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9 April 1980

USSR Report

ENERGY

(FOUO 3/80)

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ELECTRIC POWER

PROGRESS MADE AT HYDROELECTRIC POWER PLANT CONSTRUCTION SITES

Moscow GIDROTEKHNICHESKOYE STROITEL'STVO in Russian No 11, 1979 p 48-49

[Excertps from "Construction and Operation Newsletter"]

[Excertps] In August work was done on the roof and the right bank facing wall of the machine room near the first three units at the Kegumskaya GES [hydroelectric power plant]. Support structure installation is being completed on the tail race side. Brickwork on the upper mill race side near the first hydraulic turbine has been finished.

At the Nizhnekamskaya GES construction site the roof of the volute chamber of hydraulic turbine No 2 is being concreted. Installation of the rotor and stator have begun. Installation of the generator stator was started at the end of August. The transformer has been manufactured and is in storage. The stator of hydraulic turbine No 3 has been completely installed. Concreting of the volute housing has begun.

Construction has been started on the high-voltage electric power line which will transmit current from the Zeyskaya GES to the Baykal-Amur Mainline project. The 220 kw electric power transmission line is about 190 km long. The first kilometers of right-of-way have been cleared over a spur of the Soktakhan ridge. The builders will have to erect hundreds of poles on the rocky spurs and in swampy marshes and suspend from them a cable through which electric power will go to the new region under development to the north of Priamur'ya.

Construction has begun on a high-voltage electric power transmission line from the Chirkeyskaya GES to Ordzhonidze. The new line will be 214 km long. It will traverse the territories of three autonomous republics of the Northern Caucasus. The first reinforced concrete supports have been placed along the Caspian coast in the Derbent-Khaehmas area. The 330 kw line joins the Northern Caucasus and Transcaucasus systems. Electrification is making rapid progress in Dagestan. Even the outermost auls have been linked to the state systems. In recent years a 10,000 km electric power network has been installed under the challenging conditions of impassable roads and across turbulent rivers and deep ravines. The additional electric current has accelerated the growth of new settlements and industrial and agricultural facilities. In addition, the hydroelectric power plant construction projects have become reliable regulators of runoff from mountain rivers. This has made it possible to increase the area under irrigation and to include large new tracts of land in crop rotation.

In Belorussia there are plans to construct a deep-lying underground pumped storage plant. Its power will exceed a million kilowatts. Such plants aid in successfully accomplishing the task of increasing electric power production during peak hours and consuming its surplus in the power system during the night. Pumped storage plants are promoting an increase in the efficiency of atomic and thermal power plant operation so that they operate whenever possible in a constant, more advantageous and efficient mode.

The Zagorskaya pumped storage plant with a 1.2 million kilowatt capacity is under construction near Moscow. Its first phase will go on line at the end of the current five-year plan.

The Kayshyadorskaya pumped storage plant with a 1.6 million kilowatt capacity is being built in Latvia.

There are plans to build pumped storage plants with 2 million kilowatt capacities on the Dnestr River. Sites for approximately 10 pumped storage plants have already been selected. Some of the plants will be part of large-scale power systems.

All dams larger than 30 km on the banks of the Amu-Dar'ya at the access to the Tuyamuyunskiy hydrosystem in Uzbekistan are being raised to a planned height of up to 10 meters. This will make it possible to prevent river flooding when its level is raised after damming. The damming is scheduled for October. The Tuyamuyunskiy hydrosystem will provide the potential for regulating the flow of the Amu-Dar'ya during low periods and irrigating hundreds of thousands of hectares of arid land.

8945
CSO: 1822

ELECTRIC POWER

FORGING-STAMPING PRODUCTION OF ATOMIC ENERGY MACHINE-BUILDING

Moscow ENERGOMASHINOSTROYENIYE in Russian No 1, Jan 80 pp 36-38

[Article by Doctor of Engineering Sciences, Professor Ye. N. Moshnin and Engineer S. A. Yeletskiy]

[Text] The containers of AES units, which are cylindrical high-pressure vessels, are most laborious and difficult to manufacture. The rigid requirements on reliability and durability and the great size of the vessels dictate that they be manufactured by stamping and welding or forging and welding.

The production technology of atomic power plant containers is determined to a considerable extent by foundry technology. Mechanical processing, assembly and welding of sectional assemblies in the floor, made of several elements welded together, are eliminated by the construction of individual large scale elements, for example one-piece forged floors. The total labor cost and AES construction time can be reduced substantially by using more progressive heavy-sheet forging technology.

Expansion of series production of AES, the construction of special atomic machine-building factories, equipped with heavy technological machinery, including forges, will facilitate the extensive adoption of progressive forging technology in the atomic machine-building industry. The construction of reactor containers from large forged blanks meets the requirements of high reliability and durability of AES.

The blanks of cylindrical containers are most effectively made of heavy sheet rolled stock with a flexible course of cylindrical sections and a forged bottom, if there are no restrictive requirements, for instance welds prohibited in the zone of strong ionizing radiation of the reactor housing.

Construction on a special press by rolling of cylindrical hollow blanks, made by open forging, is a competitive method of building large courses. However, this method of making courses has not yet been adopted by the industry.

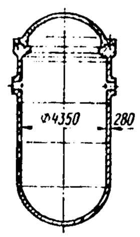

Figure 1. Container of type VVER reactor.

The cylindrical and spherical parts of fittings and branch pipes for connecting various pipes substantially complicate housing production technology. Typical designs of certain AES units are shown in Figures 1-3. The least reliable parts of forged and welded container constructions are the weld seams and near-seam zones, particularly when the welds represent a corner weld, for example where branch pipes are welded to the container. The manufacture of branch pipes as a one-piece forged element along with the container undoubtedly is the most progressive technique in terms of structural strength and reduction of labor cost and shortening of production time.

Certain guidelines should be followed in consideration of a combination of structural and technological requirements during the design of AES and search for production technology: make billets of large-scale elements of forged housings as one-piece forged assemblies for the purpose of minimizing the number of welds; the shape of forged elements, where welds are in least stressed areas, and shapes convenient for the application of automatic methods of welding and subsequent testing of seams by physical methods, in particular edges of billets to be welded, should be straight line or annular; reduce the volume of mechanical processing by increasing the precision of forged billets, particularly in places to be butted with other billets, by using mechanized dressing operations after forging, welding and heat treatment, using mechanical treatment on original blanks with a simpler shape (flat plate forgings, rectilinear profiles), rather than forged blanks.

The above-listed requirements are also applicable to the production technology of in-container systems and pipe fittings. Attempts are being made to design even a forged and welded main AES pump housing, which is extremely complicated in shape for making in forged and welded execution.

The forging of large complex blanks (often extremely heavy-wall) stimulated the search for more complex technological heavy-wall forging processes. These processes include primarily those that involve operations performed by combining several kinds of deformation.

NPO [Nongovernmental organization] TsNIITmash [Central Scientific Research Institute of Heavy Machinery] recently developed and adopted into production several combined technological processes that produce whole-forged blanks of the most important elements of AES, specifically: extrusion and processing of branch pipes and fittings on thick-wall courses, including a reactor course (Figures 4, 5); nonuniform drawing and finishing of nonradial branch pipes on steam generator courses; transverse swaging and finishing of T-pieces with a tall branch pipe; bending and longitudinal swaging and subsequent heating with HF current (HFC) of bent sections of pipes without thinning the outer wall, i.e., with uniformly strong straight sections; longitudinal swaging, closed ladling and upsetting of blanks of casings of large fittings with a two-way branch pipe; bending and transverse swaging of sharp-corner branch pipes including branch pipes of main AES pipelines. The branches have straight end parts, by virtue of which welded seams are kept away from a bent section.

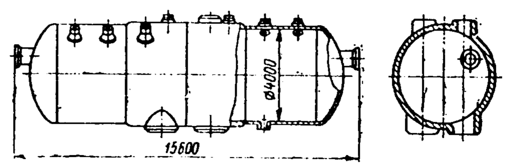

Figure 2. Case of PGV steam generator.

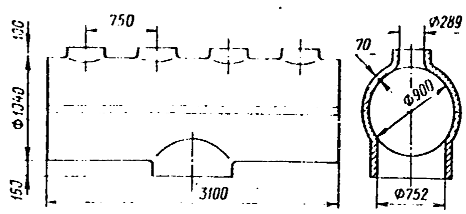

Figure 3. Manifold course.

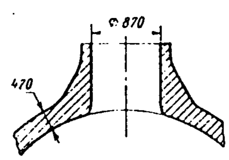

Figure 4. Reactor housing branch pipe.

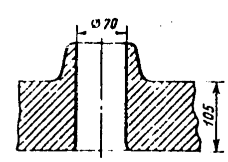

Figure 5. Nozzle of thick-wall course.

The use of combined operations will make it possible to achieve a substantially greater technological effect than the utilization of the same kinds of deformation one at a time. However, even the step by step application of simple operations, but done in the same die, with the blank located in it just one time, will bring about a substantial reduction of labor cost and production time. This will eliminate the need for repeated heating of the blank and subsequent adjustment and centering of the blank in the die. These operations are laborious and difficult, since the blanks are large and heavy and are heated to high temperatures.

The combining of operations or the successive completion of several operations in the same die requires dies of complex construction with moving parts. In their design special attention must be devoted to the analysis of uneven heating of die elements and the existence of scale that falls from the blank.

Cold forging is finding increasing application for shaping thick-wall blanks. Cold bending on sheet bending roll machines is being used today to make large-diameter blanks with a thickness of up to 150-200 mm, which eliminates heating of the blank and inconveniences related to the hot forging of large blanks. The use of cold forging in many cases will make it possible to prepare edges for welding on the original flat blank, which is substantially simpler than doing this operation on a bent blank in view of its great size and distortions of shape -- out-of-round and other geometric defects.

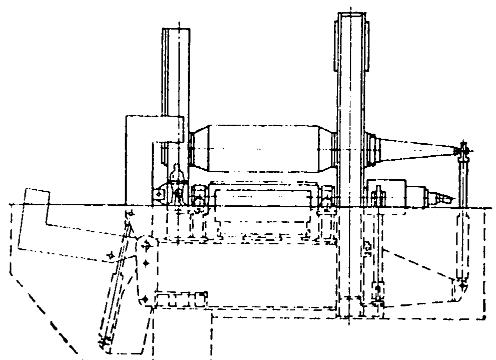

Figure 6. Sheet bending machine with 6,300 ton-force on top roller.

Cold forging is beginning to be used for heavy-wall blanks, deformed with considerable degrees of deformation, for example for forging bottoms and other such parts. Up to 50 mm thick bottoms are being forged or cold-rolled, and elements of large spherical vessels of even substantially greater thickness are being made in this fashion.

In view of the great rigidity of forged blanks of thick-wall products, reactor containers in particular, alignment of their elements during assembly for welding by means of simple tools (clamps and wedges) is an extremely difficult task. Therefore it becomes necessary to make large thick-wall forged blanks of increased precision. The use of independent calibration and straightening operations greatly increases production costs.

The use of technological processes, whereby it is possible to perform simultaneously shaping and straightening and calibration of an entire forged blank or of individual parts thereof, is an especially effective means of manufacturing rather high-precision large forged blanks. NPO

TsNIITmash has developed and adopted a method of forging large-diameter branch pipes on a large course. In this process out-of-roundness is corrected and the blank is calibrated in the zone where the branch pipe is formed, i.e., distortions of the shape of the course, which occur during shaping of the branch pipe, are corrected, in the final stage of deformation. In forging processes developed by the institute, using large tubular blanks of T-pieces and branch pipes (up to 850 mm in diameter), the outer surfaces of a forged blank are calibrated at the end of the press travel stroke.

Many technological processes that have been adopted by the Soviet atomic machine-building industry, including the PO "Izhorskiy Zavod," are being used for the first time in world history. These processes include the forging of branch pipes on reactor and steam generator courses, forging of sharp-corner or large-diameter branch pipes, etc. These technological developments are attracting considerable attention from foreign companies in relation to the purchasing of licenses.

The effectiveness of progressive forging technology brought about a need in the atomic machine-building industry for unique foundry equipment. The atomic machine-building industry uses 8,000-12,000 ton-force sheet stamping presses, up to 45,000 ton-force sheet bending presses and sheet bending machines with 9,000 tons of force on the top roller.

Atommash [Atomic machine-building industry] is equipped with the necessary heavy technological equipment, including forging equipment. With a 15,000 ton dual-action sheet stamping press it is possible to stamp bottoms and make one-piece forged branch pipes on courses with an inside diameter of up to 6,400 mm. The press has a column center distance (span) of 10,500 mm, the greatest distance between the bench and slides is 10,000 mm, the slide stroke is 5,200 mm, and bench area is 9,000 × 9,000 mm. The bench is movable. Mechanical clamping systems, driven by an auxiliary hydraulic drive system, are provided for fastening dies to the drawing and pressure slide.

With the largest three-roll sheet bending machine (Figure 6) it is possible to bend course blanks in the cold state to 150-200 mm and in the hot state to 350-420 mm using a 3,200-4,500 mm wide blank.

The feasibility of making large housings of AES products is also attributed to the availability of welding, heat treatment, metal milling and other equipment. For this reason the Soviet atomic machine-building industry is now taking a big step forward, not only quantitatively, but qualitatively as well.

7872
CSO: 1822

ELECTRIC POWER

CONTRIBUTION OF ENERGY TOOL CONSTRUCTION TO FUEL-ENERGY COMPLEX OF USSR

Moscow ENERGOMASHINOSTROYENIYE in Russian No 1, Jan 80 pp 2-5

[Article by V. V. Krotov, Minister of USSR Power Engineering Machine-Building]

[Text] The workers of our sector, along with the entire Soviet nation, have entered the concluding year of the 10th Five-Year Plan, a year in which the Soviet nation and all progressive peoples will celebrate the 110th birthday of V. I. Lenin, founder of the Communist Party and of the Soviet government. This is a precongressional year, when the results of completion of the program adopted by the 25th Party Congress, drafted and developed by resolutions of subsequent plenums of the Central Committee of our party and in addresses by General Secretary of the CPSU Central Committee, Chairman of the Presidium of the Supreme Soviet of the USSR, Comrade L. I. Brezhnev, will be published. The distinguishing feature of 1980 is the fact that the resolution of the CPSU Central Committee and USSR Council of Ministers "Improvement of Planning and Reinforcement of the Economic Mechanism to Improve Labor Productivity and Quality," will begin to be implemented immediately. This fact must be taken into consideration for organizing the completion of the state plan of economic and social development of 1980 and during the drafting of the 11th Five-Year Plan.

The 25th Party Congress assigned important tasks to the energy machine builders. Reactor machinery for breeder power plants and turbine units for them, with a unit capacity of at least a million kilowatts, had to go into series production during the 10th Five-Year Plan, unified machinery had to be developed, and its production for breeder AES units with a capacity of up to 1.5 million kilowatts had to begin. The 25th Party Congress called for speeding up the development of atomic machine-building on the basis of the complete utilization of capacities and reconstruction of existing and construction of new plants and extensive cooperation in the production of individual units with other sectors of industry and with CEMA member countries.

This is the main task of the fuel-energy system (TEK) of the country and it is being completed. The production of steam turbines for AES more than doubled during the first 3 years of the current 5-year plan in comparison with the same period of the 9th Five-Year Plan. Minenergomash [Ministry of Power Engineering Machine-Building] enterprises built several 500 MW high-speed turbine units for 1,000 MW canal type reactor power plants. Quiet-running turbines with a unit capacity of 1,000 MW are being built. The VVER-1000 earthquake-proof installation, the control and safety system of which has fewer drives (there are no main gates), is being made ready for series production. This original and courageous engineering achievement will significantly improve the technical-economic indices and reliability of the reactor installation. However, the adoption of the new main circulation pump design, the GTsN-325, and of a vertical steam generator, which would provide an opportunity to build the promising VVER-1000 unit in a very short time, is lagging.

Efforts continue on the development of highly efficient AES equipment for future 800 MW canal reactor breeder units and atomic heating plants, which are being prepared for series production. A 1 million kW high-speed turbine, specifically designed for atomic power engineering, is being developed. Soviet atomic machine-building is now on the rise.

The industrial association "Izhorskiy Zavod" imeni A. A. Zhdanov and Atommash, which is now building the second unit of the enterprise, are making new capacities available, a team of industrial workers is being assembled and work has started on the construction of the first 1 million kW reactor, which will assure future progress in the production of AES machinery. At the same time we must implement urgent measures to develop capacities for the production of turbines for AES at the industrial turbine building associations "Khar'kov Turbine Plant" imeni S. M. Kirov and the "Leningrad Metal Mill," to increase the production of heat exchange machinery by the industrial association "Krasnyy Kotel'shchik," pipes and fittings at the Belgorod and Chekhov power engineering machine-building plants, and development of capacities at the Podol'sk machine-building plant imeni Ordzhonikidze and SZEM [not further identified].

Thus, our sector is building new industrial capacities, gaining experience in the construction of AES machinery and training qualified staffs of specialists, which will facilitate the solution of our country's fuel-energy problem.

In the 1980's we will have to complete delivery of power engineering machinery for units with the VVER-440 reactors -- the Rovenskaya and Kol'skaya AES and for export equipment -- for units with the VVER-1000 reactors -- Yuzhno-Ukrainskaya and Kalininskaya AES; for units with the RBMK reactors -- Smolenskaya and Chernobyl'skaya AES; we must begin building the first 1,500 MW unit for the Ignalinskaya AES and thus assure the completion of the assignments of the 10th Five-Year Plan on the construction of machinery for atomic power plants. That is our main task. It is an ambitious program, but it is a realistic one.

The production of the most economical 500 and 800 MW units for thermal power plants will continue in 1980 and the future. Scientific-research organizations, design and technological services of associations and plants will have to design machinery for these units and improve its reliability in consideration of the fact that its production will increase with each passing year, especially for use in such giant fuel-energy complexes as Kansko-Achinskiy and Pavlodaro-Ekibastuzskiy.

Work must continue on the development of special, including fluidized bed boiler units and small vortex-stoked units, which reduce specific metal consumption, for the efficient utilization of Siberian coals, which have high ash and moisture content. The extensive utilization of small boiler units in the future will provide an opportunity to reduce capital investments and cut GRES construction time in approximately half, which is especially important in regions east of the Urals.

The distinguishing feature of Soviet hydroelectric turbine construction is our constant effort to develop efficient, highly reliable units in application to specific hydrological conditions. Power plants have been equipped with superior hydroelectric units, built by the people of the industrial turbine construction associations "Leningrad Metal Mill" and "Khar'kov Turbine Plant" imeni S. M. Kirov, in each stage of development of Soviet hydropower engineering. Late last year General Secretary of the CPSU Central Committee, Chairman of the Presidium of the Supreme Soviet of the USSR, Comrade L. I. Brezhnev, congratulated builders, assembly workers, operators, machine builders, planners and all participants in the construction of the Nurekskaya GES on their noteworthy labor victory -- they brought the energy giant on the Vakhsh up to its rated on-line power of 2.7 million kW. "It once again convincingly proved," Comrade L. I. Brezhnev stressed, "the powerful force of socialist competition, during the course of which, for achieving our objective, the hydroelectric power plant builders of Tadzhikistan, machine builders of the Ukraine, Leningrad and the Urals and workers of other industrial centers throughout the country combined forces. The 'Labor relay race' that was born here on your construction site has been adopted by many labor organizations."

Today the entire country is carefully watching the progress of work on one of the greatest power plant construction projects of the 10th and 11th Five-Year Plans -- the Sayano-Shushenskaya GES. The third unit, built by the industrial turbine-building association "Leningrad Metal Mill," has already been placed in operation at the Karlov Stvor construction site. Equipment will continue to be delivered in 1980 not only to the Yenisey, but also to the Zeyskaya, Nizhne-Kamskaya, Cheboksarskaya and Yuzhkozerskaya hydroelectric power plants, Vartsikhi and Inguri GES, and also abroad. Hydroelectric units will begin to be unloaded at the Tyuya-Muyunskaya, Kurpsayskaya and Andizhanskaya GES. This will be a concrete contribution by our sector to the solution of problems of the fuel-energy system of our country.

The Minenergomash associations have designed and built prototypes of new, more efficient 16 and 25 MW gas pumping units. They still have to undergo industrial tests, on the basis of the results of which they will be debugged and made ready for series production. As regards future developments, work will continue on the development of the PGU-250, PGU-500, and then the PGU-1000 closed cycle solid fuel gassification plants. The latter will be teamed up with an 800 MW steam turbine unit and a 200 MW gas turbine unit.

Along with building machinery for AES, GES and GRES, the associations and enterprises of the industry will have to build new types of units of increased factory completion for industrial power engineering in order to elevate the level of assembly and quality. It is essential to increase the engineering level and economic efficiency of thermal power units for industry and agriculture and to meet the day to day needs of the population. More work will have to be done on the development of efficient utilizer equipment, so that secondary energy resources can be used more efficiently and power engineering technological reprocessing of fuel can be adopted on a large scale.

In 1980 and in future years we will have to concentrate our efforts on the continued development of the capacities of the industrial turbine-building association "Khar'kov Turbine Plant" imeni S. M. Kirov, the "Energomashspetsstal'" plant in Kramatorsk, which is a member of that association, on speeding up production of turbine blades at the planning department of the industrial association "Leningrad Metal Mill," on the continuation of the construction of the Volgodonskoye industrial association of atomic power machine-building, on the development of new capabilities at the industrial associations "Izhorskiy Zavod" imeni A. A. Zhdanov, "Krasnyy Kotel'shchik," "Turbomotornyy Zavod" imeni K. Ye. Voroshilov, Podol'sk machine-building plant imeni Ordzhonikidze, Belgorod and Chekhov power engineering machine-building plants and other enterprises of our sector. Particular attention must be paid to speeding up the development of the metallurgical base of our sector, which must provide the builders of energy-generating machinery with high-quality semifinished products.

This can be done as soon as work on the construction and special outfitting of the Kramatorsk "Energomashspetsstal'" plant, assembly and delivery of a 15,000-ton force press to Atommash, reconstruction of a 12,000-ton force press and delivery of the "5000" mill to the industrial association "Izhorskiy Zavod" imeni A. A. Zhdanov, is complete.

To speed up the reconstruction and assembly of existing Soviet and import equipment extensive use will have to be made of economical construction techniques, and special construction-assembly subdivisions will have to be established for that purpose for associations and enterprises that do not have them, and at facilities where they do exist they must be reinforced and their efforts must be focused on the technical retooling of enterprises of the sector.

All these important tasks can be completed successfully through the effective, well coordinated efforts of all links of the sector, improved sense of responsibility for high-quality equipment and its safe and dependable operation, especially machinery for AES. A quality control system must be developed and adopted by enterprises of the sector, in all of its links: from the development of technical documentation to the delivery of a generating unit.

In 1980 and the ensuing years we must implement a system of measures that will breathe life into the resolution of the CPSU Central Committee and USSR Council of Ministers "On Improvement of Planning and Strengthening of the Economic Mechanism for Improving Labor Productivity and Quality," to effectively utilize the economic levers provided therein, to complete assignments of the government plan of economic and social development, especially the nomenclature plan and contract obligations.

It is important to note that some of the measures specified by that resolution have already been adopted by our sector. In particular, we have converted to the planning and evaluation of the activities of associations and enterprises on the basis of the pure production criterion. The volume of production, rate of growth of labor productivity, the specific fraction of products of the high-quality category, material incentives funds and other indices are determined on the basis of that criterion. The pure production criterion is a means of correctly evaluating the direct contribution of a labor force to the completion of assignments of the government plan of economic and social development. This criterion eliminates unprofitable purchase orders and makes possible the orderly calculation of labor productivity and of its growth rates. It replaced the gross production index and has begun to more objectively disclose the labor costs of each labor organization during the course of its industrial activity.

Our sector has adopted the standard overtime payment planning method, a new system for planning, financing and stimulating work on new technology, and the ministry is assured of receiving an overall standard profit, which remains at its disposal. However, this has not yet yielded the desired results and is not having a significant influence on the completion of nomenclature and fulfillment of government plans in volumetric indices, either by individual enterprises, or by the ministry as a whole.

The perfection of the economic mechanism, style and methods of supervision of the industrial activities of our sector depends largely on the condition of the organizational structure, discipline and sense of responsibility. The organizational structure of the Industrial Administration of the ministry is being re-examined at the present time in accordance with a resolution of the CPSU Central Committee and USSR Council of Ministers.

Its distinguishing feature is the fact that the chief curator engineer supervises and renders assistance in the production of an entire complex of machinery, manufactured by sector enterprises, and supervises its delivery to the client.

The reorganization of the activity of the Industrial Administration will make possible more concrete supervision of production, will provide more objective information about the status of the production of machinery, especially for startup facilities, will provide an opportunity to make necessary managerial decisions promptly, will permit operational maneuvering of industrial capabilities and will enable assistance measures to be taken promptly.

The industrial associations and enterprises must also take measures this year to further perfect the organization of industry and its technology, bearing in mind a reduction of metal consumption, manual labor and labor intensity. It is important to consider here that complications may arise in the 11th and 12th Five-Year Plans with the enlistment of new labor resources into production. Therefore it is essential right now to work out ways of improving productivity through mechanization and intensification of labor and extensive utilization of the achievements of inventers, efficiency analysts and industrial innovators. Another effective approach is the comprehensive development of the business activity of scientific organization of labor services, the adoption of measures developed by them, including measures to increase the coverage of labor forces by labor organization forms (75-80% of the laborers of our sector must be covered by them by the end of the 11th Five-Year Plan). The scope of standardization of labor should be expanded and the proportion of technically sound standards of output should be increased.

During approval of the procedure whereby material incentive funds are allocated it is essential that rewards be given to supervisors, engineering technicians and workers of associations and enterprises of the sector in direct proportion to the labor contribution of the labor force and of each worker.

Scientific-industrial associations, technological and planning organizations must continue to work in 1980 and in the ensuing years on the development of scientific-technical inventory stockpiles and active utilization of the results of scientific developments at enterprises of our sector. To do this it will be necessary to develop industrial scientific-research, design and technological bases for our associations and enterprises. Top priority must be given to the development of test stands at NPO [Nongovernmental organizations] TsKTI [Central Scientific Research, Planning and Design Boiler and Turbine Institute imeni I. I. Polzunov], NPO TsNIITmash [Central Scientific Research Institute of Heavy Machinery] and VNIIAM [not further identified] for conducting full-scale tests of machinery and individual parts.

To further elevate the engineering level and quality of production the associations and enterprises must implement a number of measures aimed at improving labor skill, the planning and construction of new and expansion and reconstruction of existing enterprises on the basis of highly effective technology and the use of the latest technology, which at new plants would assure the production of machinery as good as or better than the best Soviet and foreign counterparts in terms of engineering level.

The associations and enterprises must analyze bottlenecks in the manufacture and loading of machinery, expose deficient equipment, determine how effectively planning is coordinated with material-technical support, how funds are being spent and standards on material resources are being observed, which is necessary for the rhythmic functioning of an enterprise. To do this industrial leaders will have to more actively attract experts from scientific-research organizations. NIIEinformenergomash must perform to the fullest extent its functions as the leading organization in the field of information, analyze the economic aspects of industrial activity and offer suggestions on how to further improve economic work at associations and enterprises and analyze how these suggestions are being implemented.

The associations and enterprises of our sector, in implementing the resolutions of the 25th Party Congress, exerted labor initiatives in the 10th Five-Year Plan: "Work without laggards," "Labor relay races," etc. The fundamental principles of the "Labor relay race" are being utilized effectively in organizing machinery exhibitions for the Sayno-Shushenskaya GES, and at the Atommash construction site. Meanwhile the valuable and promising initiative of the "Krasnyy Kotel'shchik" industrial association -- "Work without laggards," embraced and developed in Rostovskaya Oblast, is suffering inadequate development in our sector. Supervisors and social organizations of associations and enterprises are not working actively and vigorously enough to organize socialist competition under the slogan "Work without laggards." However, if this initiative were adopted by every enterprise in consideration of the nature of production, it could play an important role in the mobilization of labor forces toward the completion of planned assignments in volume and nomenclature.

Based on the principles of perfection of the economic mechanism set forth in the resolution, attention must be devoted to the education of each laborer of the sector, irrespective of his job and the role that he plays in that mechanism, the Lenin style of management and attitude to hard work, thrifty attitude toward all material resources, high executive discipline and desire to continuously improve one's skills.

An active, vital position, intolerance for waste and violations of planning, labor and technological displicine, disorganization, lack of discipline, losses of work time and antisocial behavior must be instilled in each worker. The resolution of the CPSU Central Committee "On Further Improvement of Ideological and Political Education Work" should be the foundation of this important routine activity.

"Power engineering machine builders build excellent machinery" is the main motto of the workers of our sector.

The successes of the national struggle for socialism and communism in all stages of the glorious history of our Soviet government are assured by the wise leadership of the Communist Party and by its wisdom to promptly predict and to correctly solve unforeseen problems. The resolution of the CPSU Central Committee and USSR Council of Ministers "On Improvement of Planning and Reinforcement of the Economic Mechanism to Improve Industrial Efficiency and Labor Quality" is bringing to bear considerable theoretical and practical activity on the part of our Party on economic construction. The objective of our sector and of each of its workers is to devote all efforts, knowledge, experience and energy to the vitalization of the economic policies of the Party and to the solution of problems of the fuel-energy system of our country.

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ELECTRIC POWER

IMPROVING PRODUCTION EFFICIENCY WITH HYDROMETEOROLOGICAL DATA

Moscow VOPROSY EKONOMIKI in Russian No 1, Jan 80 pp 132-137

[Article by E. Monokrovich, Alma-Ata: "Utilization of Hydrometeorological Information to Raise Production Efficiency"]

[Text] Modern scientific and technological advances enable mankind to feel increasingly protected against the forces of nature. In spite of this fact, interest in the state of the atmosphere and the ocean and in weather and river water flow forecasts is constantly increasing. The social role of the hydrometeorological service is also correspondingly growing. The principal purpose of its activities is to ensure people's safety on the sea, land, and in the air. Therefore, as stated in the resolutions of 25th CPSU Congress, achievement of "further elaboration of methods of forecasting weather and natural disasters" constitutes an important task.

In the last decade there has been a sharp increase in the role of hydrometeorological information for monitoring environmental pollution and for taking measures to reduce losses from adverse weather conditions in a number of sectors of the economy. A network of air, water and soil pollution monitoring stations has been established in this country and is in operation. Information from these stations is taken into account in planning and designing new industrial and other facilities, as well as in day-to-day management of enterprise operations.

Growth and development of an observation network and technical equipping of the hydrometeorological service (employment of weather satellites, weather ships, weather radars, atmosphere probing with rockets, etc) has been accompanied by a sharp increase in the cost of operating this service. Its "return" should increase correspondingly, by utilizing hydrometeorological information to raise production efficiency.

The dependence of production processes in many branches and sectors on the state of the weather is still quite substantial. In addition, demands on volume and quality of hydrometeorological information by users of this information are steadily increasing. In our opinion this is determined by three factors. In the first place, by construction of capital-intensive facilities and transport-production complexes in areas with harsh climatic conditions (the northern part of Western Siberia, the Baikal-Amur Mainline zone, Mangyshlak). With a lack of reliable climatological data, newly-built facilities prove to be either unwarrantedly costly or insufficiently sturdy (or inadequately insulated). For example, in the winter of 1968/69 the water pipeline to the town of Novyy Uzen' went out of commission because the pipe had been buried too shallow, a consequence of inaccurate information on the depth of ground freezing in that region.

Secondly, by increasing complexity of equipment and increased volume of information required for its operation. In the past, for example, comparatively simple and inexpensive information on the state of the atmosphere up to an altitude of 10 kilometers was required for aviation, while now it is necessary to determine with a high degree of accuracy figures on temperature, humidity, wind, and turbulence up to an altitude of 30 kilometers, the physical properties of clouds, data on cosmic radiation and ozone concentrations (which present a hazard to passengers and aircrews, especially at the time of solar flares). It is quite expensive to obtain such data.

Thirdly, by boosting the organizational level of production management. Hydrometeorological data are being increasingly utilized as initial parameters in modeling production processes and in planning the operations of entire branches and sectors of the economy (primarily "nature-intensive" sectors). As it is not possible within the limits of a single article to show all the areas and results of utilization of various hydrometeorological materials in many branches and sectors of the economy, we shall cite only a few typical examples. In the spring of 1977, according to the information of local hydrometeorological service agencies, soil moisture was considerably below normal at planting time in a number of rayons in Northern Kazakhstan. On the basis of this information it was decided to reduce seeding to 20 kg/ha for spring crops in an area of 5 million hectares. This resulted in saving 100,000 tons of seed, worth 14 million rubles. (That year adverse weather conditions prevailed in Kazakhstan, and the spring crop harvest was poor. If seeding figures had not been reduced, losses would have been greater, since the plants would have had even less available soil moisture).

Weather service spring frost warnings and forecasts make it possible to save a considerable quantity of vegetable and industrial crop seedlings, while autumn freeze warnings make it possible to take measures to speed up the harvesting of ripe fruits and vegetables and their hauling into storage. The economic effect of these warnings totals tens of millions of rubles each year. Weather service warnings of dangerous weather phenomena are also essential to stockmen, such as warnings of temperature drops at sheep dipping and shearing time. On a sovkhoz in Alma-Atinskaya Oblast, for example, failure to heed a weather forecast led to the death of 200 sheep. This occurred because, in spite of a warning of a sharp temperature plunge, the sheep were dipped. When hail, heavy frost and blizzard warnings are received, herds are driven into shelters, where feed has been stocked in advance.

In management of hydroelectric power stations with large reservoirs, every spring a determination must be made on how much water to release before the spring floods. If one bases the decision on average reservoir fillup volume over a period of many years, during the flood period it may either be necessary to spill water (if inflow is above average), or at the end of the spring floods the reservoir water level may be down (if inflow is below normal). In both cases energy losses will occur. For this reason today volume of preflood drawdown is determined on the basis of a long-range inflow forecast. Such hydrological forecasts (they average 85 percent correct) produce considerable economic and ecological effect, since an increase in hydroelectric power generation means a corresponding decrease in power generated by thermal electric power stations and consequently fuel savings and reduced air pollution by stack gases and particulates and soil pollution with boiler slag.

Heavy winds, ice storms and wet snow cause damage to power transmission lines. When warnings of such impending weather conditions are received, all emergency repair crews are placed on alert, which makes it possible to cut emergency repair time and to reduce power outages to the customer (loss due to a power supply interruption frequently is many times more expensive than the cost of power-line repairs). Special power line operating conditions are employed to melt ice on the wires, which require temporary disconnection of power customers. Therefore prompt information on the probability of icing is important.

With change in temperature and wind velocity not only the thermal but also electric power load on power systems changes. When a warming trend is forecast the power system load dispatcher, foreseeing a decrease in loads, shuts down the least economical boilers and turbines, which results in fuel savings equivalent to the energy consumption of this equipment operating under no-load conditions. In large power systems this means saving thousands of tons of fuel. On the other hand, when a cooling trend is expected and a consequent increase in loads, the load dispatcher takes steps to put standby equipment on-line in order to increase reliability of power supply to the customers.

Weather information is even more important for aviation. Consideration of forecasted weather at an aircraft's destination promotes not only air safety but also economy. Disregarding weather forecasts frequently leads to the necessity of flying on to alternate airports, and the cost of this is three to five times as much as that of delaying the flight. Figuring en route wind directions and velocity enables the flight engineer-navigator to determine the optimal fuel load to carry. According to our calculations, this makes it possible to save approximately 3 percent of costly aviation fuel.

Similar information is also essential to other modes of transportation. Wind, fog, heavy seas, and floating ice hinder the operations of the commercial fishing fleet and slow the progress of passenger and cargo ships when plying the traditional routes. Navigating vessels on ocean routes selected on the basis of weather forecasts and sea conditions boosts the operating efficiency of the transport and fishing fleet. At the present time the USSR Hydrometeorological Center, the Arctic and Antarctic Institute, as well as other establishments provide specialized forecasts on a daily basis to more than 3000 vessels belonging to the USSR Ministry of the Maritime Fleet and Ministry of Fish Industry, as well as the People's Republic of Bulgaria and the Czechoslovak Socialist Republic. Annual savings from running vessels on recommended routes total 3.0-3.5 million rubles. In the last 10 years this service has been provided to 20,300 vessels, resulting in 21.6 million rubles.

Rapid growth in the volume of Arctic maritime shipping requires that the cost of these operations be reduced. Especially effective in this regard are long-range ice forecasts, consideration of which leads to time savings and reduced wear and tear on icebreakers and transport vessels, fewer emergency situations, and savings in fuel and other materials. Extending the navigation season in the Arctic and in non-Arctic ports which freeze over in the winter is of prime importance for the economy of this country's northern regions. Scientific research and experience in providing ice navigation services in the Barents Sea, White Sea and other seas have made it possible to provide hydrometeorological substantiation and calculations for organizing winter hauling of cargo to the coast of the Nenets National District, where considerable oil and gas exploration activity is in progress. In April 1975 equipment, machinery and other cargo for the Varandeyskaya oil exploration expedition was off-loaded for the first time ever onto annual shelf ice and hauled across the ice to shore. These operations, dubbed by the press "Ice Docking," continued the following year (these operations were provided support service by the Northern Administration of the Hydrometeorological Service). These operations resulted principally in discovery of four fields and accomplishment one year ahead of schedule of the planned target for increasing proven oil and gas reserves. A coordinated effort by seamen, geological and hydrometeorologists made it possible to double the period of navigation, to employ motor ships, and to work out improved off-loading procedures (previously cargo had been transferred from motor ships to small vessels, operations of which were frequently hindered by fog, wind, and heavy seas).

In 1978 vessels carrying cargo for Noril'sk were brought across the Arctic seas and down Yenisey Bay unusually early in the season. These ships delivered 12,000 tons of cargo for a metallurgical plant under construction, and on the return trip these ships carried copper and nickel out 3 months ahead of schedule. This has demonstrated the possibility of year-round navigation in the Arctic on the Murmansk-Dudinka route. An even more complex task is being accomplished at the present time -- early navigation along the entire Arctic Ship Route. As we know, cargo shipped to the Chukchi Peninsula and to other northeastern regions is subjected a large number of transshipments, often lying idle en route for long periods of time. Everywhere warehouses and manpower are required for these transshipments. Direct transport communication by Arctic Ocean route will greatly facilitate and reduce the cost of shipment of goods to these regions.

While various weather forecasts are being increasingly more widely utilized for day-to-day production management, climatic and hydrologic characteristics, determined from data gathered by an observation network, are absolutely essential for capital construction and design. Climatic data are also needed for various zonal divisioning of regions (agroclimatic, balneological). Utilization of such data in construction design makes it possible to achieve an annual savings of approximately 100 million rubles on a nationwide scale, money which would have to be spent on requisite surveys and studies.

Considerable savings in construction are obtained by utilization of hydrologic research of a computational-reference nature performed by the State Hydrological Institute and other agencies. As indicated by calculations made by Lengiprogor, employment of the new method of determining the maximum water level on river floodplains, elaborated at GGI [State Hydrological Institute] and incorporated in construction standards, has made it possible to reduce costs by 10.3 million rubles in designing protective structures (against flooding) in the cities of Velikiy Ustyug, Vologda, Tobol'sk, Kurgan, and Tyumen'. Employment of the new GGI method to calculate maximum snowmelt and rain runoff will save a minimum of 13.5 million rubles per year just in transport construction (by reducing the cost of culverts in road embankments).

Speaking of the economic effectiveness of hydrometeorological service activities, one should take into consideration the fact that in spite of improvement in equipment, it is not a capital-intensive branch. In the Kazakh SSR Hydrometeorological Service Administration, for example, the capital-labor ratio is approximately 2,500 rubles per person, that is, less than in a number of other sectors. The economic effect from utilization of hydrometeorological information in the nation's economy in the Ninth Five-Year Plan totaled approximately 5 billion rubles.[1] But this figure, which characterizes actually obtained savings and prevented losses, is much smaller than the savings which could be achieved by optimal utilization of forecast and condition information.

Hydrometeorological science cannot yet provide accurate and reliable forecasts at the present time. Aviation weather forecasts (3-6 hour forecasts) prove 95 percent correct, 24-hour forecasts prove 90-92 percent correct, while 10-day forecasts are considerably less accurate, and monthly and seasonal forecasts even less accurate. The situation is particularly poor at the present time as regards long-range weather forecasts. These forecasts could play an important role in government planning, distribution of resources (fuel and seed, for example), and organization of major seasonal operations. At the present time, however, they are not sufficiently accurate or provided sufficiently in advance to satisfy either users or meteorologists. Hydrological and agrometeorological forecasts also must be improved.

Depending on degree of satisfaction with the quality of forecasts and the specific features of production, users select a strategy of either complete confidence in forecasts or disregard of forecasts; in the latter case one usually employs the average value of a meteorological element over a period of many years.[2] L. Gandin (Main Geophysical Observatory imeni A. I. Voyeykov) and Ye. Zhukovskiy (Agrophysical Institute of the All-Union Academy of Agricultural Sciences imeni V. I. Lenin), however, have demonstrated that in most cases neither strategy is the best. Inasmuch as detriment to the user as a rule also varies with deviations of a meteorological element from normal in different directions, it is more advantageous to focus not on the standard but on a certain meteorological element value which is displaced relative to the normal figure. One can fully trust a forecast only when there is a very high degree of reliability; more frequently one should figure not on the predicted value of the element but rather on a corrected value relative to the forecast.

When employing alternative (containing prediction of occurrence or non-occurrence of any meteorological phenomenon, without indication of quantitative characteristics) and phase forecasts (which indicate anticipated gradation of the element -- "above normal," "below normal," "within normal limits"), in many instances the strategy of partial faith in the forecast proves to be optimal. For example, top-dressing application of mineral fertilizers under moisture conditions which are average for the non-Chernozem zone produces a yield increase in the order of 3 quintals per hectare for spring crops. Additional profit averages 18.4 rubles per hectare. With excessive moisture top dressing causes plants to lodge and development of weeds, while insufficient moisture also has an adverse effect on crop yield. In both instances economic effect is negative (9.7 and 16.7 rubles per hectare respectively).

Farms receive phase forecasts, with a qualitative description of these forecasts as follows: when below-normal moisture is predicted, dry conditions are 90 percent probable and normal moisture probability is 10 percent; with a forecast of average conditions, the probability of excessively dry conditions is 17 percent, with an 83 percent probability of normal conditions; when above-normal moisture is predicted (a more frequent prediction) probability of excessively dry conditions is 1.5 percent, normal -- 65 percent, and excessive moisture -- 33.5%. As indicated by the calculations of A. Fedoseyev, with the climatic recurrence of weather phases characteristic of a given zone, annual top-dressing application will produce an a average gain of 7 rubles per hectare (strategy of total disregard of forecasts). With complete confidence in forecasts, top-dressing applications are made only in those years when average moisture is forecast, which will result in an average gain of only 2.8 rubles per hectare. The most advisable is the strategy of partial confidence in forecasts: top-dressing application should not be performed when drought is predicted, but top-dressing should be performed with a forecast both of average weather conditions and excessive moisture (for probability of average moisture is high in the latter case). The average gain corresponding to this optimal strategy is 8.5 rubles per hectare. With the vast acreage planted to spring crops, employment of an optimal strategy will make it possible to obtain a larger additional quantity of grain.

For optimal utilization of forecast and condition materials, operations research methods, matrix games, construction of economic-statistical models, linear and dynamic programming, theory of graphs, etc have been increasingly more extensively utilized in recent years as one type of input information for solving problems of branch economics. Optimal solving of a branch problem can minimize detriment from adverse weather (or hydrological) conditions, and on the contrary maximum profit can be obtained under favorable conditions. Unfortunately in practice optimal economic management decisions are not always made, even when obtaining sufficiently reliable hydrometeorological information. For example, upon receiving a forecast which indicates that river flow will be below normal, local water management agencies cut the water limits for individual irrigation systems and farms according to the principle of "offend nobody." The same principle of uniform undersupply is observed on farms in distributing water among brigades. And yet the relationship between yield of different crops and volume of water applied is not linear. By reason of this fact alone the above-mentioned principle does not produce an optimal solution. According to our calculation employment of mathematical methods to obtain optimal distribution of water for irrigation promotes an approximately 10% increase in profit per hectare. For practical implementation of such methods, however, it is initially necessary appropriately to change the system of labor remuneration currently employed on farms. Thus we see "feedback": taking hydrometeorological information into account improves production management; boosting the organizational level of management promotes greater effectiveness in taking this information into account.

Another way to improve production efficiency is close cooperation between enterprise and farm management and hydrometeorologists. Frequently the former do not understand the actual capabilities of the latter, while the latter possess inadequate knowledge of the technology of the enterprises to which they provide service. For example, today almost everywhere heating system temperature conditions are adjusted on the basis of 24-hour weather forecasts. But the thermal inertia of municipal heat supply systems does not as a rule exceed 4-6 hours. Therefore it is quite sufficient to have a 6-8 hour temperature and wind forecast to adjust delivery of heat. Such forecasts can easily be obtained at any local forecasting agency (weather bureau, aviation weather station), and their reliability is considerably greater than 24-hour forecasts. Transition to utilization of more frequent forecasts in Alma-Ata, Ust'-Kamenogorsk, and Kustanay, for example, made it possible to improve the quality of heat supply and to obtain considerable fuel savings. Recently this heating system weather service arrangement has been adopted in such large cities as Leningrad and Riga.

Unfortunately at the present time all possibilities are not being utilized to strengthen contacts between users and weather forecasters. For example, the above-mentioned arrangements based on selection of optimal management strategies taking weather forecasts into account have appeared only in the publications of institutes and other specialized publications and for this reason remain unknown to many enterprise economic and technical managerial officials.

The results of utilization of hydrometeorological information depend in large measure on whether users possess effective means of protection against harmful weather phenomena. For example, hail forecasting became effective only after technical means were developed to seed clouds for the purpose of preventing hail. Today measures to protect against hail damage are being performed in the Transcaucasus, in the Northern Caucasus, Moldavia, Central Asia, and other regions. There are as yet no effective means of protecting orchards and vineyards from frosts. And in many parts of the country losses from this phenomenon are quite substantial even with adequate warning. Attempts are presently being undertaken to develop frost-protection installations utilizing retired aircraft motors.

In view of the great socioeconomic importance of protection against natural disasters, large-scale projects to combat such disaters are being carried out in this country. For example, a dam erected in the Malaya Almaatinka River valley saved the capital of Kazakhstan in 1973 from an enormous mudflow. In August 1979 the CPSU Central Committee and USSR Council of Ministers issued a decree entitled "On Construction of Facilities to Protect Leningrad from Floods." Leningrad, Kronshtadt, Petrodvorets, Lomonosov and other cities will be protected from flooding caused by wind-boosted abnormally high tides, which cause enormous damage. Large flood control facilities will be constructed in 1980-1990 for this purpose -- a 25.4 km levee, as well as two structures for passing ships and water discharge. A number of important jobs have already been completed, including determination of the maximum water level occurring once in 10,000 years, a figure used to determine the dimensions of the protective structures. Problems pertaining to operation and maintenance of these structures as well as prediction of hydrochemical conditions and water quality in the Neva have been solved.

Further development of the hydrometeorological service in this country is continuing successfully. There is increasing scientific and technical cooperation with other countries, facilities and technical base are improving, as are quaiifications of personnel. There is no doubt that the quality of hydrometeorological services performed for this nation's economy will steadily improve. Correct, extensive utilization of hydrometeorological information is one of the ways to improve the efficiency of societal production.

FOOTNOTES

1. Yu. A. Izrael', "Principal Tasks of the USSR Hydrometeorological Service and Its Development Prospects" (METEOROLOGIYA I GIDROLOGIYA, No 7, 1976, pp 3-11).

2. Defined as total precipitation within a specified period, average temperature, river discharge, ice thickness, soil moisture, etc during that period.

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ELECTRIC POWER

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CLARIFIER ASSEMBLY TECHNIQUES DESCRIBED

Moscow ENERGETICHESKOYE STROITEL'STVO in Russian No 12, Dec 79 pp 7-8

[Article by D. B. Budovskiy: "Large Unit Assembly of the VTI-1000IM Clarifier at the Rostov Thermal Electric Power Plant"]

[Text] The Kharkov branch of the Energomontazhproyekt Institute has developed a technology for large-unit assembly of the main specimens of the VTI-1000IM supply water illuminators, using a DEK-50 caterpillar crane.

The clarifier (Figure 1) is a steel reservoir consisting of a cylindrical shell which forms the housing. The cone rests by means of a support beam on the reinforced concrete columns of the pedestal base. Inside the housing, to whose lower part is welded the mixing chamber, is situated the internal housing with its welded sludge-compactor floor. The outer surface of the reservoir is coated with a layer of thermal insulation with a decorative metallic sheathing on top of it. For protection against sludge, a screen is set over the clarifier (Figure 2), consisting of walls, a rotunda and cover shields resting on the clarifier housing.

The clarifier arrived at the assembly area from the Kharkov Boiler Machine Plant in separate parts consisting mainly of sheet metal. About 500 meters of welds had to be made to connect the parts together.

In conformity with the production schedule, there are two versions of large-unit assembly. In the first version, the clarifier and the cover above it are assembled by the DEK-50 crane in the boom and tower-boom mode; in the second version, the clarifier and its cover are assembled bythe DEK-50 crane in the tower-boom mode.

In both versions the mechanization arrangements carry out large unit assembly. Their characteristics (in the first version) are given in the table. In the second version there is an increase in the number of cone, shell and internal housing units (by one, two and one units, respectively).

Enlargement of plant procurement elements in assembly units is accomplished near the installation site so each unit is within the operational zone of the proper capacity DEK-50 during assembly and fitting.

About 250 meters of welded joints of thin sheet metal are used in assembly of the units, small parts and hooks for attachment of thermal insulation are welded thereto.

The clarifier elements are assembled in the following sequence: pedestal columns, support beam, mixing chamber (in temporary position at the zero mark), housing cone, mixing chamber (in planned position), sludge compactor floor, internal housing, shell, illuminator cover and parts supplied in bulk.

units	no. of units	weight, kg	
		one unit	total
Mixing chamber	1	9500	9500
Sludge compactor floor	1	5300	5300
Support beam	2	11,900	23,800
Housing cone	3	10,800	32,400
Internal housing	1	10,800	10,800
Shell	2	9400	18,800
Total...........................	10		100,600

When the cover is assembled over the clarifier the wall units are first set into place and then the rotunda and cover shield; the thermal insulation and bulk parts are then assembled.

The units are slung up on assembly loops and other sling devices welded to the units (tie beams, connecting pieces, etc.), while the rotunda (diameter of about 19 meters) is slung up by the central pipe step (Figure 2).

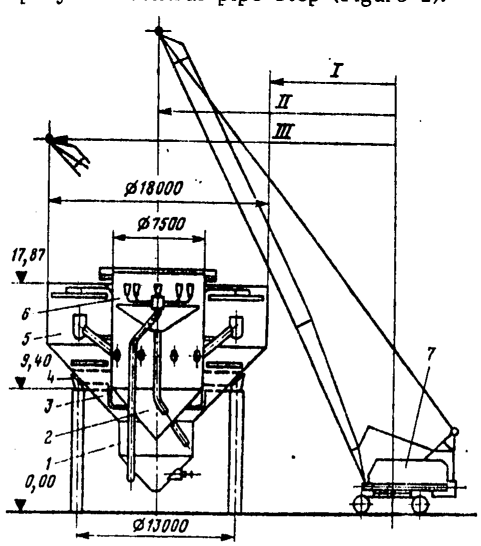

Figure 1. VTI-1000IM clarifier. 1—mixing chamber; 2—sludge compactor floor; 3—housing cone; 4—support beam; 5—shell; 6—internal housing; 7—caterpillar crane DEK-50 (in boom mode); I, II, III—crane radius 11; 19.4; 28.5 meters; load capacity is 15; 8.3 and 3.5 tons, respectively.

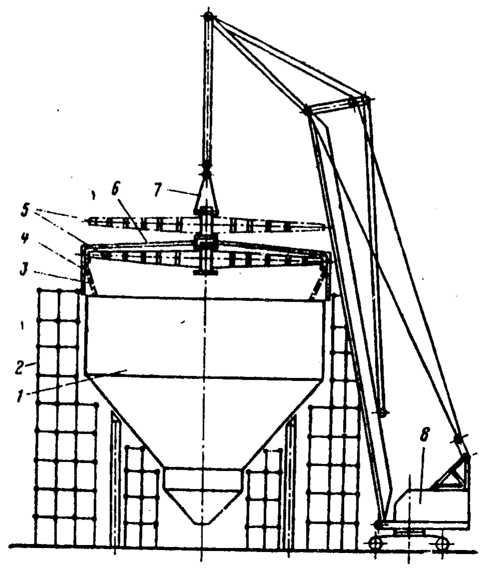

Figure 2. Assembly of clarifier cover.
1--clarifier; 2--prop timbers; 3--assembly strut; 4--cover walls; 5--rotunda; 6--covering shield; 7--sling; 8--DEK-50 crane (30 meter boom, 10 meter bucket).

The first VTI-1000IM clarifier was assembled by the Rostov Assembly Administration of the Teploenergomontazh Association. Practice showed the advisability of large-unit assembly using standard DEK-50 caterpillar cranes which exist at virtually all facilities. Transfer to the assembly site of most of the assembly and welding work done at elevated levels reduced the labor-intensiveness of this work by 15 to 20 percent.

The incorporation of safety techniques guaranteed the conditions necessary for elevated work outside and inside the clarifier as well as for assembly of the cover.

Conclusions

1. Further development of the large-unit assembly technology for similar clarifiers will make it possible to elaborate a standard plan and PPR for repeated application at large thermal electric power plants and GRES.

2. Solution of questions of delivery of clarifier units in rolls will reduce the amount of welding operations done at the assembly site.

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ELECTRIC POWER

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NEW TECHNIQUE OF BOILER CONSTRUCTION

Moscow ENERGETICHESKOYE STROITEL'STVO in Russian No 12, Dec 79 pp30-34

[Article by V. Ya. Slagoda and Yu. M. Marder: "Assembly of Technological Equipment of the Severodvinsk TETs-2"]

[Text] The plan of the gas and fuel oil TETs-2 has been accomplished by the Riga division of the Teploelektroproyekt institute. A distinctive feature of the plan is the combined main housing (OGK) in which are placed the chemical water purification unit, reagent supply, purification devices, water heating boiler and central repair shops, in addition to the energy units (Fig. 1).

The electric power plant is modular in design. The turbines are positioned cross-wise.

The main steam conduit of the Sverodvinsk thermal electric central station is made of 15Kh1M1F steel; the feeder pipeline is made of 15GS steel. They are of unifilar design. Elimination of cross steam connections and feed water between adjacent units reduced the length of the pipelines and the amount of reinforcement, and thus the cost of the equipment.

In the machine hall there are two bridge cranes with a capacity of 50/10 tons each, serving both the machine hall and the chemical water purification unit (KhVO). The region of energy and water heating boilers is serviced by two bridge cranes with capacity of 30/5 tons; the exhaust section has a half-gantry crane with 20 ton capacity. In the deaeration section there are two electrical beam cranes with capacity of 5 tons each.

The electric power plant building has no basement. The condensation floor of the machine hall and the floor of the boiler section are situated at the zero level. The roof of the turbine service is at the 12.00 meter mark. In the auxiliary section, water heating boilers are placed on metal structures with the upper mark of 8.50 meters.

Chemical water purification of the TETs consists of the folowing devices: thermal desalinization, purification of condensate returned from fuel oil management; purification of condensate returned from steam users; and feeding of the heating network.

Fuel oil management consists of a standard receiver and pouring device, two-stage fuel oil pump connected to the oil equipment, three metal reservoirs and a fuel oil depot. The fuel oil pumping room contains a sludge pump.

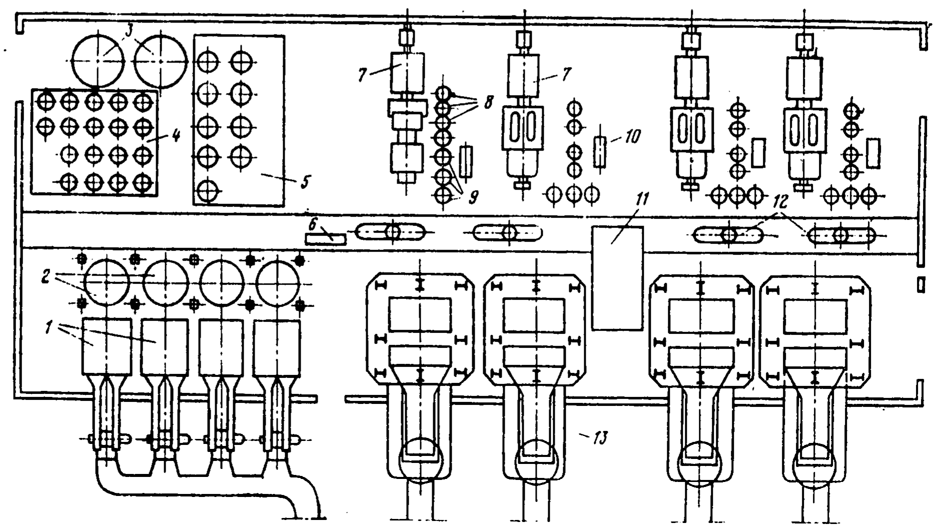

Figure 1. Arrangement of equipment of combined main housing. 1—water heating boiler; 2—technological tank, capacity 400 cubic meters; 3—clarifier 4—filtration hall; 5—reagent supply; 6—type ROU-U-B-VAZ rapid reduction and cooling unit; 7—turbine unit; 8—low pressure preheaters; 9—high pressure preheaters; 10—feeder pump; 11—modular control panel; 12—deaerator; 13—steam boiler.

The reagent discharge section, compressor, electrolyzer, and supply rooms are situated in the auxiliary service unit (BVS).

In the central pumping station (TsNS) are situated the OPV-2-110-KE pumps.

The plan of the Severodvinsk TETs-2 is based on conditions of organization of standard TETs construction:

complete modularity of all buildings and structures (except for the smokestack) based on delivery to the construction site of reinforced assembly units of structures with complete plant readiness;

high degree of plant readiness of equipment, pipelines and block delivery;

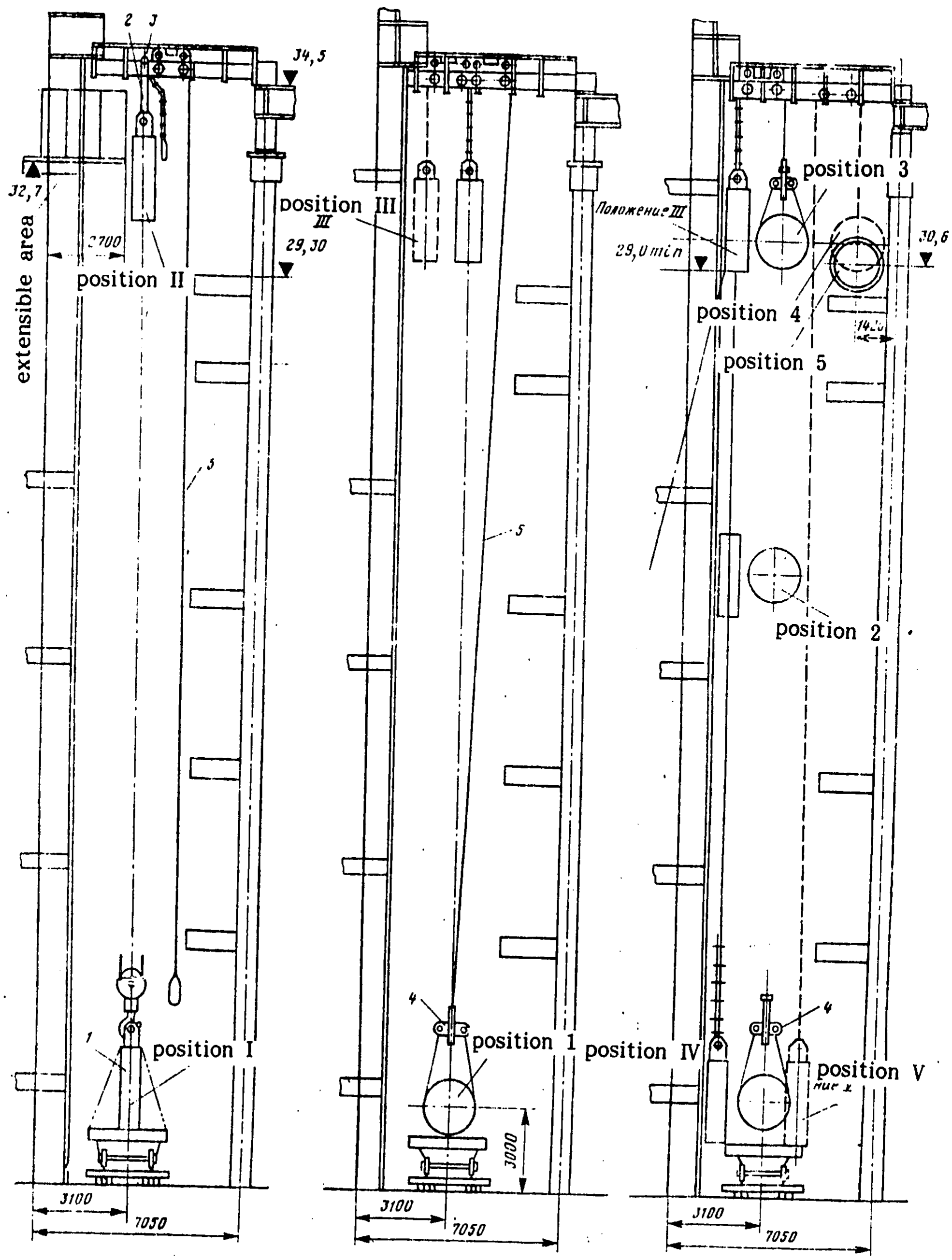

Figure 2. Boiler drum lifted by two cranes using counterweight.

centralized repair of equipment and consequently, reduced number and sizes of auxiliary TETs management.

The Arkhangel'sk assembly section of the Sevzapenergomontazh association received aid in assembling the thermomechanical equipment of the first energy unit from the Kol'sk, Ukhtinsk and Kotlassk assembly sections. The Arkhangel'sk assembly section, which carried out most of the work, was the general contractor. The Kol'sk section had an independent agreement with the construction administration of the Severodvinsk TETs-2. The Ukhtinsk and Kotlassk assembly sections were subcontractors of the Arkhangel'sk section.

The volume of work was distributed among the sections as follows: assembly of equipment and pipelines of the deaeration level was done by the Kol'sk assembly section; equipment, metal structures and pipelines of the auxiliary section of the turbine division of the OGK--by the Ukhtinsk section.

To carry out assembly and reinforcing work and store equipment in the construction site, a modular area 400 x 42 meters was built with ascending rail tracks to the machine hall and boiler division. Furthermore, the area across the rail tracks of the construction site emerged near row G (rail entry at axes 1-2). The rail track to the exhaust division laid in the plan by the Orgenergostroy institute was accomplished for the second TETs energy unit.

In the work production schedule for the assembly site there was planned the installation of two gantry cranes with capacity of 50/10 tons each, span of 42 meters. But only one crane was specified. As a result the section had to set up a gantry crane unassembled from the assembly area of the Arkhangel'sk TETs with a capacity of 30 tons, span of 32 meters, leading to a considerable reduction in usable area.

The PPR contained a complex of temporary structures and was accomplished by the section during full scale preparations for assembly.

To assure oxygen welding work an oxygen-gasification station was set up consisting of an 8G-513 well for storage of liquid oxygen and a stock oxygen distributor (IKRU-80), receiving and gasification (AGU-2M) devices. Oxygen was fed to work sites in the assembly area and the OGK from centralized locations. The supply of propane and butane was done individually for the OGK and assembly area. Each system consisted of dispensing (15 tanks) and gas distributors. Furthermore, there were centralized power outlets in the main housing and assembly area for electrical instruments and welding apparatus.

During the work production preparation period, the engineering and technical staff took a trip to the Rostov TETs-2 to study assembly experience. Members of the Arkhangel'sk assembly section repeatedly visited planning organizations (Riga division of TEP, Energomontazhproyekt) where they got to know technical documentation, OGK mockups, solved several questions of PPR elaboration. The work volumes and labor expenditures were determined, manpower graphs were plotted, and mechanism, instrumentation and material graphs were drawn up.

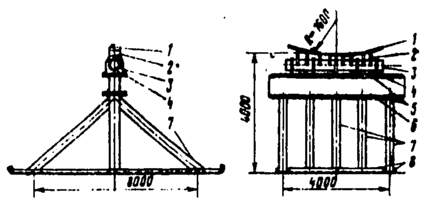

Figure 3. Installation of tanks by a single crane using a special adapter. 1—saddle; 2—rib; 3—rotary pipe; 4—guide supports; 5—sheet packing; 6—base made of #40 I-beams ; 7—prups made of 273 x 7 pipes; 8—foundation made of #30 channels.

It should be noted that engineering developments were hindered by late publication of the planning esimates.

In view of the brief directional periods of assembly of energy unit number 1, organizational and technical steps were elaborated for assembling the water-heating boiler and the energy unit itself which specified:

acceleration of delivery of bridge cranes and other hoisting mechanisms;

strict observance of technological assembly sequences for fuel oil management, exterior scaffolding, technical water supply systems, equipment and pipelines of the auxiliary OGK section and electrical equipment;

assembly of construction cranes of the deaerators, exhaust pipeilnes of reagent storage tanks, network pipelines of the deaerator level;

strict observance of the auxiliary boiler equipment and technology delivery scheduule;

lifting of the drum using counterweights, assembly of the 20,000 cubic meter tank using one DEK-25 crane, and KhVO filters in reinforced units;

modular assembly of the general station equipment and pipelines.

An important element in the engineering preparation was the elaboration of a reinforced assembly production schedule for all work in the startup complex. The schedule was drawn up based on data obtained from the general contractor concerning construction readiness and deliveries of primary and axuiliary equipment, pipelines and metal structures. In elaborating the schedule, it was found necessary to employ the assembly site for receiving equipment early in the year, in accordance with the planned technological sequence of assembly work; to accelerate delivery of bridge cranes; and to obtain planning estimates on time.

The solution of these questions and the accomplishment of organizational and technical steps made it possible to arrange rhythmic work patterns and reduce labor expenditures in assembly by 2300 man-days.

A temporary bridge was used with a slide block mounted on a column in row B of the building and frontal columns of the boiler frame at mark 34.50 meters was used to lift the 90 ton drum with two 30 ton bridge cranes and a 40 ton counterweight (Figure 2).

The 40 ton counterweight (1) was set in position I on the rail platform and was slung onto hooks of two 30 tons bridge cranes and raised into position II; it was suspended by truss (2) to the bridge beam (3) at position 34.50 meters. After relieving the cranes without unhooking the hooks, safe performance of this work was assured when the boiler drum was slung up.

The drum and its 100 ton capacity cross piece (4) were moved to position 1. The loop of the traction cable was attached to the cross rod. Then the counterweight was raised by the bridge cranes to 100-200 meters, the truss (2) was removed and the ends of the traction cable (5) were put in its place; then the counterweight was lowered and its load was transmitted to the traction cable. The bottom of the counterweight must be no lower than marker 29.00 meters.

The crane hooks were removed from the counterweight by the pre-positioned guy wires.

Ordinary jacks advanced the slide block and counterweight to position III. Then the boiler drum was slung onto the brdige crane hooks and was raised through intermeidate position (2) to position 93), while the counterweight dropped to position IV during this time. Then the drum and counterwight moved to position 4 and V, respectively.

After installing the drum in planned position (5), the counterweight was dropped to the platform, the rigging, cross piece and traction cable was removed, and the temporary bridge and slide block were disassembled.

Assembly of the drum using a counterweight reduced labor expenditures for installation of additional rigging devices, mounting hardware for winches and pulleys, and also saved traction cable and metal for production of the temporary adapters.

To assembly the 20,000 cubic meter tanks with one 25 ton crane, a special adapter was used (Figure 3). On the lower end of the roller was markd a groove at a height equal to that of the adapter (about 4,000 millimeters); then the 25 ton crane with its 14 meter boom raised the lower end of the roller and lifted the adapter towards it to the marking with the aid of a bulldozer.

The roller was lowered onto the saddle of the rotary pipe and was attached to it by welding using gussets to avoid sliding when the upper end of the roller was raised. Then the upper end was raised by the same crane with an 18 meter boom.

When the upper end of the roller is raised, the pipe rotates around its axis and generates two forces (counterweight), one of which acts downward (lower end of roller), while the other acts upward (upper end of the roller raised by the crane). Thus the weight is easily set in a vertical position. Then the gussets were cut off and the adapter was removed from the tank.

This method of manipulating the rollers of a 12 meters high tank weighing up to 55 tons with a single DEK-25 crane is very simple and requires no great expenditure of labor for the preparatory work.

The adapter can be used for assembly of several tanks at one facility; it can be moved to another facility on a regular trailer.

By analyzing the flow of assembly work on the basis of planned measures, the following factors must be stated.

Leading assembly could not be done in its full volume in fuel oil management because of a three month delay in deliveries of pipelines of the fuel oil pumping room and scaffolding; in chemical purification and the water-heating boiler rooms because of late delivery (in April-May) of pipelines by the KVOiT plant, and the bridge cranes as well.

It was also impossible to assemble such equipment as exhaust and network pipelines and reagent storage tanks with the construction crane in the process of erecting the main housing. This was caused by the late delivery of said equipment by the Ivangorod plant. For assembly of tanks of the reagent storage depot, the covering had to be dismounted at marks 12.00 and 7.00 and the tanks had to be dragged to the installation site using winches.

Measures were fully successful in hoisting the drum using the counterweight and assembly of the 20,000 cubic meter tank with a single crane.

A basic reduction in labor expenditures (1,600 man-days) was planned for assembly of large units manufactured in the Ivangorod KVOiT plant.

The pipeline units were to have been manufactured in three types: complex, packet and single.

The complex blocks contained equpment and pipelines for delivery by different plants. The bulk of the low pressure pipelines was supplied by the Ivangorod KVOiT plant, while equipment (pump heat exchangers) generally came from plants of other ministries.

The packet blocks included only pipelines and metal structures mainly supplied by the Ivangorod plant. Of the total number of planned packet units, only about 50 percent were manufactured and delivered. These units, however, were delivered late and were incomplete. For this reason much additional work had to be done during assembly to eliminate defects and make up complete sets. In some cases, because of late deliveries, some packet units had to be cannibalized to guarantee the planned assembly technology. In addition, because of break-downs in delivery of the units, the major portion of assembly work was shifted to the startup period, leading to an increase in the number of workers, causing hardships in their living accomodations and difficulties in providing them with small tools and instruments.

As a result of performance of assembly operations within compressed time periods, the section was still able to achieve the planned reduction of labor expenditures.

Conclusions

1. The planning of the Severodvinsk TETs-2 can be considered promising as far as assuring minimal labor expenditures for assembly of the thermomechanical equipment. New planning solutions developed for modular auxiliary facilities of the TETs and modular assembly make it possible to achieve a considerable reduction in labor intensiveness and reduce the duration of assembly work.

2. For further improvement of organization of assembly work in standard thermoelectric power plants of increased plant readiness, the following requirements are made:

output of technical paperwork by planning organizations no later than September 1 of the year prior to startup;

placing of orders at plants of the Teploenergooborudovaniye (thermal energy equipment) association and coordination of delivery schedules with them no later than December 1 of the year prior to startup;

elaboration of planning organization of the material and equipment requirements plan and coordination with the plant suppliers before the start of construction;

output of PPR no later than January 1 of the startup year;

elaboration of POS with participation of members of the Energomontazhproyekt institute and assembly organizations to include processes in the construction work schedule which are performed by assembly organizations using construction hoisting mechanisms;

assurance of leading delivery of equipment making up complex units to the plants and bases manufacturing these units;

strict observance of equipment and pipeline delivery schedules by plants of the Teploenergooborudoaniye association and imposition of strict economic sanctions for non-observance of periods and makeup of deliveries;

assurance of 100 percent plant readiness of units by plant manfacturing plants (including hydraulic testing and verification of assembly of units to be interconnected).

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FUELS

FIXED RENTAL PAYMENTS IN THE OIL INDUSTRY

Moscow VOPROSY EKONOMIKI in Russian No 1, Jan 80 pp 128-132

[Article by A. Bozhedomov, Groznyy: "Fixed Rental Payments in the Oil Industry"]

[Text] The economic function of fixed payments in the oil industry is to serve as a means of centralized removal to the budget of surplus rent profit with a natural basis obtained by production associations at deposits with average and optimal natural conditions.[1] Rent payments collected by the state neutralize the impact of natural factors on the economic accountability activity of associations and even out the conditions of their economic activity.

The system of rent payments for petroleum and gas is defined in the "Statute on Fixed Payments to the Budget," which was ratified on 11 November 1966. This statute observes that "fixed payments are established for enterprises which, owing to especially favorable natural and transportation conditions, accumulate differential net income." On 1 July 1967 differentiated rent payments per ton of oil extracted and sold and per thousand cubic meters of gas were instituted in the petroleum extraction regions of the country for field enterprises exploiting deposits with different natural productivity and situation. Until 1969 the rates of rent payments were calculated by sectorial planning agencies and delivered directly to each enterprise and oil field administration. From 1969 until 1975 the rates of rent payments were worked out and delivered to the production association, which then differentiated them by petroleum and gas extraction administrations belonging to the association. In 1976 uniform rates of fixed rent payments were instituted for each association.[2]

However, such a system of rent payments, where contributions to the budget are figured on the basis of volume of finished (extracted) output, do not simulate rational use of oil and gas reserves. For a small payment the associations now receive explored natural resources from the state for exploitation, and the prime cost of petroleum and gas extraction includes only an insignificant part of expenditures related to oil prospecting and exploration. The existing fixed rental payments in the oil industry do not give a good picture of the full cost of oil and gas extraction. As a result of this, significant oil and gas losses occur at the fields and petroleum resources are not fully extracted. In the 1960's and 1970's the degree of extraction of petroleum resources from the interior averaged 40-50 percent for the country. It is no more than 50 percent today.[3] The remaining petroleum is not recovered, even though the percentage of extraction could, as observed by N. Baybakov, chairman of USSR Gosplan, be raised to 90 percent given current advanced technology and equipment.[4] The efficiency of use of resources of by-product petroleum gas averaged 60-70 percent in the country between 1970 and 1978. The remaining gas is irretrievably lost, burned off in flares. These losses are especially great in new petroleum regions, where they reach 80 percent.[5]

The fixed rental payments to the budgets made by oil field enterprises in reality put them in a favorable situation. The associations have virtually no interest in enlarging new explored oil and gas reserves and direct capital investment chiefly to increasing petroleum extraction from sites in operation, devoting little attention to rational exploitation of the interior.[6]

The most important question in the problem of fixed rental payments in the oil industry is the method of distribution and withdrawing part of the oil "rent" to centralized state income. This is a timely question, for one, because the fixed oil payments form a significant and steadily growing part of budget income and, for two, because shaping the optimal structure of the country's fuel balance and rational use of natural resources depend directly on solving this problem.

The problem of withdrawing surplus rental profit to the state budget concerns all sectors of extracting industry, in particular fuels. The works of Academician S. Strumilin, Academician N. Fedorenko, and Academician T. Khachaturov were the first to make suggestions on improving the mechanism of collecting fixed payments in the mining sector, and these may be applied fully to the petroleum extraction industry as well.[7] N. Fedorenko and T. Khachaturov proposed basing rent payments in the mining sectors not on the unit of output extracted but rather on the unit of natural resources contained in the interior, explored and prepared for industrial exploitation.

In application to the oil industry V. Kozyrev proposed a technique of calculating oil "rent."[8] He wrote,"Because the oil industry is not yet ready to calculate rent per hectare of oil-bearing area, rent payments could be calculated per ton of petroleum reserves and cubic meter of by-product gas extracted. This would make it possible not only to centralize differential land income and even out conditions of economic activity, but also, and this is especially important, to make the withdrawal of this income dependent on the amount of oil reserves, on the volume and quality of natural resources. This would encourage enterprises to extract hydrocarbon reserves more fully because they would have to pay for industrial reserves left in the earth even though the oil (and by-product gas) had not been extracted."[9]

In fact, petroleum and gas extraction production associations today do not have a cost assessment of the deposits they are exploiting on their balances. There is no such assessment in sector plans or in the uniform national economic plan either. "This causes great harm to the national economy," N. Feytel'man observes. "Losses of useful minerals during their extraction and processing are not taken into account in plan calculations of the economic efficiency of capital investment."[10]

After acknowledging the advisability of collecting fixed petroleum rental payments per unit of natural resources deposited in one hectare of a site, not per unit of output extracted, nonetheless it should be observed that the prime cost of extracting a ton of petroleum and a cubic meter of by-product gas must be taken into account in establishing the level of payments. In many cases geologists, drilling experts, and operations workers are inaccurate in their determinations of the reliability of extractable (industrial) oil and gas reserves in the earth's interior. Industrial oil reserves per hectare of area are not the only, and sometimes not the determining, factor affecting the value of petroleum deposits in terms of natural productivity. Deposits with equal industrial reserves of oil in different geological conditions will have a significant difference in the prime cost of extraction and also, consequently, a different surplus rent profit on a natural basis, which is the material basis of the fixed payment. Oil deposits also differ significantly in their structure and spatial extent, the thickness and layering of pools, volumes and degree of saturation of rock with oil, layer pressure, degree of flooding, specific proportion of oil, and the like.[11] Only when all these factors are taken into account is it possible to give a complete evaluation of deposits with respect to productivity and determine the conditions of formation and level of surplus profits. Although it is very difficult to take these factors into account, it is possible. Their influence on the results of production at each deposit are ultimately reflected in the individual cost of production (prime cost of output) exactly calculated for production associations and the petroleum and gas extraction administrations subordinate to them.

Unlike the exploitation of reserves of solid minerals, exploitation of petroleum deposits causes not only extraction of industrial oil reserves but also major changes in the geological condition of occurrence of the remaining oil. These changes in natural factors have a significant effect on the production process and, therefore, also on the mechanism of formation and the level of differential "rent."[12] Thus, fluctuations in well yield also depend on the appearance of new natural factors that come into play during exploitation of oil fields. The impact of these factors can also be taken into account because they are reflected in rising production costs.

Different forms of occurrence of oil in layers leave their mark on the production process. The petroleum in the horizon is usually in contact with water and by-product gas, which plays the part of the working agent (force) that moves oil toward the face of the well under pressure. Because layer pressure diminishes as exploitation of the field progresses, the flow of oil to the well also decreases. At the same time the annual extraction from the deposit drops, which leads to a significant increase in the costs of production associations. The difference in natural layer pressure at deposits and change in this pressure as exploitation of deposits proceeds have a significant impact on the output of layers and, consequently, the evaluation of deposits with respect to productivity. Because the level of natural well productivity resulting from differences in layer pressure varies several-fold for deposits with equal oil reserves, the level of differential rent I fluctuates within roughly the same limits.

But layer pressure is not the only factor that influences well yield and the level of oil differential "rent" I. Equal layer pressure in oil pools with identical industrial oil reserves per hectare of area (and equal capital investment) still does not signify equal natural productivity from the earth. It may be greatly affected by a natural factor such as the coefficient of oil yield of the layers which depends on the physical properties of the collector (layer), its porosity and permeability, and the characteristics of petroleum migration in the horizon. A great difference in production cost is observed at deposits with different collector properties, and this means a difference in surplus rent income on a natural basis. Therefore, this natural factor too has a major impact on the formation and level of differential "oil rent" I.

The exploitation of petroleum pools leads to flooding with water. The degree of flooding determines the enormous difference in useful yield of wells. The value of petroleum deposits with respect to productivity and the level of surplus rent profit depends, in turn, on this.

The presence of by-product gas in petroleum pools in the form of a gas cap and gas dissolved in the oil under high pressure also has an enormous influence on the qualitative evaluation of deposits with respect to natural productivity, which therefore influences the magnitude of rent income received by the associations.

The level of differential oil "rent" I also depends on the physicochemical properties of the petroleum. When the industrial reserves of oil in pools per hectare of area are the same but the quality of the oil is different (with other production conditions being equal), the yield of each well and extraction for the entire deposit are conditioned by the viscosity of the oil and the quantity of harmful impurities it contains. The greater the viscosity is and the more harmful impurities there are, the lower extraction will be and the higher production costs will be. This means that surplus rent income on a natural basis will be less.

The temperature of the oil is one more natural factor that affects the value of deposits with respect to productivity. The higher the temperature is, the more intensive oil movement toward the well face will be. As temperature rises the effect of those natural factors which hamper oil movement in collectors diminishes. As a result, well productivity increases and surplus rent profit is greater.

Distinctive characteristics of the formation of differential "rent" I in petroleum extraction are also seen in the different order of opening up different sections of deposits. In the mining sector the time that different sections are brought into operation does not affect their natural productivity. In petroleum extraction, however, the natural productivity will differ depending on the time and place that wells are set up at the same pool, which means that surplus rent income on a natural basis will also differ. The reason for this is the unique migration of oil, gas, and water in the pool as a single hydrodynamic system.

The following conclusions can be drawn from the above. In the first place, when assessing petroleum deposits with respect to natural productivity and level of "rent," one must begin from the aggregate of all natural factors, not just the amount of industrial oil reserves and volume per hectare of area.

In the second place, fixed rent payments in the oil industry should be collected per ton of industrial (recoverable) oil reserves in the earth, but with due regard for the prime cost of extraction at each deposit because the costs of petroleum and gas extracting associations are the most approximate generalizing index of the value of oil deposits with respect to natural productivity.

We believe that it is possible to establish a differential scale of payment for useful minerals on the basis of consideration of industrial oil reserves in the interior with a correction for the prime cost of extraction of a unit of output. Under these conditions the payment will have a rent basis, which is very important. Otherwise the surplus profit taken from production associations may have been attained by improving their economic accountability activities or may even be profit which did not have a rent basis. This has a negative effect on the economic accountability interest of production associations. The CPSU Central Committee and USSR Council of Ministers Decree entitled "Improving Planning and Strengthening the Influence of the Economic Mechanism on Raising Production Efficiency and Work Quality" says that it is essential "to insure further development of economic accountability at production associations (enterprises)...on the basis of the assignments of the five-year plan and long-range economic norms that guarantee an increase in the resources put at their disposal, depending on improvement in the final results of economic activity."

The specific impact of natural factors in petroleum recovery on the formation of surplus rent profit on a natural basis should be carefully considered by planning and economic agencies using production costs and the structure and elements of them. This must be done when computing the level of fixed rent payments. Natural factors and the economic accountability activity of associations should be defined and considered separately, which is entirely within the capabilities of associations and their economic services. This will make it possible to create greater incentive to improve the quality indexes of the work of associations and petroleum and gas extraction administrations.

The theoretical aspects considered here of collecting fixed rent payments from industrial oil reserves in the earth illustrate the difficulties of calculating these payments per ton of oil contained in the layers for each production association. Nonetheless there are already examples where rent payments are charged on the basis of natural resources used, not per unit of output produced. In the "Statute on Fixed Payment to the Budget" mentioned above, rent payments (so-called stumpage) for the forest industry are set per cubic meter of wood in a calculated cutting area, not per cubic meter of cut and yarded timber. This principle can also be used in the oil industry, needless to say taking into account its specific characteristics. The technique of calculating the stumpage payment may be useful to some extent in working out a technique for determining oil rent payment.

FOOTNOTES

1. We adhere to the point of view which holds that in economies where a monopoly on the land as an object of ownership and object of economic activity is concentrated in the hands of the state alone there cannot be pure rent relationships. In this case "rent" assumes the form of differential surplus income or differential surplus profit, on the basis of which the oil rent fixed payments are formed.

2. See NEFTYANOYE KHOZYAYSTVO No 10, 1977, p 47.

3. See NEFTYANOYE KHOZYAYSTVO No 7, 1974, p 3; No 5, 1975, p 8; No 10, 1977, p 4; No 1, 1979, pp 6-7.

4. See N. K. Baybakov, "A Problem of National Economic Importance" (NEFTYANOYE KHOZYAYSTVO No 7, 1974, p 5).

5. See PLANOVOYE KHOZYAYSTVO No 6, 1975, p 59; EKONOMIKA NEFTYANOY PROMYSHLENNOSTI No 1, 1976, p 4; NEFTYANOYE KHOZYAYSTVO No 2, 1977, pp 3, 9; No 10 p 14; AZERBAYDZHANSKOYE NEFTYANOYE KHOZYAYSTVO No 4, 1979 p 72; PRAVDA 26 June 1979.

6. See Baybakov, op. cit.

7. See S. G. Strumilin, "The Price of 'Nature's Gifts'" (VOPROSY EKONOMIKI No 8, 1967); N. P. Fedorenko, "Economic Evaluation of Natural Resources" (VOPROSY EKONOMIKI No 3, 1968); T. S. Khachaturov, "Economic Evaluation of Natural Resources" (VOPROSY EKONOMIKI No 1, 1969).

8. See V. M. Kozyrev, "Renta, Tsena, Khozraschet v Neftyanoy Promyshlennosti" [Rent, Price, and Economic Accountability in the Petroleum Industry], Izdatel'stvo Nedra, 1972; V. M. Kozyrev, "Dobavochnaya Pribyl' v Neftyanoy Promyshlennosti" [Surplus Profit in the Petroleum Industry], Izdatel'stvo Nedra, 1975.

9. Kozyrev, V. M., "Dobavochnaya Pribyl'..." op. cit., p 89.

10. EKONOMICHESKIYE NAUKI No 11, 1977, p 54.

11. The conditions under review are typical of all deposits, but we have in mind only fields with average and good productivity, be- only there is surplus rent profit on a natural basis created.

12. In this article we are abstracting from differential "rent" by location of the selling market, so in what follows we will use the term differential "rent" I for differential "rent" based on productivity.

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