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14 May 1980

USSR Report

ENERGY

(FOUO 7/80)

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USSR REPORT

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CONTENTS

ELECTRIC POWER

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PROPOSED JOINT USE OF HYDROELECTRIC AND PUMPED-STORAGE ELECTRIC POWER STATIONS

Moscow GIDROTEKHNICHESKOYE STROITEL'STVO in Russian No 2, Feb 80 pp 44-45

[Article by L.A, Karol', candidate of technical sciences: "Utilizing the Storage of Electricity by Increasing the Head of a GES-GAES"]

[Text] At the GES's that are now in operation or are being built in the European part of the USSR (with the exception of the Caucasus), only one-third of that area's technical hydraulic energy potential is being or will be used. The fuller utilization of these resources is prevented primarily by the fact that in the ranges of the proposed GES's on the remaining unused sections of the large and medium-sized rivers, the head is limited to 10-15 m. Even when there is integrated utilization of the hydraulic resources, as a rule the capacity and electricity produced under these conditions are inadequate to justify the construction of a GES.

Some increase in efficiency without any substantial increase in the capacity of low-head GES's can be achieved by converting them into GES-GAES's [pumped-storage electric power station] [1]. However, this type of electric power stations is not widely used because of its high cost under low-head conditions.

As is well known, hydraulic storage is normally carried out by pumping water up to an elevated plateau and then releasing it through hydroturbines. A similar but somewhat more complicated system involving three reservoirs [2,3] and a GES-GAES is shown in Figure 1: water from the head race enters the pumps, which are located in electric power station building 1, and is pumped by them through pipelines 2 into elevated basin 3. As electricity consumption increases, water from this basin passes through the hydroturbines into tail water 4, thanks to which the static head of the hydraulic accumulator's discharge H_t is

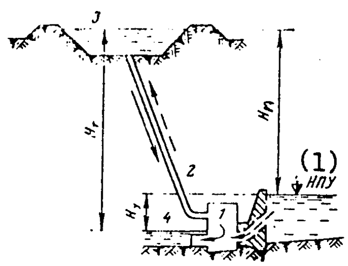

Figure 1. Diagram of a GES-GAES with an increased head and separate turbine and pumping units: --- = path of water in the turbine mode of operation; --- = the same, in the pumping mode.
Key: 1. Normal backwater level

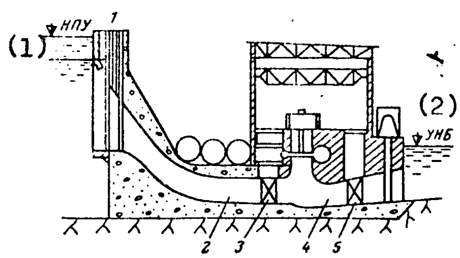

Figure 2. Diagram of a GES-GAES with increased head and reversible hydraulic machinery.
Key: 1. Normal backwater level
2. Tail water level

greater by H_n than the head H_y of the section of river that is being used. The reservoir located in the head race must have enough capacity for extended regulation, which will insure the fuller utilization of the fluvial drainage. The capacity of elevated basin 3 can be limited by the requirements for daily regulation. In tail water 4 it is sufficient to create the minimum backwater needed according to the conditions for equalizing the passages of water in the GES-GAES's tail water.

The proposed plan can be used on plains rivers, in ranges where one of the banks is comparatively steep and there is a terrace or area for the creation of the elevated basin. The flaw in this method is the need for separate installation of the pumping and turbine equipment, which is rarely used at the present time even for heads of more than 500-600 m. Meanwhile, on plains rivers the turbine mode heads H_t do not exceed 100-150 m when this plan is used.

Thus, for the more efficient combined utilization of hydraulic energy resources with the storage of electricity in the plains regions of this country, it is necessary to look for methods that use two-machine equipment, primarily the reversible radial-axial hydraulic machinery for operation with heads of 100 m that we have mastered. In particular, we have proposed a design for a GES-GAES with increased head (Figure 2) where in the pumping mode, the water passes from the head race through water intake 1 and is not sent directly into the reversible hydraulic unit's vortex chamber, but into the specially installed pumping section 2 of the unit's suction pipe. In connection with this, in the pumping mode its suction section 4 is closed by gate 5, because of which the water from the reservoir first reaches the hydraulic machinery and then goes into its vortex chamber and, through a conduit, into the elevated basin (see Figure 1). In this mode, gate 3 is open. When the hydraulic storage area is discharging gate 3 closes and gate 5 opens, and the water from the elevated basin passes through the conduit, turns the hydraulic machinery and flows into the tail race through suction pipe 4.

This design for a GES-GAES with reversible equipment can be used for integrated drainage utilization not only in GES's located in front of dams, but also with river GES's and even in systems involving the drawing off of water from the main flow. In this case, in the area of the station there must be the appropriate topographic and geological conditions for the placement of an elevated basin and the installation of a head conduit.

The location of the gates in the underwater part of the electric power station building makes it possible to use the crane equipment of the hydraulic units to install and repair them. They can also be produced with hydraulic drives and installed in the head race and on the tail water side of the pipe's suction section.

Conclusions. The proposed structural plan for a GES-GAES (see Figure 2) with a turbine-mode head H_t that is greater than the charging head H_n provides the following advantages:

1. It expands the possibilities of using pumped storage in the plains regions of the country, with high unit capacities of reversible equipment, and increasing the economic potential of the hydraulic energy resources of rivers, including integrated river drainage utilization.
2. It reduces the depth to which hydraulic machinery and electric power station buildings must be sunk into the ground.
3. Depending on how much less H_n is than H_t, it is possible to make the optimum efficiencies of both pumped storage modes converge or coincide and to increase the overall efficiency of this method; a more thorough description of the proposed plan can be obtained after experimental design work and laboratory investigations of models of aggregate GES-GAES's with increased heads are carried out.

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ELECTRIC POWER

CONSTRUCTION AND OPERATION NOTES

Moscow GIDROTEKHNICHESKOYE STROITEL'STVO in Russian No 2, Feb 80 pp 47-49

[Briefs: "Construction and Operation Chronicle"]

[Text] Construction of the Nizhnekamskaya GES -- the last stage of the Kama River chain -- is continuing. The station's first unit, which has a capacity of 80,500 kW, is already in operation. The gate for the Nizhnekamskaya GES's dam weighs 67 t and is being finished ahead of schedule.

In 1979, 1,500 more ships than were planned passed through this hydraulic engineering complex's navigation lock. The construction of both branches of the lock was completed before the sailing season began. Mastery of the equipment ahead of schedule and close cooperation with the river transport workers made it possible to reduce the lock transit time by 10 percent. The cooperation of all the river transport services made it possible to extend the sailing season on the Kama by more than a month. Despite the difficult meteorological conditions encountered in the area, the lock is functioning without interruption.

* * *

Good results in hydraulic turbine building have been achieved by the "Metal Plant" association in Leningrad. For instance, the turbine for the Sayano-Shushenskaya GES contains 8 percent less metal than the one used at the Krasnoyarskaya GES. The introduction of new techniques for manufacturing rotor blades made it possible to reduce the rotor's weight and save 59 t of stainless steel. The efficiency of the turbines for the Sayano-Shushenskaya GES is 1.5-2 percent higher than that of the ones previously produced.

* * *

At the All-Union Shock Komsomol Construction Project for the Cheboksarskaya GES, which will have a capacity of 1.4 million kW and will be the last stage on the Volga River chain, the construction and assembly work is proceeding on a large scale. Concreting of the above-water section of the lock has begun. More than 1.5 million m^3 of concrete have been poured for the basic structures of the Cheboksarskaya hydraulic engineering complex.

Installation of the first turbine's stator was completed in the first half of December 1979. This complex assembly for the power-generating unit weighs more than 150 t. Its installation required special accuracy and high production standards. Assembly of the rotor chamber has begun. First-class equipment and structural parts are arriving at the construction site from Leningrad, the Urals, the Ukraine and cities along the Volga. The cleaning of the bottom of the future "Cheboksary Sea" is proceeding at full speed. This hydraulic engineering complex's reservoir will be almost 350 km long and will make it possible to improve navigating conditions on the Volga.

The hydraulic construction workers have decided to prepare the GES's first unit for operation by the end of 1980.

* * *

Construction of the Baypazinskaya GES -- the sixth in the Vakhsh River chain -- began early in December 1979. The basis of its construction was an existing hydraulic engineering complex for irrigating virgin lands in the Yavanskaya Valley. The height of the existing dam must be raised by 20 m. This complex's reservoir will serve as a counterbalance for the Nurekskaya GES when the latter is operating under peak load conditions. The uneven water discharge from the Nurekskaya GES will be redirected into the reservoir and it will insure the uniform discharge of the Vakhsh River's water into the lower reaches. Four units with a total capacity of 600,000 kW will be installed at this GES.

The construction of the Baypazinskaya GES is in the hands of the collectives of Nurekgesstroy and its subcontracting organizations, who put the Nurekskaya GES into operation ahead of schedule. The preparatory period work will be combined with the basic construction work, which will make it possible to accelerate the GES's introduction into operation considerably.

This electric power station will be completed by the end of the 11th Five-Year Plan. It will contribute up to 2.5 billion kWh of cheap electricity to the Unified Power System of Central Asia every year.

* * *

The rate of construction at the Rogunskaya GES -- the largest one in Central Asia -- on the Vakhsh River is increasing. Its rock-filled dam, which will be 335 m tall, will create a reservoir containing more than 13 billion m^3 of water. The hydroelectric power station's six units will generate 13.3 billion kWh of electricity. Residential construction is proceeding on a large scale: about 40,000 m^2 of living space has already been built, mountain roads are under construction, construction tunnels are being driven, a bridge is being built across the Vakhsh River, a concrete plant is in continuous operation, and bases are being set up for the subcontracting organizations.

* * *

The Vilyuygesstroy administration's collective, which built the unique Vilyuyskaya GES -- the first one to be built in the permafrost zone -- has begun working on the construction of a second GES on this river. The first crew of construction workers, led by Communist Party member O. Kharev, one of Vilyuygesstroy's leading crew chiefs, has arrived at the site of the future GES. There it is working to set up transportation and power lines, a concrete plant, machine shops and living quarters. A dam almost 60 m high must be erected here, along with the GES building and a comfortable workers' settlement. The first unit of Vilyuyskaya GES-3 is supposed to begin operating in 1985.

* * *

Khramskaya GES-1, with three power-generating hydraulic units having a total capacity of 112,500 kW, went into full operation in Georgia in 1949. Work on the construction of this GES was begun in 1937. The war with the Fascist aggressors interrupted the construction work. It was begun again after the war ended, and the first units were already in operation in 1947.

This GES consists of a main unit, a diversion section and a station unit. The rock-filled dam, which is 110 m long and has a maximum height of 32 m, was built at the entrance to a narrow ravine. The dam's body consists primarily of rock fill, and also contains a stainless steel antifiltration screen on a prepared concrete base made from dry masonry. The dam holds back a reservoir with a capacity of 312 million m^3. The spillway for discharging a catastrophic river flow rate at 500 m^3/s consists of a concrete spillway with six spans that are each 6.5 m wide and are closed by flat gates, as well as an overflow channel; the water intake's deep-water gate is designed for a flow rate of 36 m^3/s.

The head diversion unit, which has a total length of 7.5 km to the equalizing shaft, consists of three sections: two pressure tunnels 3.5 m in diameter and a reinforced concrete water conduit that lies between them.

The station unit's structures include a two-chambered equalizing shaft, a turbine water conduit with a disk gate building, the GES building (in which there are three power-generating units with vertical bucket turbines and synchronous generators), a discharge channel, and a high-voltage outdoor distribution system. The maximum static head is 400 m and the rated head is 370 m. The average annual amount of electricity that is produced is 217 million kWh.

* * *

The builders of the ultralarge Tuyamuyunskaya hydraulic engineering complex stemmed the flow of the Amudar'ya River on 6 December 1979, almost a year ahead of schedule. In all, it took the hydraulic construction workers 2 days to perform one of the most critical stages in the construction of this unique complex.

Before the spring floods, the builders must erect the main dam, which will stop the flow of this river that for centuries has washed away its banks and caused great damage to nearby agricultural areas. The hydraulic engineering complex being built on the Amudar'ya will make it possible to create a large zone for the cultivation of cotton and rice at the juncture of two deserts -- the Karakum and the Kyzylkum -- and develop and improve the water supply for 1 million ha of land.

* * *

Water from the Nurekskaya GES's reservoir will flow through a tunnel that is about 14 km long and then be used to irrigate an area of 100,000 ha of arid land in the Dangarinskaya Valley.

In order to shorten the construction period, tunnelers from the Gidrospetsstroy construction administration in Dangara are sinking three vertical shafts to different depths. The driving of the basic tunnel is being done simultaneously from both the intake and outlet portals.

By the end of October 1979 shaft No 1 had been sunk to its full depth of 242 m. Of the 318 m to which shaft No 2 is to be sunk, 220 m have been completed and lined with structural concrete. The drilling of this shaft was made more complicated at the very beginning by the fact that a quicksand zone was encountered at a depth of 13 m. After freezing this soil, the builders moved ahead rapidly. In August 1979 a record driving rate of 38 m [sic] was achieved here. Blasthole drilling for shaft No 3 began in the spring of 1979. Here the shaft has reached a depth of 70 m, with the lagging rate being related to the lack of a powerful hoisting machine.

The latest period of work on the driving of the tunnel is characterized by highly productive shock labor. Comrade Sharikov's work crew section removed 96 m^3 of rock on its shift in shaft No 2; in shaft No 3, A. Kasatkin's section beat this record by removing 100 m^3.

* * *

The Andizhanskoye reservoir began filling in December 1979; by the spring of 1980 it will contain about 1 billion m^3 of water. The rivers of Uzbekistan were full of water in December 1979 and the workers of the irrigation system operation services were collecting water in all 18 of their large reservoirs. More than 5 billion m^3 of water is to be held in them.

* * *

The Gissarakskoye reservoir will supply water to more than 55,000 ha of arid land in Kashkadar'inskaya Oblast. Construction of a discharge tunnel was completed in the first half of December 1979. It will be used to divert river water away from the dam that is under construction.

* * *

The strait connecting the Caspian Sea and Kara-Bogaz-Gol Gulf was closed in the middle of December 1979. For the last 150 years, the Caspian's water level has been dropping continuously. One of the reasons for this is the constant outflow of 180 m^3 of water per second from the Caspian to the gulf, where the water level is about 3 m lower than that of the sea.

Specialists from the Soyuzgiprovodkhoz institute designed a unique dam for the strait. Its upper mark is at 25.6 m and it is 550 m long and 15 m wide. The banks slope and are not washed away by waves. Next to the dam there will be a water-transmission building that will make it possible to fill Kara-Bogaz-Gol Gulf with water from the Caspian if it becomes necessary.

The closing of the strait was carried out in three stages: engineering preparation, preliminary constriction of the channel and closure of the gap.

The gap was closed during a severe storm on the Caspian. Previously it had been assumed that three suction dredges working at night could fill in the partitioning dam from the Caspian side, but in view of the bad weather it was necessary to halt this operation. It was decided to intercept the path of the Caspian water with two pipes 1 m in diameter and 250 m long. They were laid across the race and damped the water's erosive force. After this, concrete cubes that held the pipes down and closed the narrow throat were put in place.

The closing of the strait will make it possible to stabilize the level of the Caspian Sea and reduce the water losses from it.

* * *

At the end of October 1979, a detachment of young people arrived to begin building a complex of protective structures that will save Leningrad from flooding forever. This construction project was announced by the All-Union Shock Komsomol. In 1979 the value of the work done amounted to several million rubles. The main organizations responsible for building the complex (the dike is about 25 km long) have been specified.

* * *

Construction of a bypass tunnel that is half a kilometer long was completed in connection with the construction of the Papanskoye reservoir in southern Kirgizia in November 1979. The Ak-Bura mountain river was blocked and its waters directed into a diversion tunnel dug for use during the construction period. Erection of the future reservoir's dam, which will reach to a height of 100 m, was begun. The reservoir's total volume will be 260 million m^3, which will increase the amount of water available for 40,000 ha of land.

* * *

A program for the radical reorganization of the Volga River's delta has been developed. The main purpose of the reorganization is to create more favorable conditions for the rapid growth of reserves of valuable commercial fish in the lower Volga and the northern Caspian. The reorganization will be carried out in three different spheres: redistribution of the water between the delta's eastern and western zones, improvement of the natural spawning grounds, and restoration of the channels through which fish travel upstream and downstream.

A powerful water separator has already been built not far upstream from Astrakhan'. Its purpose is to transfer additional water resources into the eastern side of the delta, which is the more convenient part for use as a spawning ground. An earthen dike more than 60 km long and up to 6 m tall separates the eastern and western sides. Normally, two-thirds of the water flows through the Volga's main channel and only one-third passes through the Buzan channel. The dam will make it possible to direct half the Volga's water to the east and will support hundreds of thousands of hectares of spawning grounds.

Improvement of the sections suitable for spawning has already been accomplished over an area of 215,000 ha. A plan for converting another 100,000 ha on the delta's southern edge for this purpose has been drawn up. Here it will be necessary to clean out hundreds of deep and shallow channels, lay out and clean up meadows, create ponds that are suitable for the growth of young fish and their subsequent transportation to the sea for fattening.

A plan for the capital repair of fish runs constructed more than 10 years ago has been formulated. These channels exit into the sea over a stretch of several dozen kilometers. In connection with the drop in the water level in the northern Caspian, however, the fish runs have become too shallow. They must be deepened and widened, as well as lengthened an average of 20 km each.

This reorganization will make it possible, with maximum benefit, to pass through the spawning ponds the maximum amount of fresh water, thereby improving the hydrological and biological situation in the areas of the most intensive fish reproduction.

* * *

Construction work has begun on a large new reservoir in the mountainous Bortagay region not far from Alma-Ata. At an altitude of more than 1,000 m above sea level, a reservoir will be formed on the Chilik River that will make it possible to irrigate tens of thousands of hectares of agricultural land.

The construction of the Bortagayskoye reservoir, which will hold up to 320 million m3 of water, is only the first step in the irrigational development of this region. Here there will also be a canal many kilometers long, along which the water will reach the fields by gravity flow.

At the present time the working plans for the first stage of the construction are being completed. A settlement for the hydraulic construction workers is already being built in the Bortagay region, access routes are being constructed, and work has begun on a tunnel 400 m long that will be used to divert the Chilik's water during the construction of the dam.

* * *

Every day the Vazuza River replenishes our capital city's drinking water. In addition to this, however, the Vazuza turns the blades of turbines that produce electricity for the hydraulic engineering system's own needs. Two hydraulic power-generating units were put into operation at the Perepadnaya GES in November 1979.

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ENERGY CONSERVATION

METHODS OF FUEL-ENERGY CONSERVATION EXAMINED

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 3, Mar 80 pp 3-7

[Article by E. I. Vertel', chief of the Department of Budgets and Plans for Distribution of Fuel and Petroleum Products, Gosplan USSR]

[Text] The Communist Party of the Soviet Union and the Soviet Government have always given considerable attention to improving the effectiveness of sectors of the fuel-energy complex.

The fuel-energy complex of the nation unites the petroleum, petroleum processing, gas, coal, shale and peat sectors of industry, as well as electric power and the production of heat. This is a vast multisectoral national economic system that plays a leading part in development of the material and technical basis of communism.

To a decisive extent the development of this complex determines the pace and scale of economic and social development of the USSR, allocation of the productive forces of the nation, and sets up the necessary prerequisites for further development of mechanization and automation of production processes, improvement of working conditions and elevation of the standard of living of the people.

The fuel-energy complex is closely related to all sectors of the national economy, and therefore its development is considerably dependent on the development primarily of machine building, ferrous and nonferrous metallurgy, the construction industry and so on. The sectors of the complex consume about 70% of the pipes being produced in the nation; more than a third of the capital investments directed at industry are allocated for maintaining and developing the complex; about 35% of all national economic funds are concentrated there; about 10% of the industrial workers are employed there.

The fuel-energy complex of the USSR is developing at a rapid pace. During the period of 1961-1978 the extraction of petroleum and gas condensate increased by a factor of 3.4, gas by a factor of 6.3, and coal by a factor of 1.4.

In 1978 the overall volume of extraction and production of primary fuel-energy resources was 1,772 million metric tons of standard fuel, or about one-fifth of world production. Petroleum, gas and coal occupy a predominant place in the overall extraction and production of primary fuel-energy resources. In future, the percentage of these forms of fuel will decrease in connection with the ever increasing amount of electric power being generated in hydroelectric and nuclear plants, heat energy based on nuclear heat supply plants, and also thanks to the use of nonconventional forms of energy such as solar, geothermal, wind and so on.

Despite the enormous amounts of fuel-energy resources being extracted and produced in the nation, there is still a certain strain on providing fuel and energy to the national economy, but the reasons bear not even the remotest resemblance to the causes of the energy crisis in nations of the capitalist world.

First of all, it should be noted that the natural supplies of fuel-energy resources are nonuniformly distributed over an enormous territory of our nation, a considerable portion being located in the eastern thinly populated regions with severe natural and climatic conditions.

At the same time, in the European part of the USSR, where most of the population is located and more than 75% of all production forces of the nation are concentrated, a considerable part of the most accessible supplies of fuel has already been used up, and the mining and geological conditions have appreciably worsened in a number of coal, gas and petroleum deposits that are being worked.

For example right now in Donbass mining is being done at a depth of 1000-1100 meters in a number of mines, which involves additional expenses to deal with increased gas release, mine detonations, and sudden emissions of coal and gas. At such depths there has been a considerable increase in rock pressure, which has acutely complicated shoring and raised the temperature in the working space.

The main increase in petroleum and gas is now coming from west Siberia, including from the northern territories, which has involved increased expenditures for rigging fields, building roads, living quarters and facilities for communal, cultural and maintenance purposes, and has tripled or quadrupled the extent of gas and oil supply lines. All this requires considerable monetary and material expenditures.

Thus our difficulties in developing the sectors of the fuel-energy complex and providing fuel and energy to the national economy can be characterized as difficulties of growth and economic acquisition of new unpopulated and remote territories with severe natural and climatic conditions.

These difficulties to a considerable extent can be overcome first of all by limiting new construction and expansion of fuel-intensive and energy-intensive facilities in regions of the European part of the USSR, locating them close to fuel bases in the eastern territories of the nation, and secondly by cutting the requirements for fuel-energy resources by more efficient and economic consumption. Fuel economy is the cleanest and cheapest source of additional reserves, and therefore we have given and will continue to give first-rank importance to the solution of this problem. However, there are difficulties here as well.

We have recently noted a trend toward reduced effectiveness of steps aimed at saving fuel itself, and toward increased effectiveness of steps aimed at economic consumption of thermal and electrical energy and the use of secondary thermal resources. The savings (in millions of metric tons of standard fuel) of these fuel-energy resources in different periods has been:

	1961-1965	1966-1970	1971-1975
Boiler-furnace fuel . . .	108.9	75.9	52.6
Electric and heat energy (adjusted to standard fuel)	24	37.1	41.5
Secondary thermal resources (adjusted to standard fuel).	2.8	4.1	6.1

In 1976-1980 the savings of boiler-furnace fuel is expected to amount to 30 million metric tons, and in 1981-1985 the savings is not expected to exceed 22-25 million metric tons of standard fuel. Such a reduction in the size of fuel savings due to reduced specific consumption is explained by the fact that at the present time we are approaching the engineering limit for a whole series of fuel-utilizing and energy-utilizing equipment now in operation. This limit is predetermined by the design particulars of this equipment and the technological arrangements used in production.

Thus a further reduction in the specific norms for consumption of fuel-energy resources will depend mainly on the scale and pace of re-outfitting industry with new and more progressive fuel-utilizing and energy-utilizing equipment, and introduction of less energy-intensive technological processes, and also on how rapidly and effectively the machine builders can set up production of such equipment in the amount needed by the national economy.

The Central Committee of the CPSU and the USSR Council of Ministers, recognizing the great importance of economic use of fuel-energy resources, passed a decree in 1973 "On Steps to Improve Efficiency in Using Fuel-Energy Resources in the National Economy." This decree outlined an extensive program of work on updating existing fuel- and energy-using equipment and monitoring and measurement instrumentation and producing new and highly effective equipment and instrumentation, established quotas on the use of secondary fuel-energy resources, production of equipment and devices to be applied to the use of unconventional forms of energy, and a number of other measures. This decree has played a great part in the matter of increasing efficiency in the use of fuel-energy resources.

Ministries have carried out a number of steps to update existing fuel-utilizing equipment and to replace worn out and obsolescent equipment. During the Ninth Five-Year Plan 1200 boilers, 640 turbines, 250 generators and 80 transformers were modernized in electric power plants of the USSR Ministry of Power, saving 9 million metric tons of standard fuel. There has been an increase in the production of heat and electric power in TETs.

The Councils of Ministers of the Soviet republics have begun work on installing devices for automatic control of heat supply on the equipment for public-heating entrance services in apartments and public buildings. The Council of Ministers of the Ukrainian SSR and the Ministry of the Electronics Industry have organized production of these instruments and equipment for subdepartmental enterprises.

In the enterprises of Goskomsel'khoztekhnika of the USSR, 65 shops and 75 mobile teams have been organized for repairing and servicing oil tnak storage facilities in kolkhozes and sovkhozes, where losses of petroleum products are especially high. For instance at the Ryazan' Repair Plant there has been an increase in the production of updated gasoline pumps for fueling diesel tractors, which provided 80% of the need for these pumps in agriculture as early as 1976.

The Ministry of the Gas Industry has developed and started production on improved gas and gas-mazut jet burners and gas-utilizing equipment. Small-series production of these burners has been organized at the Kamenskiy Experimental Plant, and construction is being completed on a specialized plant for producing gas jet burners in Fastov.

The Ministry of the Electrical Engineering Industry has worked out a group of State standards aimed at introducing more economic electric motors that have better technical indices (higher efficiencies, power factors and torques).

However, not all the measures specified in the decree of the Central Committee of the CPSU and the USSR Council of Ministers have been carried out. Many machine building ministries have not fully completed work on organizing series production of modern efficient fuel- and energy-using equipment, monitoring instruments and automation facilities, and are carrying out this work with delays beyond set deadlines.

The Ministry of the Electrical Engineering Industry together with the USSR Ministry of Millwright Work and Special Construction, the Ministry of the Gas Industry and Instrument Making have not yet approved steps for setting up production facilities and organizing series output for machine building enterprises to produce standardized mechanized and automated flame heaters and thermal furnaces that work on liquid and gaseous fuel with high efficiency. Such furnaces are currently being made by every machine building ministry individually, and are not as good in the technical characteristics as the best individual non-Soviet models. Nor has production been organized on recuperators for existing furnaces. Overconsumption due to this reaches several million metric tons of standard fuel.

The ministries of the motor vehicle and machine tool industries, heavy machinery and railroads are behind in work on converting to roller bearings for use in railroad freight cars that are being produced or are now in use. In this connection we observe a yearly overconsumption of considerable amounts of diesel fuel, electric energy, axle grease, and large numbers of personnel are occupied with servicing axle bearings.

In the decree of the Central Committee of the CPSU and the Council of Ministers it was pointed out that the Ministry of Chemical Machinery should, beginning in 1977, switch to production of piston compressors only with straight-flow rather than plate valves, which will save 13-15% of the electric energy in producing compressed air, and will simultaneously increase the capacity of the compressors by 10%. However, the Ministry of the Chemical Industry has fallen behind in retooling the Venibe Plant for producing these valves.

The Ministry of Heavy and Transport Machine Building should have begun providing all mainline locomotives with new four-cycle diesel engines in 1978. These engines have a 5-6% lower fuel consumption than those presently in use, and plans were made to build a special plant to make them in 1976-1978. However, it was not until 1978 that construction of the plant was started.

The Ministry of Power Machinery has not met the quotas set by the decree of the Central Committee of the CPSU and the USSR Council of Ministers relating to fully satisfying the needs of the national economy for auxiliary boiler equipment, and spare parts for boiler facilities beginning in 1976.

Enterprises of the Ministry of Chemical Machinery have not organized series production of pump units with regulated discharge or valves for automatic control of fuel systems at the inlets with diameter of 50-150 mm, and enterprises of the Ministry of Road Building Machinery have not started series production of blowers with controllable capacity. The Ministry of Instrument Making has not planned to produce new instruments and facilities for automating regulation of the supply of heat transfer agent to steam heat and hot-water supply systems until 1980-1981.

Enterprises of the Ministry of the Petrochemical Industry and the Ministry of the Chemical Industry have not been producing the necessary amounts of heat insulating materials and sealants, and enterprises of the USSR

Ministry of Construction Materials are not mass-producing high-quality window and door hardware with tensioning devices that keep windows and doors tightly closed, and also heat-reflecting windowpanes.

The effectiveness of steps to conserve fuel-energy resources is hampered by unsatisfactory completion of a number of assignments on improving efficiency in the use of fuel, delays in setting up facilities for producing more economic fuel-utilizing equipment, and shortages in supplying builders with heat insulating materials and sealants. Our task is to eliminate this lag in the near future, and moreover to carry out large-scale steps to ensure savings of fuel-energy resources in amounts commensurate with the savings once realized by converting from steam to diesel and electric locomotives on railroads, conversion to more powerful generators (300, 500, 800 and 1000 MW) and higher steam parameters in fossil-fuel electric plants.

Such possibilities are to be found first of all in the field of production and utilization of electric and thermal energy.

In the electric power industry, these capabilities are accelerated construction of nuclear electric plants and mastery of fast reactors, introduction of MHD generators that will cut fuel consumption by 25-30% in the production of electric energy, the use of solar, geothermal and wind energy, improvement of the main parameters of working conditions in electric networks, reduction of power losses in networks and so on.

There are enormous reserves for fuel savings in the production of thermal energy.

There are a large number of low-potential heat sources in industry: elements for cooling furnaces and technological facilities, purified waste water from cities and enterprises, with year-round temperature of at least 13°C, water from cooling towers and so on. There are also sources of thermal energy in nature: non-freezing lakes, deep ground water and so on.

In the Black Sea, the temperature at a depth of about 50 m remains constant at 8°C. Use of the heat contained in 0.5 cu. km of this water could solve the problem of year-round heat supply to the city of Odessa, and the heat in 2 cu. km of this water could meet the heating needs of all cities on the Black Sea coast. The utilization of low-potential heat involves the use of heat pumps that have an electric drive and convert low-potential thermal energy of the surrounding environment to thermal energy that can be used to heat the heat-transfer agent in forced-air heating units. The electric energy expended by the heat pump in producing heat when adjusted to standard fuel will be 30% lower than when this heat is produced in a boiler house.

Heat pump stations are already in operation in Georgia at the Samtredia Tea Plant, for heating the auditorium at the resort in Pitsunde, and in the Simferopol' Electric Power Plant. At the present time a large heat pump station is being planned for construction near Moscow in the near future. The heat transfer agent will be the heat from purified waste water of the city.

The advantages of such a method of heat production are obvious if we consider that the heat pump station operates with the use of electric energy that can be generated in a power plant operating on low-grade coal that could not be used in a boiler house, and in a nuclear power plant. The heat pump station is an absolutely clean source of heat that does not contaminate the environment. Moreover, there is a sharp reduction in the numbers of service personnel since control of the station can be automated and implemented from a dispatcher station. The heat pump station could be disconnected for 3-4 hours during the maximum electric load.

During the first stages of introducing these facilities, it would be advisable to concentrate on existing designs of refrigeration machines with capacities of 0.5, 2 and 5 Gcal/hr, and also on a machine with capacity of 25 Gcal/hr for which technical documentation has already been worked out. These machines need to be modified to produce heat (instead of cold) with the use of Freon-12 as the working fluid.

More powerful machines (50 and 100 Gcal/hr) with electric motors of 15 and 30 MW have no prototypes at present, and will have to be designed from scratch. These facilities will have to use a new working fluid with physicochemical characteristics such that the water from the supply network would be heated in the heat exchangers of the pump units to 120-125°C instead of the 80-90°C when freon is used.

The production of thermal energy planned for these facilities by 1990 will be only 10% of the total volume of thermal energy that will be produced in the nation for the needs of heating, ventilation and hot water supply by sources of centralized heat supply, but even this will save about 12 million metric tons of standard fuel.

Improvement of the efficiency of utilizing thermal energy will also result in considerable savings.

More than 20% of the thermal energy being generated is expended for heating and ventilation purposes. In each industrial shop in the process of operation of technological equipment, substances are released into the atmosphere of the shop that are hazardous to human health; exhaust blowers operate to remove these pollutants. Depending on the amount and toxicity of these substances, the number of exchanges of air in the shop fluctuates from 6-10 in conventional shops to 40 in the galvanic, paint and varnish, and some other shops. This means that on the average every 6-10 minutes all the air in the shop at a temperature of 20-25°C is released to the outside and replaced with fresh air from the street at a temperature of from -10 to -20°C in winter, which is heated to +18°C and

6-10 minutes later again released to the outside. Analogous phenomena are also observed in public buildings with organized exhaust ventilation (hospitals, motion picture theaters, hotels and so forth).

To eliminate such heat losses, regenerators were installed in 1979 in three enterprises of the Ministry of the Electronic Industry so that the exhaust heat could be used to warm the fresh air entering the shop. As a result, by using the heat of exhaust air at 23°C it has been possible to heat fresh air entering the shop at a street temperature of -9°C to +16°C, i. e. to use up to 80% of the heat of the air removed from the room.

If we consider that each year in our nation up to 90 million metric tons of standard fuel is used for producing heat for comfort, we can readily imagine the scale of the savings.

Gosplan USSR is now preparing the draft of a resolution with stipulation of appropriate assignments to ministries and agencies on making equipment for regeneration of exhaust heat and automatic temperature regulators for water supplied to living quarters from the public water system for heating, and a number of other measures. It is necessary that these assignments be carried out on time and in full volume, and that consumers get ready for the introduction and use of new equipment. Therefore it is very important for machine building ministries to follow the example of the Ministry of the Electronic Industry in immediately organizing the manufacture of exhaust heat regenerators and rapidly putting them to use. These units are very simple, and their manufacture can be organized in any machine building enterprise. All investments are paid back in less than one year.

Here we have taken up only the two main directions that will ensure great savings of fuel-energy resources, but this does not mean that we can relax efforts to save fuel and energy by conventional methods through a further reduction in specific fuel consumption, updating equipment, providing monitoring and measurement instrumentation.

A lot still remains to be done to eliminate the wide range of sizes of low-capacity boilers, to increase the efficiency and degree of mechanization and automation of boiler operation. Such boilers are needed for operation on liquid, gaseous and solid fuel. Consideration should also be given to rational amounts of production of such boilers so that they can be used only in local territories with low and dispersed heat loads, while large regional interbranch boiler houses are built in other cases.

Machine builders must make a great contribution to accelerating diesel motor vehicle transport, including passenger cars, to developing and organizing the production of electric vehicles, even if only for intracity use at first.

It is very important to improve the quality of the fuel-utilizing and energy-utilizing equipment now being produced, to organize centralized servicing and repair, to provide spare parts in the necessary amounts.

All reserves must be put into action, for the goal justifies all efforts and expenditures, and serves the noble end of improving the living standard of our people. Machine builders have a primary part to play in this matter.

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FUELS

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URAL REGION: NEW OIL, GAS EXPLORATION TARGET

Moscow GEOLOGIYA NEFTI I GAZA in Russian No 11, Nov 79 pp 11-18

[Article by K.S. Yarullin, V.A. Romanov (Bashkir Branch of the USSR Academy of Sciences) and I.A. Tagirov (Ishimbay Drilling Administration): "Pre-Devonian Deposits of the Cis-Urals: A New Target of Oil and Gas Explorations"]

[Text] The high degree of exploration of the territory of Western Bashkiria and the reduction in recent years of discoveries of significant deposits of oil in the paleozoic deposits advance the important and urgent problem of developing new possibly oil and gas bearing pre-Devonian layers. In the future the growth in prospected reserves of oil and gas in Bashkiria can be insured mainly thanks to the discovery of deposits in subsurface Vend-Riphean and partially in paleozoic deposits in new, still little studied regions.

Despite the continuous searches for deposits of oil in the Bavlinskiy (Vend) formations, so far substantial accumulations have not been discovered either in Bashkiria or in other eastern oblasts of the Volga-Ural province. Unfortunately, in many ways still unclear are the basic regional geological factors which could contribute to formation of zones of oil and gas accumulation in other deposits. As a result, doubts have arisen among some of the researchers in the possibility of generation of UV [hydrocarbons] and in the success of explorations of beds in deposits of the Vend and Riphean age. Materials from drilling and geophysics make it possible to assume that the exploratory operations were conducted in the majority of cases on sites with geological conditions not adequately favorable for accumulation of UV. In connection with this, it is extremely important first of all to determine, based on the experience of oil prospecting operations and other oil and gas basins and theoretical generalizations, the most optimal zone for oil and gas accumulation in the limits of distribution of ancient sedimentary formations in the eastern part of the Volga-Ural province.

It seems to us that one of the main zones of generation and accumulation of oil and gas is the large Western Ural paleo-depression, located between

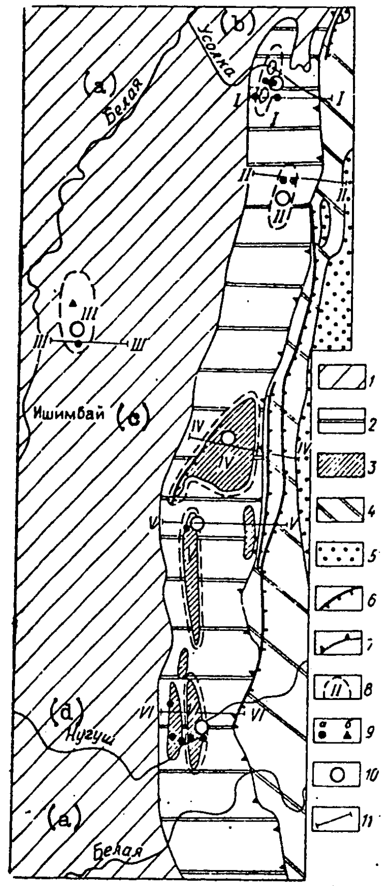

Fig. 1. Schematic Structural Geological Map of Southern Cis-Ural Region

Key:

Deposits: 1. Permian united; 2. Sakmarskiy and Artinskiy (Assel'skiy in places) united; 3. Mid-upper-carboniferous; 4. Mid-devonian lower-carboniferous united; 5. Ashinskiy series, Vend; 6. Tectonic fractures; 7. Eastern edge of Cis-Ural boundary depression; 8. Contour and number of local structures (I. Krasnousol'skiy, II. Kurgashlinskiy, III. Shikhanskiy, IV. Arlarovskiy, V. Urazbayevskiy, VI. Ishtuganskiy); 9. Wells which have revealed deposits of the Ashinskiy series (a) and the upper part of the upper-Riphean complex (b); 10. Section suggested for deep drilling; 11. Geological profiles.

a. Belaya, b. Usolka, c. Ishimbay, d. Nugush

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the Ural geosyncline and the Eastern Europe platform, from the Karatau structural complex to the north to the Aktyubinsk Ural region in the south. The western side of the paleodepression in the folded bed at a depth of 6 kilometers is traced along the meridian to the west of the city of Ufa and to the east of the city of Orenburg. Its more submerged (up to a depth of 12-14 kilometers) eastern side is arbitrarily marked east of the Alatau anticlinorium. Within the indicated boundaries it has a depth of 6-12 kilometers, a width of 100-150 kilometers and a length of up to 500 kilometers. The paleo-depression is filled with a thick layer of subaqueous formations of the Proterozoic era (6-10 kilometers) and primarily the same sediments of the Paleozoic era with a capacity of 2-4 kilometers to the north of it and up to 10 kilometers to the south.

The accumulation of the huge mass basically of marine formations occurred as a result of a prolonged submergence of the basin according to graduated fractures in the bed, having courses coordinated with the main dislocations of the Urals. The axis of the paleo-depression with the maximum capacities of pre-Cambrian deposits was displaced towards its eastern side, in the region of the leading folds of the Urals. In a modern structural plan the highest hypsometric position of the complicating structures coincides with the eastern side of the Cis-Ural boundary depression, with its central part and the zone of the Alatau anticlinorium on the section between the Usolka river on the north and the Nugush river on the south (figure 1). Here the Vend deposits are uncovered by wells at depths of 1-2 kilometers (figure 2,B). Consequently, in a structural respect, folds of the indicated section posses the best conditions of accumulation of UV in the paleo-depression.

Already pointed out [7, 9, 10] have been the presence of anticlinal traps, their favorable paleotectonic development for formation of oil and gas accumulation zones, and also the presence of OV [organic material] and bitumoids in the rocks of the Vend and Riphean periods in this area. Questions of the development of pre-Cambrian oil and gas formation, and information about the numerous accumulations of oil and gas in the pre-Devonian strata in various regions of the world have been treated in detail in works [1,3-5,8].

Pre-Devonian formations in the Cis-Ural boundary depression have been revealed by wells at a depth of from several dozen to the first hundred meters. Practically illuminated by them is only the upper part of the Vend complex and just Shikhanskaya well 5, which reached a depth of 3972 meters. These deposits have been completely cut and the upper half of the upper-Riphean cut has been uncovered (see figure 2). The data obtained are clearly inadequate for a positive judgement about the sequence of occurrence and the composition of the Vend and upper-Riphean rocks. To some degree the meagerness of the information can be filled in by materials about the plicated Urals adjoining the east of the area, where they have been studied in natural outcrops [6]. Also compiled taking these data into account was a probable cross-section of sedimentary formations of the upper Riphean and Vend in the zone of the Cis-Ural trough (see figure 2).

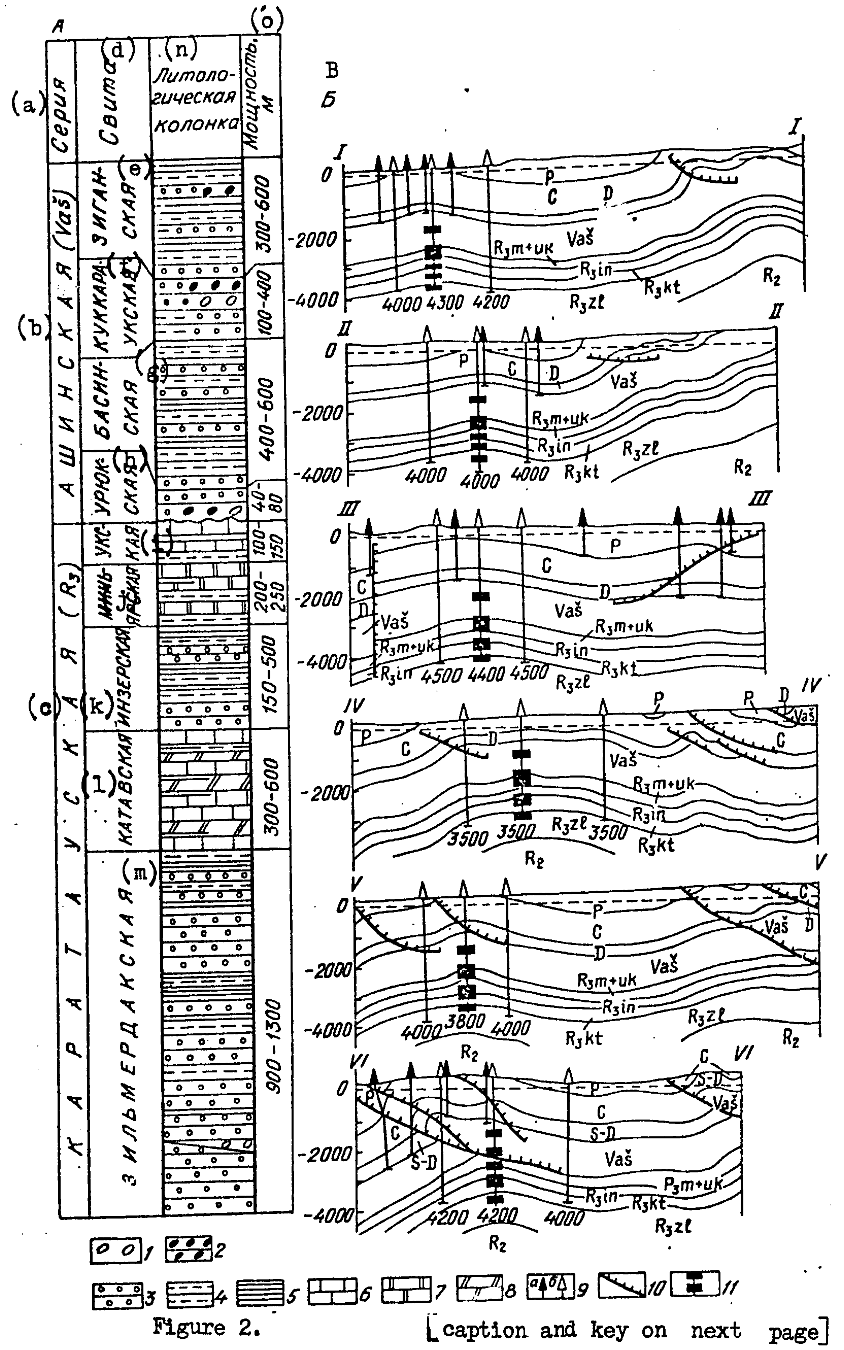

Figure 2. [caption and key on next page]

Figure 2, continued

Composite theoretical cross-section of upper-Riphean and Vend deposits of the Cis-Ural boundary depression (A) and geological profiles (B) through the Krasnousol'skiy (I-I), Kurgashlinskiy (II-II), Shikhanskiy (III-III), Arlarovskiy (IV-IV), Urazbayevskiy (V-V) and Ishtuganovskiy (VI-VI) structures.

Key: a. Series
b. Ashinskiy (Vas)
c. Karatau (R_3)
d. Suite
e. Ziganskiy
f. Kukkaraukskiy
g. Basinskiy
h. Uryukskiy
i. Ukskiy
j. Min'yar
k. Inzer
l. Katav
m. Zil'merdakskiy
n. Lithologic column
o. Capacity, meters

1. Conglomerates
2. Gravelites
3. Sand particles
4. Aleurolites
5. Argillites
6. Limestones
7. Dolomites
8. Marle
9. Drilled (a) and planned (b) wells
10. Explosions
11. Intervals of possible oil and gas bearing cross-section

The oil source deposits in the upper-Riphean Vend complex (according to lithological composition, content of OV) could be argillo-aleurite and marlaceous-limestone layers, present in the cuts of the Nugush and Bederyshinskiy rock masses of the Zil'merdakskiy suite, the sub-Inzer mass of the Katav suite, the upper half of the Inzer suite, the Min'yar suite and certain suites of the Vend. Whereas in the indicated rocks the content of bitumoids fluctuates basically in the limits of $n \cdot 10^{-3}$– $n \cdot 10^{-4}$ percent in the rock, a significant increase in them (up to 0.3 percent) has been established in the Cis-Ural trough and in the boundary part of the platform, where accumulations of hydrocarbon gas have been revealed (Shikhansk and Kabakovsk sites).

However for conversion of OV and concentration of disperse UV up to industrial accumulations it is necessary to have a favorable geological situation in the course of the whole history of development of the sedimentary basin (complex of physico-geochemical, hydrogeological, hydrodynamic and other conditions). Many researchers consider this indicator as the determining one [1-3]. It seems to be a fair statement [3] that it is necessary to consider without fail the period for which the rock mass is in the main phase of oil formation and the main phases of gas formation and the especially favorable conditions for preservation of the deposits of oil formed.

Analysis of the major lithological-paleogeographic indicators of the Riphean, Vend and paleozoic deposits, calculations of the paleodepths and paleotemperatures, and also reconstruction of the history of tectonic development of the territory of the Cis-Ural boundary trough show the following.

At the end of the late Riphean, after extended sagging, sedimentation ceased everywhere (pre-Ashinskiy gap). In the area of the Western Ural paleo-depression the short-lived gap was not accompanied by a noticeable washout, since the deposits of the Ashinskiy series in the zone of the forward folds of the Southern Urals with visual conformity occur at the highest levels of the basement rocks. A substantial washout occurred only beyond the limits of the paleo-depression, in the area of the eastern framework of the Tatar arch [4], and in the central and eastern regions of the western slope of the Southern Urals [6].

The extended gap in sedimentation began from the boundary of the Vend and Paleozoic and continued to the beginning of the mid-Devonian. It is true that in the Silurian and early Devonian periods on individual sections of the paleo-depression shallow deposits did accumulate at times [4], but on the whole this territory was developed in a calm tectonic situation without deep submersion or marked washout of earlier accumulated rocks. The gap was not accompanied by a folding process, although some gently sloping hill-shaped dislocations could have begun their formation in this period. The absence of a substantial washout is confirmed on the whole by the conformity of the Vend and Devonian deposits both in the zone of the forward folds of the Urals and in the limits of the slope of the platform.

The early-Paleozoic gap continued for approximately 170 million years. According to duration and intensity of manifestation of tectonic movements it is considerably inferior to the gap which began from the boundary of the Paleozoic and Mesozoic and is continuing up to now (230±10 million years). In the course of the last gap the paleozoic deposits on the territory under consideration underwent deep and irregular erosion. However this did not lead to destruction of the deposits of oil. A deciding factor in preservation of the UV accumulations was the presence of a regional impermeable rock mass above the oil and gas bearing layers of the Paleozoic.

Analogous impermeable rock masses are known in the cross-section of the upper Riphean and Vend and, consequently, they have also served as fluid-stops on the path of lateral and vertical migration.

The calculations made by Ya.B. Smirnov (1970) indicate that in the period of active development of the eugeosinclinal in boundary troughs (with a certain lag in time) the heat flow on the average reaches 55-60 megawatts per square meter, which, according to V.Ye. Sal'nikov's data (1977) is approximately 1.5-fold higher than the value of the present-day flow in the cis-Ural boundary depression.

High values of the heat flow with a gradient approximately of 25-30 degrees Centigrade per 1 kilometer could have arisen in the depression, apparently, only since the beginning of the paleozoic stage of accumulation (mid-Devonian), that is, after the laying of the Ural eugeosinclinal. Prior to this the heat flow in the cis-Urals, probably, was characterized by smaller values and was close to today's value. By the start of the mid-Devonian the bottom of the upper-Riphean rocks was submerged to a depth of 2500-3500 meters. The cross-section of interest to us began from the bottom surface and was loacted in an interval of paleo-temperatures of approximately up to 70 degrees Centigrade. Consequently, the basic oil-source rock masses at this time, apparently, still had not gone through the main phase of oil formation and the main phases of gas formation. The upper Riphean deposits underwent the main phase of oil formation from the Devonian to the mid-Carboniferous, that is, when their bottom was submerged up to 400-5000 meters, and the whole cross-section was placed in the paleotemperature interval of 70-130 degrees Centigrade. Later, up to the middle of the early Permian the main phase of oil formation was experienced by the Vend layers, the depth of occurrence of which reached 2500-3500 meters and the paleo-temperatures 70-100 degrees Centigrade.

The modern structural plan of the Cis-Ural depression was formed at the concluding stage of the Hercynian tectogenesis, at the boundary of the Paleozoic and the Mesozoic. Namely at this time the previously accumulated sediments (including the Riphean and Vend) underwent the first collapse here, leading to the appearance of a single system of plicated and split dislocations for all these rock masses. The basic anticlinal traps arose, and active migration of UV began not only according to the rise of the beds, but also according to the zones of explosive ruptures. However the latter were formed in the main under conditions of compression of the rocks (thrusts) and hardly had an essential effect on scattering of fluids. In any case the fractures as a negative factor of preservation of the deposits should be regarded in equal measure both for the Riphean-Vend and for the Paleozoic deposits. One can only note that at many oil and gas deposits which were formed in paleozoic rock masses of the boundary depression such fractures have been established, but they scarcely led to complete destruction of the deposits.

As is known, the hydrogeologic factor plays a large part in the accumulation and preservation of hydrocarbon deposits. Many researchers consider the mountainous part of the Ural region as the feeding area for the sedimentary complex of rocks, and the Cis-Ural depression and the Caspian syneclise as discharge areas. The paths of movement of the fluids could have been the numerous breaks in the forward folds and structures of the depression. It is considered that in the process of active movement and discharge of the waters the hydrocarbons are washed out of the traps, oxidized and destroyed. However these ideas, not without reason, are disputed by a number of hydrogeologists (N.K. Ignatovich, A.Ye. Khod'kov, V.V. Kolodiy, A.V. Kudel'skiy and others). In their opinion, the role of the Urals as an area for feeding the water-bearing layers of the paleozoic in the eastern territory of the platform was very modest. This is evidenced by the high mineralization and often high metamorphization of waters of the unified pre-Cambrian and Paleozoic hydrogeological complex (Beketovskiy, Voskresenskiy and other sites) and the numerous sources of fresh waters on the western slope of the Southern Urals. Consequently, the basic discharge of waters is carried out still on the periphery of the Urals, not reaching the depression, and the negative effect of the water on accumulation of hydrocarbons was hardly significant. The existence of industrial deposits of oil and gas in the sediments of the Paleozoic even in the zone of the forward folds broken by fractures serves as a vivid example of the hydrodynamic discreteness of the Cis-Ural depression and the Urals.

Favorable paleogeologic conditions, and also the presence of the major factors controlling the formation and disposition of aggregations of hydrocarbons make it possible for us to recommend exploratory operations for oil and gas in the Riphean-Vend complex of the cis-Ural depression.

Aggregations of hydrocarbon gas have been established at the Shikhanskiy and Kabanovskiy sites. In Shikhanskaya well No. 5 at depths of from 3152 to 3900 meters tested (jointly) were five intervals represented by sandstones with bands of aleurolites and fissured limestones (an analog of the Min'yar suite of the Urals). Observed at the mouth of the well was intensive liberation of gas and air. The analysis of the sample is as follows (vol. %): CH_4--24.6, C_2H_6--6.68, C_3H_8--2, CO_2--0.6, N_2--66.1,

and density of the gas 0.894 grams per cubic centimeter.

The well, along with the gas, yielded mineralized water (573 mg/equiv.) of the calcium chloride type with a density of 1.15 grams per cubic centimeter. During subsequent separate testing of the beds the inflow of gas, however, was not obtained, just of bed water. An inflow of mineralized water from the Vend deposits occurred also in the Ishimbay well 300.

Among the rocks of the Vend and upper Riphean both in the outcrops and in the cuts of the wells there are rather many layers which can be regarded as collectors of hydrocarbons. Possessing the best properties are the loosely cemented, friable sandstones and aleurolites encountered in the composition of the Bederyshenskiy mass of the Zil'merdakskiy suite, in the sub-Inzer mass of the Katav suite, in the lower part of the cross-section of the Inzer, Ukskiy and Kukkaraukskiy suites, and in the middle part of the Min'yar and Uryukskiy suites. Also deserving of attention are the fissured aleurolites occurring in the upper half of the Inzer suite and in the composition of the Basinskiy and Zigazinskiy suites. The good collectors may be the horizons of fissured and porous (leached) limestones and dolomites known in the cross-section of the Min'yar and Ukskiy suites.

The collector properties of rocks from outcrops and core samples as yet have been little studied, nevertheless on the basis of study of more than 300 samples it is possible to conclude the following. In natural outcrops Vend aleurolites have a porosity of 3.7-14 percent, sandstones have a porosity of 4-32 percent and a permeability of up to 3.5 mD, for the upper Riphean aleurolites the figures respectively are 4.8-14.1 percent and the same permeability, and for carbonate rocks it is from 2.2 up to 5.4 percent [7]. In Shikhanskaya well 5 the sandstones of the Vend (depth of 2302-3028 meters) are characterized by a porosity of 1.4-9.8 percent and a permeability of from 0 to 14 mD, and for sandstones of the Inzer suite of the upper Riphean (3600-3834 meters) the figures are respectively 4-9.6 percent and from 0 to 10 mD.

The cited values of the porosity and permeability of the collector rocks, of course, do not give the full idea of the capacity parameters of the rocks, but nevertheless they describe these parameters from the positive side. It can be hoped that as the depth increases there is an increase in the role of fissure and fissure-cavernous collectors in comparison with the porous ones, especially if it is considered that the sedimentary mantle of the Ural region has undergone intensive tectonic deformation.

In the profile of the Vend-Riphean deposits lying above each potentially oil and gas bearing horizon are practically impenetrable rock masses--dense aleurolites, argillites, merles and fine crystalline limestones.

The eastern side of the Cis-Ural depression is complicated by numerous anticlinals and brachyanticlinals, clearly expressed along the layers of the Devonian, Carboniferous and Lower Permian. With the aim of studying the structure and oil and gas content of pre-Cambrian formations the Krasnousol'skiy, Kurgashlinskiy, Arlarovskiy, Shikhanskiy, Urazbayevskiy and Ishtuganskiy structures merit attention. These large high-amplitude folds have a comparatively simple structure. Pre-Paleozoic complexes in the arch sections occur here at depths of 1200-1500 meters. Consequently, wells with a depth of 4500 meters fully may reach the trough of the upper-Riphean deposits (see figure 2).

The Western Ural paleodepression is an area with already proven oil and gas accumulation, with industrial deposits in genetically varied traps in the rock mass of sandstones and carbonate deposits from the Eifelian stage of the Devonian to the lower Permian inclusively. It bears oil in all the studied structural zones: in the fracture folds of the slope of the platform, in the reef, central and eastern parts of the boundary depression. There are also well-founded grounds to begin work in the near future on solution of the problem of the oil and gas content of the pre-Cambrian formations developed here. It is necessary to consider as priority structures the largest Shikhanskiy, Arlarovskiy and Temirarkinskiy [7, 10] structures, in the limits of which it is necessary to conduct seismic prospecting of the MOGT [not further identified] and, according to the results of it, perform exploratory drilling.

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