C, as well as the heat of secondary steam and condensate on the units for isolation and purification of butadiene by the method of extractive rectification. These plans were developed by the Giprokauchuk and will save 113.4 GJ/h of heat for one unit. In this same association a similar plan is operating on units for isolation and purification of isoprene by the method of extractive rectification that uses heat of the desorbed extractant taken from the cube of the desorption column at temperature 156°C. The Yefremov synthetic rubber plant has introduced a perfected system developed by the Giprokauchuk for degasification of rubber. This guaranteed an increase in the output of products, as well as a reduction in the consumption of heat from 34.4 to 31.1 GJ per 1 T of rubber.

The educational and branch scientific research institutes are widely atracted to solving problems of saving fuel and energy resources by the enterprises of the oil refining and petrochemical industry. The Novopolotsk oil refinery, the Novopolotsk Polytechnical Institute, the production association "Kuybyshevnefteorgsintez" and the Tol'yatti production association "Sintezkauchuk" closely cooperate in this area with the Kuybyshev and Tol'yatti polytechnical institutes.

The enterprises of the branch are working to reduce the consumption of electricity in the cooling units in cooperation with the Leningrad Technological Institute of the Cooling Industry. In particular, the production association "Fergananephteorgsintez" is working jointly with the institute on separation of the users of cold according to boiling isotherms with simultaneous introduction of pumping systems to feed the cooling agent to the crystallizers. It is working with the VNIPIenergoprom [All-Union Scientific Research and Planning Institute of the Power Engineering Industry]on increasing the efficient use of low-potential heat, including by means of using steam-compressor heat pump units.

The questions of using energy resources can be solved most effectively only if the energy systems of the production processes are examined in inseparable unity with the technology. In this respect the VNIPIneft' has set up a laboratory of energy technology, while the Kuybyshev Polytechnical Institute has organized a multiple-branch department to improve the qualification of the power engineers and production engineers of the industrial enterprises and planning organizations for chemical energy technology.

Recognizing that a prudent attitude towards the consumption of fuel, heat and electricity, as well as the maximum use of the available secondary energy resources

promote a stable supply of fuel and energy to the oil refining and petrochemical industry, the industrial associations and enterprises, jointly with the planning and scientific research institutes have formulated plans of organizational and technical measures to save fuel and energy resources in the 11th Five-Year Plan. The knowledge, experience, energy and enthusiasm of the branch workers will be directed towards the realization of these plans.

9035
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FUELS

UDC 553.98:550.812

PROCEDURE FOR CHOOSING BEST AREAS FOR OIL, GAS EXPLORATION SUGGESTED

Moscow GEOLOGIYA NEFTI I GAZA in Russian No 10, Oct 80 signed to press 22 Jan 80 pp 1-6

[Article by E. M. Khalimov, G. P. Ovanesov and A. A. Aksenov of Minnefteprom [Ministry of Oil Industry] and M. V. Feygin of IGiRGI [Institute of Geology and the Development of Minerals]: "Questions of Standard Procedures for Planning Prospecting and Exploration for Oil and Gas"]

[Text] In recent years ever-greater importance has been attached to the planning of geological exploration for oil and gas, which is called upon to support the creation of a reliable raw-materials base for the expanded reproduction of the oil and gas recovery industry [9]. Exploration has acquired special urgency in the development of long-range programs (for 10-15 years or more) for developing this branch of the national economy, because of which the procedural bases for long-term planning of prospecting and exploration have received further theoretical substantiation.

One of the more acceptable standard practices used in long-range planning of oil and gas prospecting has been based upon the principle of forecasting effectiveness as a function of the extent to which the potential oil or gas resource of regions being studied or of individual areas of prospecting have been explored. Research has shown that, where the degree of exploration of the initial potential resource (NPR) is 20-40 percent, the effectiveness of prospecting and exploration begins to be reduced appreciably. This consistency was established in 1967 by G. B. Ostryy and V. V. Poteryayeva [7] and was reflected in later works by other investigators [2-4 and 8].

It should be kept in mind that the reliability of estimates of effectiveness over the long term that are made according to the indicated methodology depends to a great extent upon the structure of the initial potential oil or gas resource of the region being studied. This resource is the total quantitative expression of the cumulative recovery for the entire period preceding the one being planned, industrial category reserves ($A+B+C_1$), and category C_2 reserves, which have different degrees of certainty, as well as a quantitative evaluation of the forecasted presence of oil and gas of a probabilistic nature. Therefore, for regions that have been explored adequately, where the forecast evaluation of the potential oil and gas resource does not predominate in the overall value, a forecast of the effectiveness of prospecting and exploration will be marked by greater certainty. And, on the contrary, in poorly studied regions, a similar forecast of effectiveness will be less reliable.

It is also desirable during long-range planning to use an analysis of the dynamics of the pace of converting the unexplored portion of the potential resource into industrial category reserves as a function of the degree of exploration (or use) of the NPR, since this factor superimposes serious restrictions upon the potential for realizing within a short time the still undiscovered oil and gas resource that exists in the country's regions. A consistent reduction, as time goes on, of the pace of converting the unexplored portion of the NPR into industrial-reserve categories ($A+B+C_1$) has been established in the example of most of the old regions, it being the case, no doubt, that the sizes of the reserves prepared are a function of the amounts of drilling being done for this purpose, but the trends of their later dynamics can be forecast reliably enough.

The authors have studied the dynamics of the indicated function for many regions of the country for long time periods (28 years). In so doing, the latest forecast evaluation of the NPR for oil (on 1 January 1979) was taken as the basis for the calculations, being more authentic than previous ones.

The unexplored portion of the potential resource as of 1 January 1951 was determined by subtracting the value of the initial reserves of categories $A+B+C_1$ that existed on 1 January 1951 in the regions being examined from the NPR value as of 1 January 1979. From this value, which reflected the sizes of the reserves still undiscovered on 1 January 1951 (that is, tentatively C_2+D), determination was made of the annual pace of their conversion into category $A+B+C_1$ reserves (figure 1).

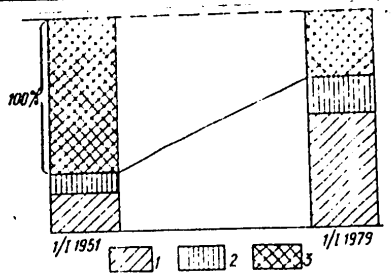

Figure 1. Diagram for Computing the Pace of Conversion of the Unexplored Portion of the NPR [Original Potential Resource] of Oil into Industrial Category Reserves.

Key:

1. Cumulative oil recovery.
2. Oil reserves of categories $A+B+C_1$.
3. The undiscovered portion of the NPR.

The function obtained was stable for most of the oil oil-recovery regions, and, during the period being examined, the pace of converting the unexplored portion of the potential resource into industrial category reserves was sharply reduced (figures 2 and 3). The averaged curve for these values can be extrapolated to the forecast period with adequate validity and used in calculating possible amounts of preparation of reserves.

Another approach also is possible. In this case, the portion of the potential resource that is unexplored (on 1 January 1951) does not remain unchanged for computations for the following years but is reduced annually by the amount of growth in reserves. However, in the first case, during the whole period being analyzed, the unchanged "price" of 1 percent of the unexplored portion of the NPR is preserved, and therefore the function being examined is accurately observed. In the second case, the "price" of 1 percent of the unexplored portion of the NPR will be dropping, and the pace of conversion, naturally, will become higher and can even turn out to be growing. The first method for reflecting the function being examined is more convenient for forecast calculations for a five-year period.

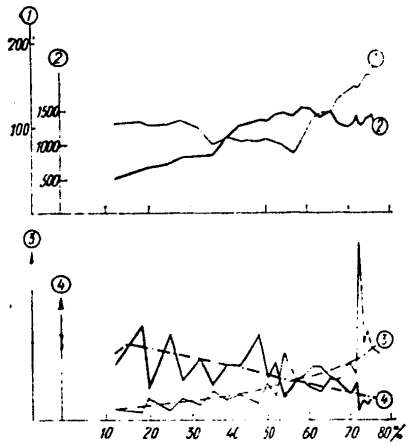

Figure 2. Dynamics of the Indicators for Prospecting and Exploring for Oil in the Urals-Volga Region.

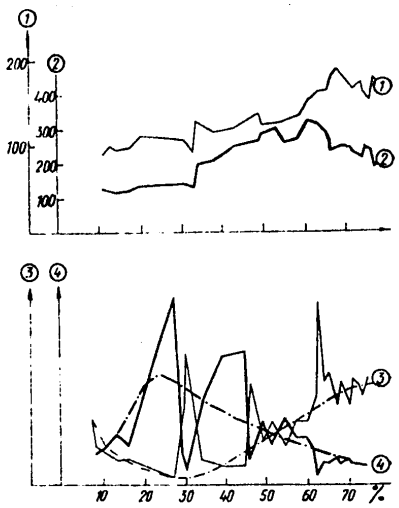

Figure 3. Dynamics of the Indicators for Prospecting and Exploring for Oil in Kuybyshevskaya Oblast.

Key:
1. Cost per 1 meter of penetration for prospecting and exploratory drilling, rubles.
2. Amounts of prospecting and exploratory drilling, thousands of meters.
3. Costs for prospecting and exploratory meterage for preparation of 1,000 tons of industrial category reserves, m/1,000 tons.
4. Pace of converting the unexplored portions of the NPR [Initial Potential Resource] into industrial category reserves, percent.

For solving long-term planning tasks in the area of preparing industrial category reserves, it is desirable to combine the indicated function with a forecast of the dynamics of such indicators as costs for prospecting and exploratory meterage for preparing a unit of reserves (1,000 tons) and the cost of 1 meter of penetration (see figures 1 and 2). A study of the dynamics of specific costs for prospecting and exploratory meterage for each percent of rise in the degree of exploration of the NPR is of great importance in determining the economically justified levels of capital investment for prospecting and exploration of the fields.

For all the diversity in the geological structure of the regions and in the circumstances of the spatial distribution of the deposits, the consistencies in the dynamics of the indicator being examined are similar--with the achievement of 20-40 percent exploration of the NPR an intense growth occurs in specific costs for the prospecting and exploratory drilling needed to raise the degree of exploration by each additional percent. If it is considered that, simultaneous with this, the cost per meter of penetration rises, then the growth of specific expenditures of monetary resources per 1 percent of exploration of NPR's becomes still greater.

The situation under which the magnitude of this indicator will begin to grow almost without limit and will exceed economically tolerable limits will be common for all regions in the future. The economically justified levels of monetary costs for prospecting and exploration for oil and gas fields should be computed separately

for each region and for a concrete time frame, taking into account both the prices for the oil and the highest expenditures incurred. The joint use of these data relative to each oil-recovery region will enable the most optimal variant for preparing oil reserves during the plan period to be determined.

Another important question of long-range planning is how to use correctly during the computations the values of the quantitative evaluation of the forecasted presence of oil and gas and of the NPR.

Values are determined for the forecast evaluation and for the NPR by region of the country at the start of each five-year plan. These data serve as the basis for the plan computations for the volume of prospecting and exploration and for the preparation of oil reserves for the forthcoming five-year period and for a lengthier long-term period. However, in making the plan computations and studies of the dynamics of effectiveness, there has existed for a long time the incorrect (in our opinion) practice of keeping the value of the forecast or the NPR unchanged during the five years.

Let us look at arbitrary examples of the consequence of this practice.

1. On the date of confirmation of a forecast evaluation (1 January 1975), the NPR for oil amounted to 180 million tons and it had the structure shown in the table. During the next 4 years changes occurred that were reflected: a) in the conversion into categories $A+B+C_1$ of 10 million tons of reserves from category C_2 and of 5 million tons from the forecast evaluation group; and б) in the conversion into category C_2 of 25 million tons of reserves from the forecast evaluation group. In sum, the category $A+B+C_1$ reserves grew by 15 million tons and the reserves of category C_2 increased by 15 million tons, but the forecast evaluation was reduced by 30 million tons.

	Reserves	Status on 1 Jan 79 [sic]	Changes during the period, as a consequence of: Conversion and exploration	Recomputation	Writeoff	Status on 1 Jan 79
а.	Initial, categories $A+B+C_1$	20	+15	–	–	35
	Category C_2.....	60	– 10 + 25	–	–	75
	Forecast, category D.....	100	-30	–	–	70
	NPR[*].....	180	Σ_{meas} = 0	–	–	180
б.	Initial, categories $A+B+C_1$	20	+15	–	-10	25
	Category C_2.....	60	– 10 + 25	–	-30	45
	Forecast, category D.....	100	-30	–	–	70
	NPR.....	180	Σ_{meas} = 0	–	Σ_{meas} = -40	140
в.	Initial, categories $A+B+C_1$	20	+15	20	–	55
	Category C_2.....	60	– 10 + 25	–	–	75
	Forecast, category D.....	100	-30	–	–	70
	NPR.....	180	Σ_{meas} = 0	Σ_{meas} = +20	–	200
г.	Initial, categories $A+B+C_1$	20	+15	+20	-10	45
	Category C_2.....	60	– 10 + 25	–	-30	45
	Forecast, category D.....	100	-30	–	–	70
	NPR.....	180	Σ_{meas} = 0	Σ_{meas} = +20	Σ_{meas} = -40	160

[*] NPR—initial potential reserves.

As is evident, retention of the forecast evaluation unchanged until 1 January 1979 is incorrect, since this will lead to an overstating of the actual amount of NPR by 30 million tons. Therefore, the forecast evaluation should be decreased by the amount of the reserves converted to categories C_2 and $B+C_1$, that is, by 30 million tons.

The magnitude of the NPR can in this case remain unchanged during the whole period being examined.

However, in practice the movement of oil and gas reserves in each region is of a more complicated nature: the conversion of reserves from a low to a higher category usually is accompanied by writeoff of a portion of the unconfirmed reserves and, simultaneously, the reserves increase as a result of the review of the computed parameters, thanks to the intake of new data on exploratory and operational drilling, as well as the report of the conditions for development.

2. Let us examine in that same tentative example the effect of the writeoff of reserves on change in magnitudes of the forecast evaluation and the NPR (see δ in the table). Here, in addition to the conversion of reserves from one category to another in the indicated amount, the writeoff of initial reserves of categories $A+B+C_1$ (10 million tons) and of category C_2 (30 million tons) was observed. While in this case the amount of the NPR (180 million tons) remains unchanged, it is necessary, in order to obtain this sum, to increase artificially the forecast evaluation by 70 million tons versus the actual amount. If the forecast evaluation remains unchanged, then the NPR proves to be overstated by 10 million tons relative to what was confirmed on 1 January 1975 (but, if the writeoffs are not removed, then by 30 million tons). Consequently, in this case, in addition to reducing the forecast evaluation by the amount of the conversion of reserves to categories C_2 and $B+C_1$ (that is, by 30 million tons), it is necessary to reduce the NPR by the amount of the writeoffs of the categorized reserves (that is, by 40 million tons.

3. Let us examine the effect of the increase in categorized reserves during a review of the parameters for previously discovered fields (see β in the table). Here, in addition to the conversion of reserves from one category to another in the indicated amount, an increase thereof during recomputation of the initial reserves of categories $A+B+C_1$ by 20 million tons is noted.

While in this example the value of the NPR (180 million tons) remains unchanged, it is necessary, in order to obtain this amount, to decrease artifically the forecast evaluation by 20 million tons in accordance with a comparison with the actual evaluation (or by 50 million tons relative to 1 January 1975). If the forecast evaluation remains unchanged, then the NPR must be reduced by 10 million tons. Consequently, in this case, in addition to the decrease in forecast evaluation by the value of the conversion of reserves to categories C_2 and $B+C_1$ (that is, by 30 million tons), the NPR must be increased by the value of the increase in categorized reserves during the recomputation (that is, by 20 million tons).

4. An examination of a still more complicated case of simultaneous conversion of reserves from category to category, the writeoff of categorized reserves, as well as an increase thereof during recalculation for previously discovered fields (see γ in the table), emphasizes still more the nonuniformity of retention of an unchanged quantitative evaluation of the forecast for the presence of gas and oil and for the NPR during the five-year period.

Thus, the values of the quantitative evaluation of the forecast for the presence of oil and gas and of the NRP that were approved for any date should be viewed only as a base (a point of reference) for reflecting later yearly changes that stem from the dynamics of categorized reserves. This work should be a component part of statistical reporting about the dynamics of the gas and oil reserves and the resource.

The question of choice of targets for prospecting and exploration merits special attention. First-priority targets for the preparation of industrial-category oil and gas reserves should be unexplored sections and horizons of already discovered fields with reserves under category C_2. Therefore, the starting point when planning growth of reserves should be primarily reserves of this category. In so doing, a knowledge of the condition and structure of these reserves relative to specific regions is necessary in order to prospect and explore, something that has not received due attention up to the present. The different certainties in the computation of Category C_2 reserves for the various targets of evaluation should be considered [1, 5 and 6].

Consequently, the use of just the absolute value of existing category C_2 oil and gas reserves for determining the real growth in industrial categories of reserves for evaluating the effectiveness of prospecting and exploration during the year being planned (a short-term period) can lead to substantial miscalculations. Additionally, a detailed analysis of the structure of the reserves is necessary in order to determine which portion of them can serve as a basis for preparing industrial category reserves.

Actually, in most oil-recovery regions, category C_2 reserves at the fields can be subdivided into those confined: а) to unexplored portions (blocks of discovered deposits; б) to undeveloped peripheral sections and to oil-water zones of deposits being worked; в) to targets (horizons) that should be mastered through reciprocation of the inventory of operating wells; and г) to untested horizons with favorable oilfield-geophysics characteristics and to promising portions of the profile that have not been drilled in (should be included in the forecast evaluation group).

It is completely obvious that the "activeness" of the conversion of these reserves into industrial categories is nonequivalent. In particular, the potential for converting reserves associated with the vast edge portions of oil deposits, taking into account the systems for developing them (edge-water flooding, center-to-edge flooding, and so on) should be carefully analyzed. The possibility of converting reserves that are confined to reciprocal targets to industrial categories should be determined individually.

A definite differentiation should also be made for category C_2 reserves of promising structures (in essence, this is the forecast evaluation group). Here reserves should be broken down by size of structure and degree of promise of the targets of exploration, while reserves that are at structures that are far from regions where prospecting and exploration are in progress, those that are associated with deep-lying horizons, and so on, that is, reserves whose exploration is economically undesirable during the planned period (or year), should be singled out.

Consequently, paramount importance should be attached to an evaluation of the "activeness" of category C_2 reserves, both of fields and uplifts, for conversion thereof into higher categories. In so doing, the confirmability of the reserves of this category must be considered by individual region and by trends in the execution of prospecting and exploratory drilling.

Thus it is necessary to distinguish the procedures and specific functions of short-term and long-term planning of prospecting and exploration for determining expected increases in oil and gas reserves.

The basis for short-term planning for an increase in oil and gas reserves and for the expected effectiveness of prospecting and exploratory drilling is a detailed analysis of the condition and structure of category C_2 reserves that are listed in the state inventory, and also a calculation of the "activeness" and of the actual potential for converting them into industrial reserves.

The basis for long-term planning for an increase in oil and gas reserves and for the expected effectiveness is a long-term evaluation of the NPR and the degree of its utilization.

The indicated analysis of the condition and structure of the reserves of various categories and of the quantitative evaluation of the forecasted presence of oil and gas should be performed systematically by individual region and for the country as a whole and should be one of the most important tasks for scientific-research organizations of USSR Mingeo [Ministry of Geology], Minnefteprom and Mingazprom [Ministry of Gas Industry].

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FUELS

OPTIMIZATION OF LONG-TERM PLANS FOR DEVELOPMENT OF BRANCH SYSTEMS

Novosibirsk OPTIMIZATSIYA PERSPEKTIVNYKH PLANOV RAZVITIYA OTRASLEVYKH SISTEM in Russian 1979 signed to press 9 Oct 1979 pp 2, 163-164

[Annotation and table of contents from book edited by Anatoliy Mikhaylovich Alekseyev and Yuriy Ivanovich Maksimov, IEiOPP So AN SSSR, 500 copies, 164 pages]

[Text] The collection covers certain results of studies made in recent years on optimal planning for the development of branch systems. Especial attention is focused on problems of modeling the development and arrangement of the branch systems. They include facilities of the extracting and raw material branches of the national economy (consideration for the dynamics of development of the extracting regions, coordination of the directions and rates of development in the extracting regions and geological exploration, adequate reflection in the models of long-term planning of the main random factors that influence the development of the branch systems, etc.).

The use of statistical-optimization methods and network models in long-term planning of the development of branch systems is examined.

Contents

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