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USSR Report

ENERGY

(FOUO 4/82)

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 [III - USSR - 37 FOUO]

ELECTRIC POWER

UDC 621.22.338.92

EXPANSION OF HYDROELECTRIC-POWER INDUSTRY IN 11TH FIVE-YEAR PLAN DESCRIBED

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY-ENERGETIKA in Russian No 8, 1981 pp 66-74

[Article by L. P. Mikhaylov, candidate of technical sciences of the Gidroproyekt Institute imeni S. Ya. Zhuk: "Hydroelectric Construction in the 11th Five-Year Plan"]

[Text] With respect to scale and the technical level of hydroelectric-power engineering and hydroelectric power plant construction, the USSR can be regarded as one of the most developed countries in the world.

The installed capacity of operating hydroelectric stations on 1 January 1981 was 52.3 million kW. The generation of power at GES's in 1980 was 182 billion kWh.

The relative contribution of hydroelectric stations to the total installed capacity of the country's electric-power stations is equal to 20 percent. That portion of the total power generated in the USSR contributed by GES's amounted to 14 percent in 1980.

With respect to the amount of installed capacity at operational hydroelectric power plants, the USSR occupies second place in the world behind the United States. It ranks third behind the United States and Canada with respect to the generation of electric power.

The major factors determining the efficiency of hydroelectric power plant construction in the USSR are the low cost of electric power, the conservation of fuel, the contribution of these stations toward covering uneven loads on power systems, the saving of labor reserves, the creation of an infrastructure in developing regions and the complex nature of water-current utilization.

The cost of energy from GES's is 4 to 6 times less than from thermal electric-power stations. In 1980, for example, the cost of power at GES's was 0.143 kopecks per kWh as opposed to 0.74 kopecks per kWh at thermal electric-power stations.

Power generation at GES's is an important factor in the conservation of fuel and the improvement of the country's fuel-and-power balance. Hydroelectric stations in 1980 provided a savings of more than 70 million tons of conventional fuel. In the postwar period alone, hydroelectric stations have conserved more than one billion tons of conventional fuel for use in other sectors of the economy. A significant question in the development of the power industry is the problem of covering peak electric loads--a problem which grows ever more acute. Hydroelectric stations are well suited to cyclical operation, since they can react very rapidly to any load fluctuation. Pumped-storage power stations [GAES's] possess particularly good maneuverability. During the hours of peak power-system loads, pumped-power stations work in the turbine mode, generating electric power. During the night, GAES's consume electricity, freeing thermal electric-power stations from forced shutdowns.

In connection with the high degree of automation and the absence of labor expenditures to obtain power resources, the operation of a hydroelectric station is characterized by a higher level of labor productivity in comparison with other types of electric-power stations. The savings of labor resources provided by GES's in 1980 amounted to 360,000 men.

The construction of hydroelectric stations makes it possible to create an industrial and social infrastructure, contributes to the formation of territorial production complexes and accelerates the growth of production forces in newly developed regions.

Hydroelectric power plant construction in the USSR is a leading factor in the integrated utilization of water resources. This construction is always carried out based on the development of the irrigation potential, the restoration of the river-transportation network, the reduction (or total elimination) of the threat of disastrous flooding and upon other water-resources management measures. It is particularly important to note that about 6 million hectares of arid land are being irrigated from the reservoirs that have been built. This exceeds by a considerable margin the agricultural area flooded by the GES reservoirs.

The "Basic Directions for the Economic and Social Development of the USSR in 1981-1985 and for the Period to 1990" proposes that we "carry out the construction of large-scale hydroelectric power station on the rivers of Siberia, the Far East and Central Asia, based on the integrated utilization of hydraulic resources, as well as the construction of pumped-storage power plants in the European sector of the USSR." The "Basic Directions" also point out the necessity of "providing for the growth of electric-power production in the European sector of the USSR, primarily at nuclear and hydroelectric power stations."

The development of the hydroelectric power industry in the 11th Five-Year Plan will take place in the presence of a qualitative change in the structure of the country's fuel-and-power balance, a gradual depletion of hydraulic-power resources in the industrially developed regions of the European sector of the USSR and the necessity for regulating the current flow in the interests of integrated utilization of water resources with a simultaneous increase in the severity of environmental-protection requirements.

The development of the hydroelectric-power industry in the 11th Five-Year Plan throughout the regions of the country can be characterized in the following manner:

in the European sector--maximum utilization of hydroelectric power resources to relieve the strain on the fuel-and-power balance in this region and the construction of special maneuverable pumped-storage power stations to increase the quality and reliability of power-system operation;

in Siberia--the construction of large-scale hydroelectric stations on the Angara and Yenisey, envisioned as a most important element in the largest fuel-and-power base being built in the east to provide electric power not only to regions of Siberia but also the European sector of the USSR. The utilization of the most abundant hydroelectric power resources of Siberia is associated with the creation of an industrial, social and institutional infrastructure and territorial production complexes and with the accelerated development of new regions;

in the Far East--the construction of GES's on the Bureya and the Kolyma for creating a stable power base for the development of the economy in the BAM zone and in remote areas of the northeast;

in Central Asia and Kazakhstan--the construction of hydraulic systems of integrated function which provide regulation of river flows for the generation of electric power and the development of irrigated farming.

In the European sector the "Basic Directions" provide for the introduction of capacities at the Chebok rskaya and Nizhne-Kamskaya GES's.

The erection of the Cherboksarskaya GES is the concluding step in the creation of the Volga-Kama cascade of hydroelectric stations [1]. The following economic problems will be resolved after the commissioning of the Cherboksarskaya GES:

the installed capacity of electric-power stations in the Unified Power System in the European sector of the USSR will be increased by 1,404 MW and the average perennial generation of electric power by 3.5 billion kWh;

an annual fuel savings of 1.15 million tons of conventional fuel due to the introduction of the Cherboksarskaya GES;

the Volga waterway from Moscow to Astrakhan will be restored, and the efficiency of river and sea transportation to the countries of Europe, North Africa and the Near and Far East will be improved;

a highway bridge across the category-one Gor'kiy-Kazan' waterway will be built via the structures of the hydraulic system. In the absence of the hydraulic system, it would be necessary to build a special bridge costing more than 80 million rubles;

the reservoir will store 8 percent of the average perennial natural flood waters of the Volga. As a result, it will be possible in the future to utilize the Cherboksarskaya GES reservoir (effective volume of 5.6 km^3) to increase the dependable water supply for irrigation of farmlands in the Povolzh'ye by 250,000 to 300,000 hectares.

The dam of the Cheboksarskaya GES raises the water level by 15 m. An increase in the water level will extend 340 km along the Volga to the site of the Gor'kiy GES, 150 km along the Vetluga, 190 km along the Sura, 180 km along the Oka as well as along their tributaries. The surface area of the reservoir formed will be 218,000 hectares. The area of flooded land will be 168,000 hectares, including 54,200 hectares of arable farmland.

A comparison of indicators for the Cheboksarskaya reservoir with other reservoirs built along the Volga GES cascade shows that the relative losses for flooding are less and the compensation greater. The flooding of arable farmland amounts to 39,000 hectares per million kW of installed capacity for the Cheboksarskoye reservoir, 41,000 for the Saratov, 43,000 for the Volgograd, 120,000 for the Kuybyshev, etc.

The relatively smaller losses of agricultural lands can be explained to a great degree by the many protective measures.

Within the limits of the protected area, plans have been made to carry out a sequence of reclamation operations to develop overgrown and swampy regions and intensify agricultural production. These measures will increase the area of agricultural lands in the protected zone by a factor of 1.5. Agricultural production will increase by more than a factor of 2.0. Plans have additionally been made to develop, reclaim and irrigate lands outside of the protected zone. Measures for the protection, development and intensification of production will make it possible to compensate fully for the agricultural losses due to flooding. The total cost of these measures will be 150 million rubles, including 95 million rubles for engineering protection of the flood plains.

An integrated approach is also being taken to solve the problem of transportation development on the reservoir and in the adjacent territories. River transportation along the line of the Cheboksarskaya hydraulic system will soon exceed 50 million tons annually.

The reservoir will be extensively utilized for recreational purposes. New sanitoriums, rest homes, tourist centers, holiday hotels and pioneer and youth camps are being built on its shores, while older existing facilities are being modernized.

The Cheboksarskaya GES is an economically efficient installation. A little more than four years will be required to recover the capital investment in this GES. Capital investment per kW of installed capacity is 260 rubles, while the cost of power at the GES's busbars will be 0.28 kopecks per kWh.

The Nizhne-Kamskaya GES--the fourth stage in the hydroelectric-station cascade on the Kama River--will solve the following important economic problems:

improving the reliability of the power supply to the central region of the European sector of the USSR;

increasing the generation of electric power within the power system by 2.71 billion kWh in years of average precipitation. This will make it possible to conserve annually 1.2 million tons of conventional fuel and to free labor reserves on the order of 5,200 men during operations;

creating a continuous, deep-water route along the Kama River as well as increasing the depth of the navigational channel for 200 km along the Belaya River;

improving water-supply conditions in regions adjacent to the reservoir [2].

The reservoir floods 115,800 hectares of arable farmland. The design provides for the protection of 20,000 hectares of farmland.

Losses of agricultural production associated with the flooding are compensated for by the development of new lands, the irrigation of lands being utilized and by a number of other reclamation measures.

Calculations which have been carried out testify to the high economic efficiency of the Nizhne-Kamskaya GES.

The "Basic Directions" make provisions for the construction of pumped-storage power stations in the European sector of the USSR. Two GAES's are now being built in this region--the Zagorskaya and the Kayshyadorskaya.

The potential for GAES construction is not associated with the presence of large-scale rivers. They require considerably less dispossession of land than river electric-power stations. In contrast to other types of electric power stations, GAES's are simultaneously generating sources and consuming regulators; that is, they provide for a reduction in nighttime gaps in the electric-load schedule.

Consuming less than 0.3 kg of conventional fuel per kWh when drawing electric power from thermal stations to recharge at night (when charging from nuclear power stations, the consumption of fuel for charging is even less), GAES's displace maneuverable gas-turbine electric-power stations burning fuel oil at the rate of 0.45 to 0.5 tons per kWh in covering the load schedule. Thus, GAES's provide for a considerable savings of scarce fossil fuel [3].

As an example, we will present data on the economic efficiency of the Kayshyadorskaya GAES constructed within the Unified Power System in the northwest [4].

The Kayshyadorskaya GAES with its installed capacity of 1,600 MW and eight reversing units is situated near the reservoir of the Kaunasskaya GES, which is utilized as a lower storage basin. The estimated head is 100 m. The annual production of electric power in the generating mode is 2.4 billion kWh, the consumption of electric power is 3.3 billion kWh annually. The effective volume of the upper storage basin is approximately 37.5 million m^3, which insures the utilization of the total installed capacity of the GAES five to six hours per day.

The capital investment in a GAES, minus the cost of roads, communications lines, repayable sums for construction equipment and local and municipal facilities, is estimated at 270 million rubles.

The efficiency of the Kayshyadorskaya GAES was determined in comparison with the gas-turbine electric-power station it replaced. The expenditures cited for the Kayshyadorskaya GAES are approximately 17 percent less than for a gas-turbine station. The period of time necessary to recoup the addition, capital investment in the Kayshyadorskaya GAES is a little more than three years. The data cited point out its high economic efficiency.

The construction of the Zagorskaya and Kayshyadorskaya GAES's is being given particular attention in connection with the fact that they should be pilot installations for a long series of similar electric-power stations with heads of 100 m. Their designs provide for the standardization of the concrete structures--water intakes, conduits, GAES buildings, retaining walls as well as structural elements in the dikes around the basins. The use of pre-assembled cast-in-situ structural elements makes industrial methods of construction possible.

The "Basic Directions" as applied to the country's eastern regions specify: "Essentially conclude the construction of the Sayano-Shushenskaya GES. Expand construction of the Boguchanskaya GES. Continue the construction of the Bureyskaya GES and complete the construction of the Kolymskaya GES-1."

The Sayano-Shushenskaya GES is a hydroelectric-power structure on the Yenisey River, unique with respect to its size and the complexity of construction. When the construction on this GES is complete, it will become the basis of the developing Sayanskiy territorial production complex [5].

The Sayano-Shushenskaya GES uses a section of the river with a drop of 200 m from the city of Kyzyl in the Tuvinskaya ASSR to the city of Sayanogorsk (the former settlement of Oznachennoye).

Ten power units, each with an output of 640 MW, are being installed at the hydroelectric station. With an installed capacity of 6.4 million kW, the station's average perennial generation of electric power will be 23.5 billion kWh.

The connection of electric transmission lines running from the Sayanskaya GES to Siberia's unified power system is being carried out using four 500-kV high-voltage lines. Two will be directed toward the Kuzbass, while two lines of increased capacity will go to the region of the Sayanskiy territorial production complex.

With the construction of the Sayano-Shushenskaya hydraulic system, a reservoir will be created, the backwaters from which will extend 312 km. The greater portion of the reservoir will be situated within the Sayanskiy canyon where its width does not exceed 3 km. Only in the Tuvinskaya basin where the reservoir will have the form of a lake will the width of the reservoir reach 9 km in places.

The reservoir of the Sayano-Shushenskaya GES will regulate the water flow for the water-management complex, including power production, water transportation, water supply and the protection of population centers from flooding.

In order for the Sayano-Shushenskaya GES to provide daily and weekly regulation of the current flow, provisions have been made for the construction of the Maynskaya GES downstream. Its reservoir will equalize the discharge after the Sayano-Shushenskaya GES.

In October 1978 the bottom passages of the first stage were closed off. Filling of the reservoir began in order to create a head which would insure the normal operation of the first hydraulic turbogenerator unit with its repaceable impeller. On 19 December 1978 the first unit of the Sayano-Shushenskaya GES was put under industrial load.

The capacities of the Sayano-Shushenskaya GES are slated for introduction in two phases: eight units will be commissioned at first. The introduction of the last two will take place somewhat later, when the necessity for additional electric capacity develops in the Siberian unified power system.

The construction of the Sayano-Shushenskaya GES provides new examples of the communist attitude toward work. During the construction of this hydroelectric station, socialist competition was begun by 28 Leningrad enterprises and has received the warm support of workers in Krasnoyarskiy Kray. At the present time more than 170 enterprises from Leningrad, Krasnoyarskiy Kray, Belorussiya, the Ukraine, Azerbaijan and other union republics, krays amd oblasts in the country are taking part in labor cooperation under the management of party organizations. The "Working Relay" has made it possible to accelerate the pace of construction work on the hydroelectric station, insured high-quality work and provided a great economic impact.

The output of the Sayano-Shushenskaya GES will be utilized to provide electric power to the Sayanskiy territorial production complex now under construction as well as to enterprises of the Kuzbass.

The formation of the Sayanskiy territorial production complex began during the 10th Five-Year Plan in accordance with the resolutions of the 24th CPSU Congress. As part of the complex, mining and chemical industries will be developed on the basis of phosphate rock and asbestos deposits. Also to be developed are electrometallurgy, railcar construction and the electrical-equipment, lumber and woodworking industries. In Sayanogorsk will be built the Sayanskiy aluminum plant equipped with powerful electrolyzers.

The commissioning of the Sayano-Shushenskaya GES will create the necessary conditions for insuring a reliable power supply to the adjacent regions.

The Bureyskiy integrated hydraulic system is located in Amurskaya Oblast on the Bureya River--the left tributary of the Amur, flowing into it below the city of Blagoveshchensk.

This hydraulic system is designed to supply electric power to industry in the region as part of the unified power system of the Far East and for combating flooding in the lower reaches of the Bureya and the central section of the Amur. Consumption of electric power will also increase considerably according to the future development of the region. The first units of the Bureyskaya GES should be commissioned after the Zeyskaya GES goes on stream.

The installed capacity of the Bureyskaya GES is 2,000 MW in six power units. The generation of power is 7.16 billion kWh. Two units will operate in a 220-kV circuit and four in a 500-kV circuit. Electric power will be sent to Khabarovsk, Urgal-Komsomolsk and the local region along three transmission lines.

The frequent floods cause considerable damage in everyday life. High-water regulation by the Bureyskaya GES will protect about 15,000 hectares of land in the region's farming industry from flooding and will insure the further future development of more than 20,000 hectares of land in the valleys of the Bureya and the central Amur. It will also make it possible to reduce capital investment in constructing levees for the flood plain and population centers as well as the operational outlay for such construction.

The reservoir created will provide for slight long-term regulation of current flow. In order to combat floods, plans have been made for the reservoir to possess an antiflood volume. The technical and economic calculations which have been performed point out the high economic efficiency of construction at the Bureyskaya GES.

The Kolymskaya GES-1 is being constructed under extremely complex natural conditions [6]. Dense permafrost, the extremely severe climate, high degree of seismic activity, the considerable remoteness from industrial centers and the difficult transportation system complicate considerably the construction of the hydraulic syatem. The rock-fill and earth dam is the largest in the USSR built under permafrost conditions.

The introduction of the Kolymskaya GES will make it possible to exploit new deposits which previously had been considered to possess an insufficient yield because of the high cost and shortage of electric power. The electric power available to mining enterprises will be increased sharply.

The reservoir of the Kolymskaya GES will accomplish long-term regulation of the current flow in the interests of power production and water transport. The reservoir's operation provides for the organization of special passage during the navigational period. This will make it possible to fundamentally improve the transportation utilization of the river.

Calculations which have been carried out point out the high economic efficiency of construction at the Kolymskaya GES.

Further hydroelectric power plant construction has been proposed in areas of the Caucasus and Central Asia. The "Basic Directions" provide for the completion of construction of the Zhinval'skaya hydraulic system, the continuation of construction at the Khudonskaya GES and the beginning of construction at the Namakhvanskaya GES in the Caucasus. The commissioning of the Shamkhorskaya GES has also been proposed. In Central Asia, it is expected that the construction of the Kurpsayskaya GES will be concluded, the Tash-Kumyrskaya and Baypazinskaya GES's will be commissioned and the construction of the Rogunskaya GES will be expanded.

The largest of the installations mentioned will be the Rogunskaya GES.

The Rogunskiy hydraulic system will have integrated irrigation and power-generation functions and should play an important role in the further development of the territorial production complex in the south of the Tajik SSR.

The electric power of the Rogunskaya GES will be delivered to the Central Asian Power Syatem and will insure the further development of the entire Central Asian economic region. It will make it possible to conserve about 4.8 million tons of conventional fuel annually, which is equivalent to 4.0 km^3 of natural gas. The output of this hydroelectric station (3600 MW in six units) will be utilized to cover a considerable portion of the peak loads in the Central Asian Unified Power System.

The irrigation-management significance of the Rogunskiy hydraulic system for the Amudar'ya is very great. The connection of the Rogunskoye reservoir to the system will insure guaranteed irrigation of the lands in the Amudar'ya basin. Although the level of water consumption in 1985 was provided for through seasonal regulation at the Nurek and Tyuyamuyunskoye reservoirs, the level in 1980 can be achieved only through the long-term regulation of the flow of the Amudar'ya, carried out with the aid of the Rogunskoye reservoir.

Provisions have been made to plant cotton primarily in the expanded irrigated lands in the basin of the central and lower reaches of the Amudar'ya. In this case, about 470,000 tons of cotton will be obtained from the new lands irrigated by the waters of the Rogunskiy reservoir [8].

The calculations which have been carried out testify to the high economic efficiency of construction of the Rogunskiy hydraulic system.

Thus, an extensive program of hydroelectric power plant construction is to be carried out in the 11th Five-Year Plan. Moreover, during this period there will be a continuation of the planning and surveying and scientific research studies associated with the development of the hydroelectric-power industry in the 12th and subsequent five-year plans.

At the November (1979) Plenum of the CPSU Central Committee Comrade Leonid Il'ich Brezhnev said: "our duty is to think in advance about the power industry of the future, on which in many ways the economic growth of our country depends."

In examining the hydroelectric-power industry of the future, we must first of all note the great hydroelectric-power resources of the USSR's eastern regions which can be used to cover not only local power demands but also the growth in the demand in the country's European regions.

Experience in developing the hydroelectric-power resources of Siberia indicates that hydroelectric power-plant construction is here not only a source for electric-power supply but also plays a pioneering role in developing the natural resources of this region.

The most efficient structure for the development of northern Siberia is the formation of territorial production complexes using hydroelectric power plants as a basis. These complexes insure the highest degree of labor productivity, the greatest savings of capital investment and a reduction in construction times.

The utilization of the lower reaches of the Yenisey and the Lena for power-generation purposes acquires particular significance beyond the 11th Five-Year Plan. The Turukhanskaya and Igarskaya GES's, the Osinovskiy Hydraulic Complex, as well as the Nizhne-Leninskaya GES can also be built here. Their total installed capacity will amount to 35 million kW, while their total power-generation will be 180 billion kWh. The annual savings of fuel provided by these hydroelectric stations will be equal to 65 million tons of conventional fuel or 130 million tons of Kansko-Achinsk coal.

Power production in the European sector of the USSR in the upcoming decades will be developed through the preferred construction of powerful AES's which function most economically and reliably in base-load operation. They should organically augment pumped-storage stations designed to carry out maneuvering functions in the power system.

In addition to the Zagorskaya and Kayshyadorskaya pumped-storage stations mentioned above, design work is currently underway on the Leningrad, Dnestrovskaya, Kanevskaya, Central and Zhigulevskaya pumped-storage stations. The majority of them have heads of about 100 meters with outputs of 1,000 to 1,600 MW. Proposals have been made to standardize these stations, which would have a considerable economic impact. Some of these GAES's are designed for peak operation. Their operational zone in the daily load schedule will be 4 to 6 hours, while some of them will be semipeak, capable of operating in a 10 to 14-hour zone.

On the territory of the European sector of the country, 22 of the most promising sites for locating GAES's have been selected from a number of sites previously identified. Pumped-storage power plants with a total output of 35 million kW can be located here. Plans have been made to switch in the future to the construction of GAES's in mountainous regions with heads of 200 to 400 m, as well as GAES's with underground basins having heads of 1,000 m and more.

Of considerable interest is the construction of GAES's which use the cooling reservoirs of nuclear power stations as storage basins.

This will make it possible not only to reduce the construction costs of such a power-production complex by approximately 15 percent in comparison with the individual construction of its components, but also to reduce the number of operations personnel by jointly locating many services and structures. Planning-and-surveying and scientific research studies will also be conducted on the first tidal electric-power stations.

Thus, hydroelectric power plant construction in the 11th Five-Year Plan as well as in the foreseeable future will make a worthy contribution to the construction of communism's material-technical base.

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HANDBOOK ON CASING OF OIL, GAS WELLS PUBLISHED

Moscow SPRAVOCHNIK PO KREPLENIYU NEFTYANYKH I GAZOVYKH SKVAZHIN in Russian 1981 (signed to press 3 Jun 81) pp 1-5, 239-240

[Annotation, table of contents and introduction from book, "Handbook on Casing Oil and Gas Wells" (2d edition, revised and supplemented), by Anatoliy Ivanovich Bulatov, Lazar' Borisovich Izmaylov, Viktor Ivanovich Krylov, Yevgeniy Moiseyevich Levin and Aleksandr Iosifovich Ovechkin, Izdatel'stvo "Nedra," 9,300 copies, 240 pages]

[Text] Designs for wells, methods for analyzing casing string, and the appropriate operating processes are examined. The sequence in performing these operations, depending upon the method of running and cementing the string, are cited. Methods for monitoring the quality of well casing are described. Basic principles for the safe conduct of the work are reflected.

This second edition (the first edition was dated 1977) describes new plugging materials, additives thereto and chemical reactants.

For engineers and technicians of drilling enterprises of the oil and gas industries.

The book contains 67 tables, 82 illustrations and a bibliography of 40 items.

Table of Contents

Introduction

The concept of "casing a well" includes the consecutive conduct of a number of production operations and processes that are associated with preparing the bore, tools and casing string, running the casing string into the well, cementing the casing, and executing the concluding operations.

In domestic field practice, three main methods for running casing string into the hole are used:

in a single procedure, when the whole drilled bore of the well, from face to mouth, will be covered by the casing string;

in several procedures, when the bore is to be covered in part by separate sections of casing string, carried out consecutively after completion of the full cycle for casing each section; and

the running of casing string in the form of a liner, which will cover only a part of the bore, at a previously chosen interval of the well, without removing the string up to the well mouth.

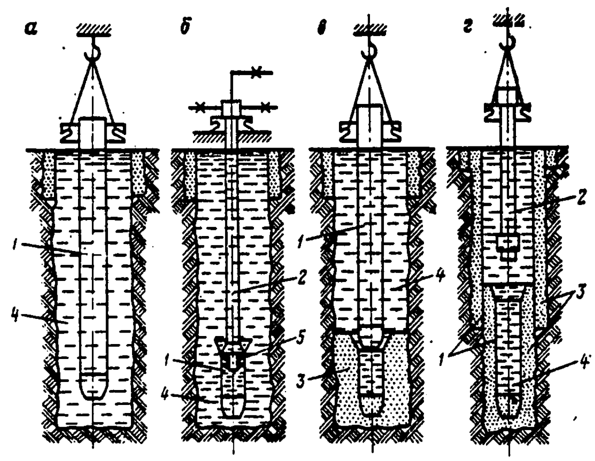
The methods enumerated, the schemes of which are shown in figure 1, differ in the technology for carrying out the operations and require the use of specialized operating equipment.

Figure 1. Diagrams of Methods for Running Casing String into Wells.

Key:

а. In one procedure (the final stage of the string).
б and в. In two procedures (the final stages of the first upper and lower sections of connected casing).
г. Casing with a liner (final stage).

1. Casing strings.
2. Drill strings.
3. Hardened cement.
4. Drilling mud.
5. Sectional cemented plug.



The choice and use of these methods is governed by technical and economic feasibility and by the technological level for carrying out the operations in the given region of drilling work. Minimal outlays for the conduct of well construction as a whole and for good-quality casing of wells in particular, which can preclude additional repair and insulating work during later periods of testing and operation, can be adopted as a general criterion for evaluation and choice of method for running strings in.

The set of preparatory operations for any of the methods for running casing string includes: preventive maintenance and repair and preparation of the drill rig's components and service lines, a critical analysis (gaging and calibrating) of the bore that has been drilled, supplementary treatment of the drilling mud, pressure testing, marking and stacking of the casing pipe, the preparation for operational rigging of the casing string, choosing a formula for the plugging fluids, preparation of the plugging materials, reactant, displacement fluid and cementing equipment, and other operations.

The casing string is made up, the operational rigging is selected, and the required amount of plugging materials and the units of cementing equipment are computed, taking into account the actual geological and engineering conditions of the field and the condition of the hole, as well as the procedures that have been adopted.

The technology for performing the work is chosen to take into account the prerequisites set by the physico-mechanical properties of the rock that makes up the well face and sides, the values of the formation pressures and temperatures, the properties of the formation fluids, the deviation of the bore, the degree to which it is cavernous, and other factors.

The design of the casing string, using pipe with various properties, is based upon an analysis of its strength that considers the effect of axial and radial loadings on the string that can occur during the casing process and also later, during drilling (or operation) of the well.

The main methods for cementing casing string in wells include:

direct cementing in one procedure (in one stage), when the plugging solutions are pumped into the casing string from the well mouth and are forced into the annular space at the prescribed depth;

stage cementing, when the plugging fluids are forced through the casing string in two (or more) procedures or stages consecutively, at first through the casing shoe, then through special devices--the stage cementing collars, which are installed on the string at a certain distance from the well face; in this case, the plugging fluids accumulate in the annular space to the height of the bore, consecutively, without a break in the continuity;

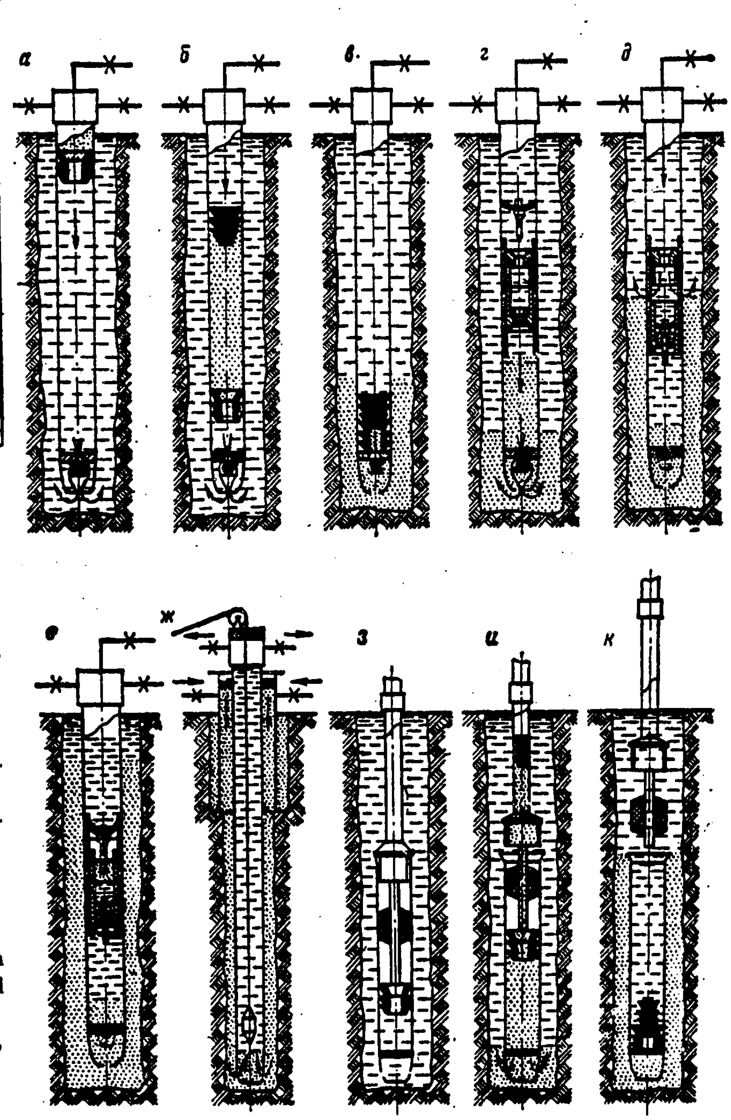


Figure 2. Schemes for Methods for Cementing Casing Strings:

Key:

а, б and в. Direct cementing in one procedure (the start, middle and concluding process, respectively).

г, д and е. Stage cementing (the first and second stages and conclusion of the process, respectively).

ж. Reverse cementing.

з, u and k. Cementing of a liner (the situation prior to cementing and the start and conclusion of the operation, respectively).

the cementing of liners and casing-string sections, when the plugging solutions are pumped into the space beyond the string by means of the drill-string shoe; and

reverse cementing, under which the plugging solutions and the overflush fluid are pumped from the mouth of the well into the annular space by the cementing string, with exit of the circulation through the casing string.

Each of these cementing methods is shown schematically in figure 2.

The cementing methods mentioned can be carried out in the following variants:

cementing of a casing string that is in a state of repose at all stages of the process;

the cementing of a string freely suspended (on a block-and-tackle system), with a certain axial displacement thereof during OZTs [waiting on cement] when the loading on the hook is changed; and

cementing of the string with reciprocation or revolution while the plugging solutions are being pumped and squeezed through.

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PIPELINES

INCREASED ROLE OF PIPELINE TRANSPORT SYSTEM IN USSR

Moscow NEFTYANAYA PROMYSHLENNOST' SERIYA EKONOMIKA NEFTYANOY PROMYSHLENNOSTI in Russian No 10, Oct 81 pp 30-33

[Article by V. G. Dubinskiy, Giprotruboprovod: "On Further Enhancement of the Role of Trunk Pipelines in the USSR Unified Transport System"]

[Text] The "Basic Directions of Economic and Social Development of the USSR for 1981-1985 and the Period up to 1990" specify accelerated development of pipeline transport of crude oil and refined petroleum products.

The CPSU Central Committee and USSR Council of Ministers Decree entitled "On Improving Planning and Strengthening the Influence of the Economic Mechanism on Improving Production Efficiency and Work Quality" calls for a radical improvement in the organization of transport of goods as well as increased influence of the economic mechanism on the end results of the operations of transport enterprises and organizations.

These tasks should always be carried out on the basis of optimal development and distribution of a unified transport system as a whole and of each component mode of transportation.

An important problem in this connection is that of further development and expansion of the area of employment of trunk pipelines for conveying a broad variety of petroleum and other commodities.

Freight traffic exceeding 6,000 billion ton-kilometers per year is presently being achieved by the unified transport system -- rail, pipeline, maritime, river, motor, and air transport. Various bulk goods are carried by these modes of transport, other than pipeline: coal, coke, oil and grain, ores, mineral building materials, mineral fertilizers, etc. They account for approximately 80 percent of total transport of goods.

Pipeline transport today includes trunk crude oil pipelines, products lines, and natural gas pipelines, extending a total of approximately 200,000 kilometers. Crude oil and products lines total approximately 70,000 kilometers.

In the immediate future the transport problem in the USSR, in conditions of a rapidly expanding economy and growing flows of various goods in all directions, should be solved by development of traditional and new modes of transportation, by expansion of the realm of application of existing economical and reliable modes of transportation for hauling bulk goods, including trunk pipelines.

Pipeline transport has not yet experienced adequate development, in connection with which refined products are not being pipeline-transported in a full volume and variety. As a consequence of this, up to 90 percent of light refined products are being transported by rail, as well as all residual fuel oils and lubricating oils.

Pipeline transport is not participating in developing the conveyance of other, non-petroleum bulk goods.

The extensive technical and economic possibilities of pipeline transport as a specialized mode, possessing advantages over other modes of transportation, are not being fully utilized. And yet trunk pipelines can carry practically all types of bulk goods in any quantity: pipelines can be constructed in all parts of the country, extending any distances, along the shortest route; pipeline operation is independent of climatic, environmental and geographic conditions, time of year or day; goods of various types and grades can be pumped through a single trunk pipeline; trunk pipelines provide continuous, uniform delivery of goods, creating conditions for dependable, continuous operation of the enterprises they serve; full automation and remote control of pipelining processes is possible; pipelines provide a complete seal and minimal losses of conveyed goods; in most cases the technical-economic performance indices of trunk pipelines are better than those of other modes of transportation; it takes less time to build pipelines and bring them on-stream than is the case with other modes of transportation; pipelines can convey goods directly from points of production to points of consumption, without unnecessary transfers or with a minimum number of transfers.

A wide variety of various bulk goods can be transported by trunk pipeline. Specialization of pipelines is possible, taking into account the most economical area of their utilization for conveying an individual type or group of goods. The technical-economic advantages of specialization of trunk pipelines are evident in the example of trunk lines which transport crude oil. Specialization of oil pipelines provides the capability to handle flows of crude of any amount and grade, directly from the oilfields to the refineries, in all directions of crude oil flow; maximum utilization of a pipeline's throughput capacity; employment of optimal pipeline parameters and design, high-output equipment, fittings, automatic control, remote control, and control system; continuous improvement in crude oil transport equipment and technology; extensive utilization of industrial methods of construction; improvement of pipeline technical-economic performance indices. Thanks to specialization, trunk crude oil pipelines have the lowest crude oil transport cost figure of all modes of transport employed to carry crude oil. Today oil pipelines link this country's principal oil refining and oil producing centers and handle 90 percent of all crude transported.

The following goods specialization of pipeline transport is possible.

All flows of crude oil, with the exception of high-viscosity crudes and a small quantity of high-grade crudes the physicochemical properties of which could be adversely affected by sequential pumping through the same pipeline with other crude grades, can be assigned to trunk crude pipelines, just as at the present time.

Trunk products lines and terminal taps from these lines should be used more extensively than at the present time to deliver directly to the customer a full variety and volume of refined products, namely: automotive gasoline, diesel fuel, kerosene, furnace fuel oil, bunker fuel, and petroleum lubricating oils. In the near future, with construction of the requisite network of products lines in all parts of the country, delivery of refined products should be accomplished as a rule by combined pipeline-motor transport.

Chemical products trunk pipelines can be used to transport carbonic acid, ammonia, ethylene, a broad spectrum of light hydrocarbons and other products of the chemical, oil refining, petrochemical, and gas industries.

Pipeline batch-container systems can be used to convey high-viscocity and other crude, various types and grades of crudes, refined products and chemical products, conveyance of which through specialized trunk lines is unprofitable, coal and coke, grain and other agricultural products, mineral building materials, mineral fertilizers, mail and other goods.

Coal (specially prepared) can be conveyed by trunk coal pipelines.

Trunk pipelines designated for other products of various branches and sectors of the economy can handle the flows of the goods of these branches and sectors and be apprropriately designated.

Matters of pipeline specialization should be determined on the basis of technical-economic justification.

The possibility of utilizing trunk pipelines for transporting a wide variety of bulk goods will make appreciable changes in the area of utilization in coming years both of pipeline transport proper and of other modes of transport. This dictates the necessity of combined solution of a most important economic problem -- determination of future optimal paths of development and distribution of trunk pipeline transport in the USSR.

To accomplish this task it is advisable to draw up a specific, comprehensive program of development and distribution of trunk pipeline transport in the USSR, which should incorporate elaboration of the entire range of technical, economic, and organizational-management problems for each type of pipeline transport, as well as rail, maritime, river, motor, air and other modes of transportation and the unified transport system as a whole, taking into account wider participation in the conveyance of bulk goods of trunk pipelines of all types and designations, as well as other modes of transport.

Since this will be the first time such a specific comprehensive program is put together, it is necessary to present some considerations of its composition and direction of development, while making no claim to completeness.

There should be elaborated as part of a specific comprehensive program, among other materials, a basic, uniform procedural method which is common to all modes of transportation, including method of calculating actual parameters and technical-economic indices and their objective comparison among different modes of transportation, in order to choose an optimal variant.

It is necessary to elaborate, on the basis of current scientific and technical advances and projected future development and deepening of scientific and technological advances, rough designs of the most advanced, dependable, economical technical means (vehicles, permanent installations, etc) for each type of pipeline transport, as well as rail, maritime, river, motor, air and other modes of transport for carrying out the transport process in coming years. These rough outline plans must specify, applicable to the technical solutions adopted in them, the parameters and technical-economic indices for each mode of transportation. They should be progressive and utilized for substantiating optimal specialization and the area of employment of pipeline and other modes of transport. Preliminary designs should serve as a standard for a given mode of transport and the unified transport system as a whole for an extended period of time. The most efficient area of utilization of each mode of transport for carrying goods in the various parts of the country should be determined on the basis of these materials.

It is necessary to elaborate in a specific comprehensive program, on the basis of planned balance sheets of production and consumption of all products in the USSR, interregional exchange of these products between points of production and consumption and efficient flows of goods in all areas and on all routes, distributing them among the individual types of pipeline and other transport, taking into consideration the optimal area of employment of each of these for carrying given types of goods.

Special attention should be focused on the presently existing elaborate network of trunk pipelines, and care should be taken to ensure fully loading its throughput capacity.

A comprehensive specific program should provide technical-economic substantiation of the advisability of establishing reserve transport capabilities on all routes of goods flows, especially in the main and potential future areas of their development.

A specific comprehensive program should provide for joint construction and operation of power generation, auxiliary, housing, cultural-services and other facilities common to each mode of transport and other branches of industry and the economy located in the same areas.

A specific comprehensive program should present the required comprehensive, coordinated development and distribution of trunk pipelines of all types and designations, rail, river, maritime, air and motor transport for fully handling the flows of goods distributed among them; volumes of work on construction of new and renovation, expansion and modernization of existing transport means; technical-economic indices; requirements in material-technical, financial and labor resources for accomplishing this development; tasks assigned to all other branches of industry for prompt and expeditious support of production and construction of the specified technical transport means.

These measures should be distributed by sequence and periods of time, with their implementation on a priority basis in those areas and on those routes with large flows of goods, a lack of reserve transport capacity, as well as in new areas of development and location of productive resources.

There should be elaborated in a specific comprehensive program a rational, flexible organizational structure of management of the USSR unified transport system. This program should include investigation of the question of forming a national-level transportation agency, which would provide the following: coordination of the operations of each mode of transportation and the unified transport system; distribution of flows of goods between the individual modes of transportation, proceeding from the most economic area of utilization of each; elaboration of materials on future development and distribution of transportation; efficient utilization of transportation; uniform technical and financial-economic policy in transportation and, in particular, in distribution of conveyance of goods among modes of transportation, and resolution of other matters.

In view of the nature and direction of this work, prospects for technological advances in transportation, a realistic assessment of decisions and research results, need for financial, material-technical, and labor resources, possibilities of their allocation as needed, and the lack of a single agency for coordinating the operations of all modes of transportation, a specific comprehensive program for development and distribution of USSR trunk pipeline transportation should be carried out under the direction of USSR Gosplan, the USSR State Committee for Science and Technology, interested ministries and agencies. Its elaboration should be assigned to branch lead design and scientific research institutes.

Elaboration of a specific comprehensive program will not per se ensure growth and development of pipeline and other modes of transportation. Practical implementation of the substantiated recommendations and proposals contained in the program is required. This should be achieved by basing on this program, and after its approval according to established procedures, elaboration of a national economic plan for development and distribution of transportation, allocation of requisite financial, material and labor resources, and construction of planned technical transport means. It is necessary realistically to view transportation as an inseparable part of the concrete production facilities, complexes, and areas served by transportation, and to permit expansion of existing and construction of new facilities, in the absence of appropriate reserve capacity of existing transportation for the future, only with development of the modes of transportation servicing them mutually coordinated in carrying capacity and timetable, specified by the specific comprehensive program. Refined petroleum products pipelines and chemical products pipelines, for example, must be designed and built together with oil refineries, petrochemical and chemical plants, with pipelines and plants coming onstream at the same time, without permitting even temporary hauling by other modes of transportation those goods planned for pipelining.

Growth and expansion of the area of utilization of trunk pipelines will promote solving the transport problem more rapidly and at lower money, material and labor costs than with utilization of other modes of transportation, freeing rail transport from hauling many bulk goods and assignment to rail transport the hauling chiefly of passengers and those goods conveyance of which by pipeline and other modes of transportation is not justified economically.

The approved specific comprehensive program should be used as the basis for drawing up proposals on radically improving organization of hauling of goods and increasing the influence of the economic mechanism on the end performance results of transportation enterprises and organizations, development and distribution plans for pipeline and other modes of transportation.

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