JPRS L/9449

16 December 1980

USSR Report

ENERGY

(FOUO 26/80)

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ELECTRIC POWER

ORGENERGOSTROY INSTITUTE'S ENERGY CONSTRUCTION EFFICIENCY GOALS DETAILED

Moscow ENERGETICHESKOYE STROITEL'STVO in Russian No 9, 1980 pp 3-5

[Article by USSR First Deputy Minister of Power and Electrification P.P. Falaleyev: "Improving the Efficiency of Energy Construction--the Main Goal of the Orgenergostroy [All-Union Institute for the Planning of Electric Power Projects] Institute"]

[Excerpt] At the present time the ministry has developed an extensive program of measures for improving the effectiveness of energy construction, covering all trends in capital construction in the energy field, and has adopted a number of important resolutions regarding the construction of electric power stations in a number of regions, including the Ekibastuz, Kansk-Achinsk and Surgut fuel and energy complexes, as well as of 1150 and 1500 kV overhead lines and other projects.

The proposal is to put into service by 1985 considerably more new energy capacities than in the preceding 10th Five-Year Plan period.

The main job of power engineers in the coming five-year plan period is to ensure an annual uniform and augmented entry of capacities into service. Success in fulfilling this assignment depends primarily on the introduction of advanced technology, on optimal organization of work, and on improved economic methods of controlling construction production, i.e., on the solution of problems which comprise the basic essence of the work of the Orgenergostroy Institute.

Furthermore, taking into account the increased labor intensiveness of the construction of power projects, especially in connection with the changeover from gas and fuel oil to nuclear and pulverized coal electric power stations, it is necessary to ensure maximum efficiency in the utilization of labor resources.

Fulfillment of the above objectives requires the practical implementation in the 11th Five-Year Plan period of the entire group of measures of the program developed and primarily of those relating to the radical improvement of the technology, organization and economics of construction production.

In particular, in the area of nuclear power plant construction the following are necessary:

The organization of assembly-line construction of groups of series-produced industrial nuclear power plants with VVER-1000 and RBMK-1000 power units in keeping with unified projects based on the extensive utilization of nuclear power construction combines (AESK's).

The introduction in keeping with approved technological rules of a unified technology for the construction of nuclear power plants providing for the organization of intra-construction-site assembly lines, the improvement of the engineering preparation of construction production, and the maximum enlistment of specialized organizations and AESK's.

Ensuring a fundamental rise in the level of overall mechanization and reduction of expenditures of manual labor by the complete furnishing of nuclear power plant projects being constructed with SKR-2200, SKR-3500, SKG-1000EM and MKG-100 cranes, concrete pumps (with manipulators), transport vehicles with a load-lifting capacity of up to 100 tons, welding equipment and materials, equipment for spanning framework elements and other equipment.

A reduction, associated with the organization of AESK's, in the amount of work for the erection of construction bases, thereby making it possible before the start of work on key nuclear power plant buildings and structures to put into service first the most important power services and concrete and mortar services, food services, administrative and personal services and transportation buildings and workshops.

The following are necessary for the purpose of further improving the efficiency of the construction of thermal electric power plants:

The enactment of a program for the assembly-line construction of groups of uniform high-capacity GRES's with power plants with a capacity of 500, 800 and 1200 MW in the areas of the Ekibastuz, Kansk-Achinsk and Surgut fuel and energy complexes, based on the utilization of mass unified highly industrial project solutions, the creation and maximum utilization of regional production and acquisition bases and the extensive enlistment of specialized organizations for performing the work.

Providing for the introduction of advanced technology, including the assembly of building structures and equipment in consolidated units and the employment of bulk construction technology sections, components and units (unitized auxiliary equipment and pipeline modules, electrical equipment room sections, ventilation ducts, sanitary engineering modules and the like).

The accomplishment in the construction of heat and power plants (TETs's) of a changeover to the construction of TETs projects only according to mass plans, including TETs projects utilizing solid fuel.

Arrangements for the extensive application for the erection of high-level structures (chimneys and water cooling towers) of a sliding falsework, as well as the introduction of new structures--a two-layer smokestack and a prefabricated ferroconcrete water cooling tower.

Providing for the development and introduction of new types of rapid-installation concrete and mortar services projects--concrete- and mortar-mixing installations, filler and cement storehouses, and compressor houses assembled from transportable units.

In solving the problem of satisfying the rapidly increasing demand of the national economy for fuel and electric power, a large rolè is being assigned to the further development of water power, which in turn necessitates speeding up the time needed to erect water power complexes. In this connection, in the field of water power construction the following are necessary:

Providing for the extensive use of high-efficiency earthmoving equipment.

The creation and mastery of a continuous-flow assembly-line technology for the transportation and placing of earth masses.

Providing for an increase in the degree of utilization of cranes, concrete plants, transportation vehicles and the like.

The creation and mastery of continuous- and cyclic-flowline highly mechanized complexes for the performance of concrete operations.

The introduction in the practice of the construction of underground water engineering facilities of high-efficiency mining and tunneling equipment, such as combines, drill carriages and the like.

Arranging for the manufacture of special kinds of equipment, such as marquees, manipulators, buckets, etc.

The mastery of a technological complex for fabricating, transporting and assembling precast ferroconcrete large-diameter conduits for hydraulic accumulator electric power plants.

Provision for reducing the extent of ancillary production and the length of the preparation period by improving the designs of temporary structures and methods of erecting them.

Further improvement of the efficiency of electrical system construction requires the use of new materials and constructions and advanced technology and labor organization. For this the following are necessary:

Arrangements for the development, manufacture and introduction of a series of special gear and equipment for the erection of overhead lines, primarily for the construction of 1150 kV a.c. and 1500 kV d.c. overhead lines, as well as for working in the northern region of the country.

Increasing the extent of utilization in the eastern and northern regions of the country of centrifugally cast and vibrated ferroconcrete towers for 35-500 kV overhead lines (including those made by using polymer concrete).

The development and introduction of a system for the materials and equipment supplying of electrical system construction projects with sets of technological equipment taking the season factor into account, based on the utilization of computer technology facilities.

The mastery of new kinds of structures--lighter towers, screw piles and anchors, fasteners without a cross bar, flexible cross pieces, etc.

Extending the use of helicopters, particularly for the construction of 1500 and 1150 kV overhead lines.

Providing for the mass utilization of plant-manufactured modular 35-220 kV transformer substations and industrial designs of outdoor distribution systems, including substation buildings made of sections of rapid-assembly buildings, unsunken foundations beneath equipment, an unsunken fence, pile foundations beneath gantry structures and equipment, etc.

The introduction of a new technology for wiring, including the installation of wires under traction and their connection by fusing.

The following are necessary for the purpose of fulfilling the program in the construction industry field:

To make possible by 1985 the construction and entry into service of new production capacities for large-panel and totally modular housing construction to an extent of 1.2 million square meters, which will make it possible to raise the level of prefabrication in housing construction from 0.62 to 0.9 and to provide with living space an additional 300,000 builders and installation personnel, primarily in regions of Siberia and the Far East, as well as in the construction of nuclear power plants.

To increase the production of classified crushed stone and gravel by a growth in output of 17 million cubic meters to make possible the maximum utilization at construction sites of high-efficiency concrete mixers, concrete placers and concrete pumps and to produce a concrete mixture of high quality, thereby making possible at all newly constructed and reconstructed enterprises a year-round cycle for washing and sorting crushed stone and gravel.

For purposes of drastically shortening the length of the preparation period, to increase the production of container-type and prefabricated collapsible buildings (including pioneer housing) to 27,000 units, i.e., threefold.

To make possible a growth in capacity for the production of totally prefabricated industrial products, such as up to 205,000 tons of galvanized building structures, up to 545,000 tons of completely painted metal structures and up to 150,000 square meters of structures for quick-assembly buildings.

Mastery of the production of new kinds of products (the total output of products indicated must be made possible by the end of the 11th Five-Year Plan period), including 300 km of pipelines for the ductless construction of central heating systems, 320,000 square meters of stock wood and metal falsework, 1.6 million square meters of ventilating air flues, and special structures for nuclear power plants, such as 66,000 tons of steel and 180,000 cubic meters of prefabricated concrete; the use of these products will make it possible to increase drastically labor productivity in construction production and to shorten the time taken to construct projects.

The following must be done in the area of che organization of construction:

The ensurance of uniform entry into service of energy capacities over the course of the year as the result of coordinating the capacities of construction and installation organizations with materials and equipment supply plans based on the fulfillment of directive quotas for a growth in labor productivity.

The utilization of the potential for improving the efficiency of the work of the ministry's subcontracting organizations, such as the introduction of new equipment, the reduction of nonproductive input and loss of work time, the reduction of personnel turnover, an increase in the equipment utilization factor, reducing the percentage of manual labor, and improving the skills of personnel; the realization of this potential will make it possible to improve labor productivity during the five-year plan period.

Ensuring the advanced construction of housing for construction and installation personnel and of buildings for social and personal purposes, based on the expansion and reconstruction of existing and the construction of new homebuilding combines.

To develop and introduce an expeditionary duty method in the construction of 35 kV and up electrotransmission lines and plans for the bases and housing required for ensuring normal work under conditions of the pioneering prestart and startup period at a thermal electric power plant and a nuclear power plant.

To create specialized organizations for the construction of temporary and permanent roads and services, temporary structures and concrete and mortar services.

To develop and introduce a unified information system for monitoring the progress of the construction of energy projects for all levels of control, on the basis of a unified technology and standards base employing computer technology.

To introduce the systems method of designing and fabricating structures, as well as of building structures on the basis of a unified nomenclature of projects, systems and operations relating to thermal electric power plants and nuclear power plants, electrotransmission lines and large substations.

To develop and test in an experimental procedure variants of the structure of USSR Ministry of Power and Electrification building and installation organizations on the basis of combining the principles of regionality and technological specialization for purposes of improving the utilization of general-construction subdivisions and construction and installation bases existing in regions, as well as the capacities of construction industry enterprises.

On the basis of these objectives the Orgenergostroy Institute should concentrate maximum effort and resources on solving problems relating to the organization of assembly line construction, to the creation and introduction of technological rules and to improving the technology for the performance of construction and installation work by working out new construction technology solutions and developing advanced gear, apparatus and equipment.

The indicators for construction production and energy construction as a whole can be improved considerably by improvement of the technical level of planning decisions by the combined efforts of construction and installation collectives, technological institutes and planning organizations. It is precisely in a situation of combined work of this sort, in which the Orgenergostroy Institute must play a leading role, that it is possible to ensure success in fulfilling the quotas of the 11th Five-Year Plan period, for advanced technology must be the basis of planning decisions.

The institute is faced with serious work relating to development of an industrial base. Its team must perform a great amount of planning and research work, involving primarily the development of the construction industry in the country's eastern regions and industrialization of the construction of nuclear power plants.

An important role belongs to the institute in problems of improving the quality of construction, and we justifiably anticipate an increase in its role both in the development and introduction of systems for controlling the quality of building and installation work, and in the performance of work relating to engineering support and controlling the quality of construction.

The most important direction of the institute's work at the present stage is improvement of the system for controlling and organizing energy construction in keeping with the decree of the CPSU Central Committee and USSR Council of Ministers "On the Improvement of Planning and Intensifying the Effect of the Economic Machinery on Improving Production Efficiency and Work Quality." For the purpose of putting this decree to work it is necessary to develop a large set of methodological and norm-setting documents providing for the improvement of planning and intensification of the effect of the economic machinery on improving the efficiency of construction and industrial production.

The following are necessary, in particular:

To bring into agreement the amounts of processed stock and entries-into-service planned. This will make it possible to accomplish to a considerable extent the uniform entry of capacities into service over the course of the calendar year, and, what is especially important, to utilize newly introduced capacities during the period of the fall-winter energy load maximum.

To balance the program of subcontracting work with the capacities of construction and installation organizations and construction industry enterprises, as well as with plans for the supply of materials and equipment.

To plan the extent of building and installation work on the basis of the requirements for assembly-line and high-speed assembly-line construction of groups of nuclear power plants with reactors of the same type in the European sector of the country, as well as the large thermal electric power plants of the Ekibastuz, Kansk-Achinsk and Tyumen'-Surgut fuel and energy complexes.

To organize planning and accounts with clients on the basis of indicators of finished construction commodity products, which will make it possible to raise the value of economics in controlling construction production and to reduce the unjustifiably high amounts of unfinished production.

To change over to an improved form for organization of the work of self-supporting crews--the section contract--and to reduce the level of the scope of crew contracts to 25 percent.

The Orgenergostroy Institute is faced with very serious problems on whose solution depend the results of the industry's work not only at the present time but also in the future. On this basis the institute's team must concentrate efforts on solving key problems in the development of energy construction and must work already today at 1985-1990 levels.

The solution of the problems named, in spite of their complexity, is totally within the capacity of the institute's honored team and the pledge for this is the successful work of the engineers, designers, economists and auxiliary service personnel working in its subdivisions. Over 25 years remarkable people have appeared in the institute, who have been justifiably granted awards of merit and prizes.

The five-year plan for the Orgenergostroy Institute's work must respond totally to the objectives set for energy construction by the CPSU 25th Congress, to the decisions of our party's plenums, and to the directives of CPSU Central Committee General Secretary and President of the Presidium of the USSR Supreme Soviet Comrade L.I. Brezhnev.

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CSO: 1822

ELECTRIC POWER

UDC 621.315.17:621.315.66

ADVANCED TECHNOLOGY FOR CONSTRUCTING PYLONS

Moscow ENERGETICHESKOYE STROITEL'STVO in Russian No 9, 1980 pp 57-61

[Article by N.A. Voynilovich, Ye.N. Kogan and V.A. Chernov, engineers]

[Text] With the mastery of new industrial regions of our country the development of electrical system construction has been accelerated and the geography of the location of overhead lines has been expanded. In the construction of many overhead lines it is necessary to surmount wide water barriers. The erection of each large pylon is a complex technical problem whose solution requires an individual approach in each individual case and the taking into account of the structural features of the project being constructed and local conditions.

For electrotransmission lines to cross over large rivers, division EM-20 of the Orgenergostroy [All-Union Institute for the Planning of Electric Power Projects] Institute over the last 25 years has developed a technology for the erection of high towers by using special equipment. According to plans for performing the work carried out by this division have been constructed more than 50 crossings of 35-750 kV overhead lines, whose geography stretches from the Dunaj to the East Bosporus, from the northern basin of the Ob' to the Amu Dar'ya. A brief description of key crossings is given in table 1.

Table 1.

Designation and voltage of overhead line (barrier crossed)	Year of development of job performance project	Pylon Height, m	Weight, tons	Basic means of erection (height)	Trust constructing overhead line--general contractor (organization erecting tower--subcontractor)
	Erection of Towers by the Pivoting Method				
Arzamas-Gor'kiy (Oka River) 220 kv	1963	80	55	Tower (45 m)	Volgoelektroset'stroy

[Continued on following page]

Oktyabr'skaya-Kirovskaya (Irtysh River) 110 kV	1965	67	46	Tower (36 m)	Sibelektroset'stroy
Tyumen'-Surgut (Tobol River) 500 kV	1967	75.5	97	Tower (45 m)	Uralelektroset'stroy
Tyumen'-Surgut (Irtysh River) 500 kV	1967	75.5	97	Ditto	Ditto
Tyumen'-Surgut (Yuganskaya Ob' River) 500 kV	1968	75.5	97	Ditto	Ditto
Tyumen'-Surgut (Yuganskaya Ob' River) 500 kV	1968	81.25	107.5	Ditto	Ditto
Vladimirovka-Astrakhan' (Akhtuba River) 220 kV	1970	55	33.8	Tower (36 m)	Yugovostokelektroset'stroy
Vladimirovka-Astrakhan' (Volga River) 220 kV	1970	77	86.9	Tower (45 m)	Ditto
Yermakovskaya GRES - Rubtsovskaya Substation (Irtysh River) 500 kV	1971	84	192.6	Two single-pedestal towers (45 m)	Uralelektroset'stroy
Mel'nikovo-Kolpashevo (Ob' River) 110 kV	1972	105	125.8	Derrick (45 m)	Sibelektroset'stroy
Kashin-Kalyazin (Volga River) 110 kV	1975	74	55.6	Tower (36 m)	Tsentrstroyelektroperedachi
Pechora-Usinsk (Pechora River) 220 kV	1975	83	98	Ditto	Ditto
Parabel' - Sovetsko-Sosninskaya (Staritsa Obi River)	1975	87	117	Tower (45 m)	Sibelektroset'stroy
Ditto	1975	75	95	Ditto	Ditto
Tungusovo-Mogochino (Ob' River) 35 kV	1978	103	104	Ditto	Ditto

[Continued on following page]

Erection of Towers by the Building Up Method

Konakovo-Kalinin (Volga River) 330 kV	1962	85	190	Tower (29 m)	Tsentrstroyelektro-peredachi
Khabarovsk-Birobidzhan (Amur River) 220 kV	1962	150	240	UPK-2,5 crane	Dal'elektroset'stroy (Gidromontazh)
Vichuga-Zavolzhsk (Volga River) 110 kV	1963	82	94	Two towers (28 m each)	Tsentrstroyelektro-peredachi
Konakovo-Severnaya (Urchinskoye Reservoir) 500 kV	1964	76		Tower (29 m)	Ditto
KamGES-Chusovaya (Sylva River) 220 kV	1965	105	125.3	Two towers (28 m each)	Uralelektroset'-stroy
East Bosporus 35 kV	1966	150	235	UPK-3 crane	
Tyumen'-Surgut (Ob' River) 500 kV	1967	188	420	UPK-5 crane	Uralelektroset'-stroy (Gidromon-tazh)
Moldavskaya GRES-NRB [People's Republic of Bulgaria] (Dunaj River) 400 kV	1968	118	160	UPK-3 crane	Tsentrstroyelektro-peredachi (Gidro-montazh)
Tomsk-Parabel' (Ob' River) 220 kV	1973	158	292	UPK-3 crane	Sibelektroset'stroy
Konakovo-Leningrad (Volga River) 750 kV	1973	172	410	UPK-5 crane	Tsentrstroyelektro-peredachi (Gidro-montazh)
Parabel' - Sovetsko-Sosninskaya (Ob' River) 220 kV	1975	150	280	UPK-3 crane	Sibelektroset'stroy
Abalakovo-Razdolinsk (Yenisey River) 220 kV	1976	108	178	UPK-5 crane	Krasnoyarskelektro-set'stroy
Ditto	1976	65	105	Ditto	Ditto

[Continued on following page]

Abalakovo-Razdolinsk (Angara River) 220 kV	1976	150	298	Ditto	Ditto
Konakovo-Kalinin (Volga River) 330 kV	1976	150	240	Ditto	Tsentrstroyelektro-peredachi
ORU [outdoor distribution system] - SShGES [Sayana-Shushenskaya Hydroelectric Power station] dam (Yenisey River) 500 kV	1977	93	227	Ditto	Krasnoyarskelektroset'stroy (Gidromontazh)
		83	216	Ditto	
		65	182	Ditto	
Surgut GRES - Ust'-Balyk (Ob' River) 500 kV	1978	144	318	Ditto	Uralelektroset'stroy
Ditto	1978	104	198	Ditto	Ditto
Mary-Karakul' (Amu Dar'ya River) 500 kV	1979	121	170	UPK-2 crane	Spetsset'stroy

As is obvious from the data in table 1, the erection of pylons is accomplished according to various technological methods (building up by means of derricks, gantries and cranes and pivoting by using dropping towers), which is associated with the variety of planning solutions for pylons, which differ from one another in geometric arrangement, division into sections and the construction of elements. Of course, the difference in the types of pylons did not make it possible to create standard technological systems for the erection of pylons at crossings.

It should be mentioned that the technology of performing construction and erection operations and the equipment used are constantly being improved. Whereas previously for the erection of the most heavy pylons specialized organizations (e.g., the Gidromontazh Trust) were enlisted, as a rule, furnished with heavy-duty erection equipment, the simplification of the technology provided for in the job performance plans developed by the Orgenergostroy Institute made it possible to be oriented to the performance of the work by the manpower of line subdivisions.

For the first time (1962), according to a job performance project developed by the division, Mechanized Column No 33 of the Tsentrstroyelektroperedachi Trust erected by the building up method, by means of erecting towers, tubular pylons of the SA-85 type at the Konakovo GRES - Kalinin 330 kV overhead line crossing across the Volga. And in 1965 Mechanized Column No 11 of the Uralelektroset'stroy Trust erected by means of two towers AS-105 pylons from angular shapes at the Kamskaya GES - Chusovaya 220 kV overhead line crossing across the Sylva River.

In 1975 Mechanized Column No 74 of the Sibelektroset'stroy Trust completed the building up of a tower 158 m high by means of a UPK-3 crane at the crossing over the Ob'. Beginning at this time the erection of high pylons by means of UPK [general-purpose swinging crane] cranes has been carried out, as a rule, by mechanized columns of trusts of the USSR Ministry of Power and Electrification.

Of course, two fundamental methods exist for erecting high structures of the tower type (under this heading come also pylons for overhead lines)--erection at the planned location and assembly on the ground with subsequent installation at the planned location.

The method of pivoting by means of a dropping derrick has found widespread application in the construction of overhead lines. The key advantage consists in the fact that the amount of work high up performed by highly skilled specialists is reduced to a minimum and the preparation of special rigging in each case is practically not required.

But it has been established on the basis of project studies and construction experience that methods of erection which include assembly on the ground are efficient in erecting towers up to 100 m high and weighing up to 100 tons, when it is not necessary to use especially heavy-duty rigging. With a greater height and weight of structures the method of building up vertically is more efficient, the effectiveness of which increases with an increase in the height of the tower being erected. Besides, this method is practically the only one for construction under constrained conditions.

A technical and economic comparison of the two key methods of erecting towers (table 2) demonstrates that from the viewpoint of the labor intensiveness of the work the building up method is preferable (expenditures of labor are 1.5-fold lower), but from the viewpoint of the duration of the basic work, the pivoting method is better. However, in view of the specific peculiarities of constructing crossings for electrotransmission lines, such as remoteness from production bases, the lack of cranes with a large load-lifting capacity or the impossibility of their being supplied, lack of mastery of the construction site and the absence of roads, and in a number of cases the constrained nature of conditions and the existence of a complicated terrain, in selecting the technology for performing the work sometimes compulsory, but not always optimum, solutions are used.

Table 2.

Voltage, kV	Type of tower	Height, m	Weight, tons	Labor input for erection, man-days: By the pivoting method	Labor input for erection, man-days: By the building up method
110	PP110-1/37,5	51	26.8	141.1	86.6
	PP110-1/47,5	61	33.4	175.9	107.9
	PP110-1/57,5	71	42.8	225.5	138.3
	PP110-1/67,5	81	52.3	274.4	169.0
	PP110-2/40	61	37.6	198.1	121.5
	PP110-2/50	71	47.2	248.6	152.6

[Continued on following page]

	PP110-2/60	81	57.5	302.9	185.8
220	PP220-1/38	53	34.2	180.1	110.5
	PP220-1/49	64	44.0	231.7	142.2
	PP220-1/59	74	54.1	285.0	174.8
	PP220-1/69	84	63	331.9	203.6
	PP220-1/79	94	75.4	397.0	243.7
	PP220-2/40	64	49.3	259.7	159.3
	PP220-2/50	74	59.4	312.8	192.0
	PP220-2/60	84	70.4	370.8	227.5
	PP220-2/70	94	83.0	437.3	268.2
330	PP330-1/41	60	63.4	334.0	204.0
	PP330-1/51	70	78.1	411.3	252.4
	PP330-1/61	80	98.2	-	317.5
	PP330-1/71	90	118.1	-	381.7
	PP330-1/81	100	136.8	-	442.1
	PP330-2/40	70	95.0	-	307.0
	PP330-2/50	80	112.7	-	364.2
	PP330-2/60	90	131.6	-	425.3
	PP330-2/70	100	147.6	-	477.0

In using the pivoting method the key operations (assembling the tower and raising the derrick and the tower itself) take up only 70 percent of the entire work time. The remaining time is spent on preparatory operations relating to the installation of heavy-duty anchors, the assembly of complicated rigging and the like.

The technology for erecting pylons, developed in detail by division EM-20, by the method of building up by means of self-raising UPK cranes, calls for the assembly at the planned location of structures of the tower type element by element or in consolidated sections (fig 1 [photograph not reproduced]). The sequence for erecting towers by means of a crane positioned inside the trunk of the tower is as follows (figs 2a-e):

Assembly and installation of the crane at the center of the tower to be erected, using bracing bolts.

Erection of the tower's structures to the maximum possible level when the crane is standing on the ground (the first station).

Fastening the crane to the erected structures of the tower and raising it to the next working position.

Continuation of erection of the tower's structures with repetition of the cycle of repositioning the crane (whereby at a single station the crane can have several working positions distinguished by the degree of extension of the mast from the housing).

Erection of the upper (cable) cross members by means of the crane.

Erection of the middle and lower cross members by means of a system of blocks or block-and-tackles in the case when the weight and overall dimensions of the cross members to be lifted do not conform to the crane's load characteristics.

Disassembly of the crane.

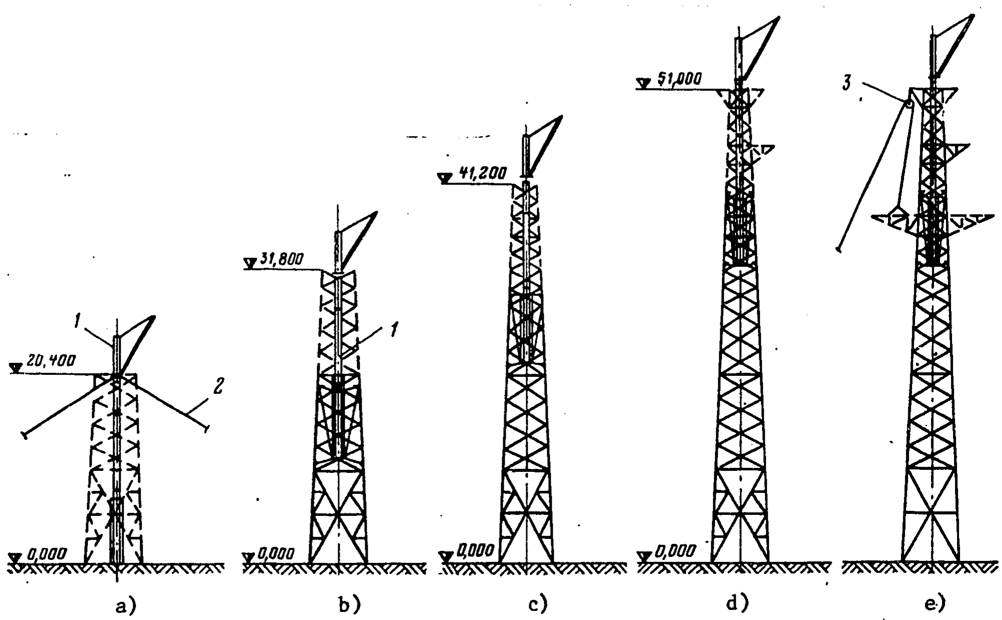


Figure 2. Sequence for the Erection of Towers by the Building Up Method by Means of a General-Purpose Suspended Crane: a-d--first to fourth crane stations, respectively; e--erection of lower cross members; 1--UPK [general-purpose suspended crane] crane; 2--temporary guys; 3--erection block

In the job performance project for each of the towers an indication is made of the number of stations and working positions of the crane, a determination is made of the design of the rigging and a precise determination is made of the places for installing erection stages on the tower. Depending on the technical characteristics of the crane, a method is adopted for consolidating elements of the tower into erection units (taking local conditions into account), the winches included in the crane's makeup are positioned, and the direction for laying out the crane before hoisting is selected.

Division EM-20 has developed the following gear and equipment for the erection of towers by the building up method:

Self-hoisting cranes with different load-lifting capacities.

Sets of suspensions, bracing bolts and stages for fastening the crane to structures of the tower being erected.

Sets of erection cradles, ladders and crossing bridges for hoisting erection personnel and enabling them to work up high.

The characteristics of cranes (depending on load-lifting capacity) designed for the erection of pylons are given in table 3.

Table 3.

Indicator	Load-lifting capacity of crane, tons			
	2	2.5	3	5
Maximum radius of operation of boom, m	8	15	11.9	15.5
Cross section of mast, mm	650 X 650	1300 X 1300	1300 X 1300	1500 X 1500
Weight, tons	7.5	12.5	19	28

A quite important stage in the development of the construction of pylons was the unification of structures of pylons 100 m high for 110, 220 and 330 kV overhead lines, performed first in 1971 by the Northwest Division of the Energoset'proyekt [All-Union State Planning, Surveying and Scientific Research Institute of Power Systems and Electric Power Networks] Institute. In designing pylons a number of solutions were provided which were successful from the viewpoint of erection technology feasibility. For example, the same geometrical layouts were used for the trunk for single-circuit and double-circuit towers of each voltage class, and common cross members and upper sections of the trunk were used for all towers of the same voltage.

Included in the unification were seven types of towers weighing up to 57.5 tons for 110 kV overhead lines, nine types of towers weighing up to 83 tons for 220 kV overhead lines and nine types of towers weighing up to 147.6 tons for 330 kV overhead lines. The number of sections in a single tower does not exceed 11 and the weight of the heaviest element of a tower is 1384 kg. Connection of elements of towers is provided for with bolts of normal precision. The number of bolts for a single tower for 110 kV overhead lines reaches 2250, 3250 for 220 kV overhead lines and 7750 for 330 kV overhead lines. It is necessary to mention certain disadvantages of these towers: The upper sections were designed as welded sections, which excluded the possibility of placing the erection gear inside the trunk; the eight-bolt feet used for a number of towers were very inconvenient under conditions of raising by the pivoting method, since thereby the design of the erection hinge was complicated considerably.

Division EM-20 has developed technological systems for the erection of unified towers. The basic job performance methods have been selected to take into account the following basic requirements:

The use of a unified simplified method of erection for the greatest number of types of towers and its mastery by line workers (in trusts of the USSR Ministry of Power and Electrification there are still no specialized subdivisions for the erection of pylons).

The use of identical equipment for installing pylons of various types.

The use of special equipment which is not only for the erection of towers with this kind of unification, which will make possible its repeated use.

These requirements are met to the greatest extent by the method of vertical building up by means of a crane placed inside the tower's trunk and by the method of pivoting by means of a dropping derrick.

Calculations of the major stresses and a comparative analysis of methods of erection have demonstrated that for installing towers of all types for 110 to 220 kV overhead lines and the lightest for 330 kV overhead lines it is advisable to use as the basic method the method of pivoting by means of an A-shaped dropping derrick with a maximum height of 45 m and a maximum load-lifting capacity of 80 tons. The derrick design developed by the division is supplied with a dropping unit which makes it possible to eliminate the added load on the pulling cable after the derrick goes out of operation, which is especially important when using heavy derricks.

For the convenience of pivoting towers with an eight-bolt foot it is recommended that the anchor bolts be replaced by studs by means of which the foot is fastened to the foundation after the tower is installed in the planned position. The studs in terms of design represent an extension of the stems of the anchor bolts and are connected to them with a thread by means of connecting pieces which are embedded in the concrete of the foundation. In this case the hinge for raising the tower has the following form (fig 3): Its lower half is fastened in the foundation's concrete, and its upper half is welded to the tower's foot. The studs are installed after the tower is raised. This solution was tested in raising the towers at the Yermakovskaya GRES - Rubtsovskaya Substation 500-kV-overhead-line crossing across the Irtysh River.

In keeping with the technological methods, erection by the building up method by means of a crane with a load-lifting capacity maximum of two tons with a boom radius of rotation of 8 m is recommended for the most heavy 330 kV overhead line towers (when they are raised by the pivoting method the tractive forces equal more than 1800 kN, and forces in the derrick up to 1500 kN), as well as for all towers installed under constrained conditions when it is impossible to lay them out on the ground. In order to make possible the conditions required for the crane's operation, it is suggested that the upper welded sections of towers be replaced by bolted.

Further improvement of the technology for erecting pylons involves the introduction of new constructions--towers of the "rocker" type. Their characteristic feature consists in the fact that they do not possess stability until the lightning protection cables and wires are installed.

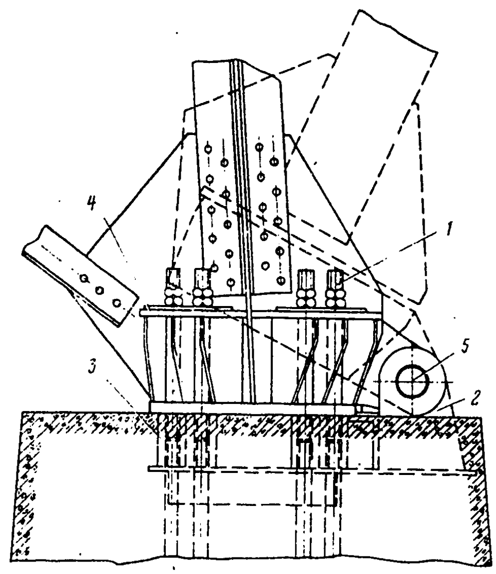


Figure 3. Construction of Pylon Foot with Erection Hinge Elements: 1--studs; 2--lower half of hinge; 3--connecting piece; 4--foot of tower with hinge element; 5--axis of hinge

At the Pechora-Usinsk 220 kV overhead line crossings across the Pechora River, as well as the Kashin-Kalyazin 110 kV overhead lines across the Volga, the raising of A-shaped towers of the "rocker" type was accomplished by the pivoting method together with the lightning protection cables attached to them. In 1979 for the Mary-Karakul' 500 kV overhead line across the Amu Dar'ya the division for the first time suggested the method of erecting a "rocker" pylon by the building up method. The height of this tower equals 120 m and it weighs 170 tons. The construction is supported by a joint at a single point. Along the axis of the overhead line its stability in use is ensured by the pull of supporting cables fastened to the upper cross member. In the transverse direction, only a single stage of guys was installed, 90 m from the ground.

As a result of comparing tower installation variants using the pivoting and building up methods, erection by means of a self-hoisting crane, with a load-lifting capacity of 2 tons (fig 4), was acknowledged as feasible. The tower is restrained vertically by a system of erection guys installed in five stages as it is assembled.

Used as erection guys is the cable used for the permanent guys of the ordinary intermediate supports for this overhead line.

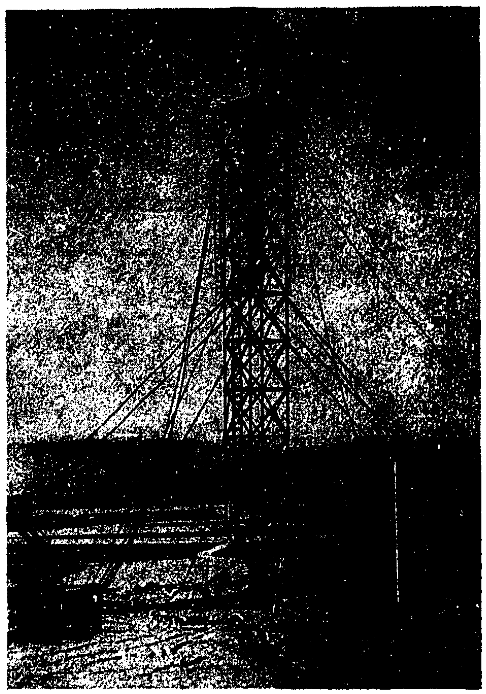


Figure 4. Erection of Rocking Pylon by Means of a Self-Propelled Crane with a Load-Lifting Capacity of Two Tons at the Mary GRES - Karakul' 500 kV Overhead Line Crossing Across the Amu Dar'ya River

The employment of this variant made it possible to refrain from preparing heavy-duty rigging and from installing heavy anchors, as well as a complicated system for protecting the foundation from displacement, which is necessary when raising a tower by the pivoting method.

Construction of the Mary-Karakul' 500 kV overhead line crossing across the Amu Dar'ya was accomplished by Mechanized Column No 37 of the Spetsset'stroy Trust, in whose production workshops the crane and necessary rigging were made.

The knowhow gained in the development by division EM-20 of methods of erecting pylons confirmed the possibility of creating standard systems (upon the condition of the unification of pylons) with the development of a unified operating technology and the use of standard rigging. Unified structures should be developed by taking into account the conditions of erection by the methods of pivoting and building up.

In installing towers by the pivoting method the basic requirement is ensuring sufficient strength for the elements to which the rigging is fastened and the creation of a convenient design for the supporting foot. For towers to be assembled by the building up method the key requirements are division into elements to conform with the load-lifting capacity of the crane, simplicity of connection, and ensuring overall dimensions sufficient for positioning the erection crane while maintaining the required rigidity of the cross section.

It is necessary to unify 500 kV overhead line pylons. The requirements for towers constructed both by the pivoting method and the building up method, using UPK cranes, should be taken into account in designs.

The observance of these requirements will make it possible to reduce the number of technological systems and to proceed to the unification of rigging and erection equipment, which will be conducive to a growth in labor productivity and to speeding up the construction of crossings.

8831
CSO: 1822

ELECTRIC POWER

UDC 621.311:33:658.314.72

IMPROVED PLANNING, MANAGEMENT OF PRODUCTION OF POWER

Moscow ELEKTRICHESKIYE STANTSII in Russian No 10, Oct 80 pp 2-3

[Article by Deputy Chief of the Main Planning and Economic Administration of the USSR Ministry of Power Engineering V. A. Verzhbitskiy]

[Text] By resolution of the Central Committee of the CPSU and the USSR Council of Ministers of 12 July 1979 "On improving the planning and intensifiying the effect of the management mechanism on improving the efficiency of production and quality of work," in view of the peculiarities of power production, power engineering has been separated into a special series of branches which are to establish the planning indexes and economic normatives considering their specific nature.

Accordingly, by resolution of the USSR Ministry of Power Engineering, planning indexes and economic normatives have been developed considering the results of economic experimentation in recent years aimed at saving fuel and energy resources.

At the present time the USSR Gosplan has investigated and approved the proposals of the USSR Ministry of Power Engineering with respect to establishment of the basic planning indexes and economic normatives which, considering the specific nature of the branch, more correctly reflect, as the indicated resolution requires, the production dynamics, the growth of the productivity of labor and production efficiency, and the contribution of the collectives to the achievement of the final results of the work.

As the basic planning index for the branch as a whole, the generation of electric power expressed in natural units is used. The given index characterizes the power potential of the country; its planned value determines the demand of the branch for fuel resources, the volume of new production capacity put into operation, and the necessity for reconstruction of equipment.

The volume of electric power production will be planned with respect to the branch as a whole and also with respect to the ministries of the union republics and the main operating administrations. The establishment of this index as the plan for the main production administrations, power systems and electric power plants would lead to an effort by the collectives to insure fulfillment of the plan at any price without considering the possible unloading of low-economical equipment. The primary goal here should be an effort by the collectives to maintain readiness of the equipment for carrying the electric load so that the agencies of the Central Dispatch Administration of the Integrated Power System of the Country (TsDU YeES

SSSR) have the possibility of assigning the load chart for the equipment and covering the electic load beginning with optimization with respect to fuel consumption.

The experience in planning and evaluating the operation of the power systems and the electric power plants with respect to the availability index of the equipment for carrying the load instead of the production volume has justified itself in practice; therefore for the main production administrations, power systems and electric power plants, the equipment availability index for carrying the electric load remains as the planning index. Simultaneously it has been recognized as expedient more precisely to define the procedure of estimating availability in order to increase the responsibility of the collectives for covering the maximum loads.

For the ministries of the union republics, the main operating administrations, the main production administrations of the union republics, interrepublic and intermain administration crossfeeding of electric power and release of electric power for export has been established as the planning indexes. The plan for releasing electric power for export must also be established for the power systems.

The most important planning index on all levels of administration both for the branch as a whole and for the associations and the electric power plants remains the specific fuel consumption for the electric power released from the buses and released from the thermal power collectors. The index of the level of specific fuel consumption is one of the main quality indexes characterizing the operation of the branch as a whole and individual collectives. For the electric power plant, in addition to the absolute magnitude of the specific fuel consumption, the assignment will also be established with respect to reducing the break between the normative and the actual specific fuel consumptions. This will permit more correct evaluation of the results of operating the electric power plant collectives, exclusion of the subjective factors influencing the absolute magnitude of the specific fuel consumptions.

The approved index remains the process consumption of electric and thermal power connected with its transport to the user. This index is confirmed on all levels of administration from the ministry as a whole to the power systems, the enterprises of the electrical and thermal networks. In the absence of electrical and thermal networks at the enterprises to account for the process consumption of electrical and thermal power it is necessary to plan measures to reduce the process consumption. In this case the fulfillment of the plan with respect to the indicated indexes will be taken into account with respect to the power system as a whole.

The electric power consumption for the inhouse needs of the electric power plants, production needs, release of thermal power (except the Ministry of Power Engineering as a whole) remain calculated indexes.

Considering the specific nature of the branch, the "productivity of labor" index with respect to the USSR Ministry of Power Engineering as a whole remains as the calculated index. The productivity of labor is defined for the branch as the ratio of the volume of normative net production output to the total number of industrial-production personnel. Analogously, also for the ministeries of the union republics and the main operating administrations. For the main production administrations, power systems, electric power plants, enterprises of the electric and thermal networks the productivity of labor will be an approved index. As the index characterizing the productivity of labor, the service coefficient has been established, that is, the ratio of the provisional (reduced) power of the equipment to the number of workers. The growth of the service coefficient will also characterize the growth of the productivity of labor.

The general wage fund and the limit of the number of industrial and office workers have been established for all levels of administration. The number of personnel are calculated on the basis of the normatives. The indexes with respect to capital construction, with respect to introduction of new equipment and advanced experience and material and technical support and finances will be planned by analogy with other branches of the national economy.

The "total sum of the profits" index remains as the generalizing index characterizing the effectiveness of the use of the labor, material and other resources from the branch as a whole to the power systems inclusively. It reflects the final results of the production-economic activity of the collectives. However, taking into account the fact that the electric power plants, the enterprises of the electrical and thermal networks and other production podrazdeleniye function as part of the power systems as production units, instead of profits, the planning of provisionally constant expenditures on the cost of production and the transmission of electric and thermal power determined on the basis of the normative is retained for them.

The primary goal of the branch is provision for the demands of the national economy for electric and thermal power. Therefore it has been recognized as expedient to leave to the USSR Ministry of Power Engineering the authority to introduce changes into the planning indexes at the end of the month and the quarter which are derived from the actual level of electrical and thermal power consumption and the hydrometeorological conditions. The granting of the authority to the USSR Ministry of Power Engineering to introduce changes in the planning indexes does not mean that they must be corrected under the actual level.

The theoretically new thing in the problems of improvement of planning is improvement of the responsibility of the collectives for the fulfillment of the planning indexes. For this purpose provision is made for transition to the normative method of planning, establishment of the planning indexes not from what has been achieved but considering what has been achieved, on the basis of the norms and normatives and engineering calculations. This improves the level of planning, and it raises the responsibility of the collectives in the matter of compiling the plans.

On deviation of the indexes adopted in the calculation during the year, it is necessary to introduce changes to the plan beginning with the approved normatives. Thus, for example, it is necessary more precisely to define the planning assignments with respect to the specific consumption of provisional fuel as a function of variation of the proportion of generation for heat consumption, the structure of generation and the fuel structure.

The draft of the procedural proposals with respect to more precise definition of the specific fuel consumptions for the ministries of the union republics and main production administrations has been developed and approved with more precise determination of the specific consumptions in the second quarter of the current year. It is necessary that the main operating administrations, the main production administrations, and the ministries of the union republics develop the corresponding normatives for the power systems, and the latter, for the electric power plants.

This permits us to exclude cases where the electric power plants and power systems not providing for the generation of electric power are in a more advantageous position with the fulfullment of the assignments with respect to specific fuel consumption by comparison with the collectives overfulfilling the production plans.

At the present time a developed plan for the organizational, economic, technical and social measures aimed at improving planning and raising the efficiency of production and quality of labor has been developed and approved by order of the Ministry No 129, 27 March 1980.

Among the organizational measures, important significance is attached to the improvement of the administration both in the area of operational activity and in capital construction so that in the next two years the transition will be made to the two-element and three-element structure of administering the branch.

In order to raise the scientific level of planning, scientifically substantiated norms and normatives must be developed for the operating and repair servicing of equipment, consolidated norms for the specific capital investments in power engineering and the construction industry, and norms for the consumption of manpower. A special role is played by the problems of transition to the normative method of planning and the development of procedural principles.

The measures provide for improvement of the planning and economic calculation of the associated dispatch administrations, the Central Dispatch Administration of the Integrated Power System of the USSR, repair enterprises, scientific research and planning and design organizations aimed at achieving high final results of the operation of the branch.

Provision is made for closer relation between the results of the production-economic activity and the material incentive funds of the collectives.

Computer engineering, the development and introduction of the subsystem for technical-economic planning have found broad application in the solution of the stated problems. The improvement of planning and the management mechanism requires adjustment of the obsolete, customary methods of operation.

There is still much to do on all levels of administration so that the new management mechanism will begin to operate with full strength in the Eleventh Five Year Plan.

10845
CSO: 1822

ELECTRIC POWER

UDC 621.31:061.6

ENERGOSET'PROYEKT INSTITUTE AND POWER LINE CONSTRUCTION

Moscow ELECTRICHESKIYE STANSII in Russian No 10, Oct 80 pp 4-9

[Article by L. L. Peterson, Director of the Energoset'proyekt Institute]

[Text] Large-scale qualitative shifts in the development of electric power engineering at the beginning of the 1960's are being connected with a sharp rise in the level of electrification of the national economy of the country, an increase in unit power of the power units and electric power plants, the beginning of the formation of associated power systems and the Integrated Power System of the European Part of the Country, structural changes in the fuel and energy balance of the USSR. The objective necessity arose for the creation of a complex scientific research and planning and design institute which would take on the performance of deep research in the field of electric power engineering in close connection with the development of electrification and the fuel and energy balance, the formation of the basic areas of development of power engineering of the country, insurance of a united technical policy when designing the power systems and the electric network projects and also the creation of specific plans for electric power transmission lines, substations and means of providing for the functioning of the power systems (relay protection, emergency automation, communications, and so on). The Energoset'proyekt Institute created in 1962 has been recognized as such an institute.

The Energoset'proyekt Institute realizes the functions of the main planning organization in the field of developments of technical areas of construction of 110 kv electric networks and higher, including the development of normative materials, standard plans, standardization of structural elements and other problems. The activity of the institute encompasses the entire territory of the USSR; a number of important projects have been carried out for many foreign countries.

Power engineering science at the Energoset'proyekt Institute has developed with respect to the following basic and interrelated areas: the investigation and substantiation of the paths of development and the depths of electrification of the country and the scales of consumption of electric power; substantiation of the prospects for the development of the fuel and power engineering complex (TEK) and the fuel supply of the electric plants; substantiation and prediction of the prospective development of the branch and its technological process structure; substantiation of the paths of formation of the Integrated Electric Power System and individual power systems of the country, the creation of superhigh voltage ac and dc electric power transmission lines.

The goal of the studies was insurance of an all-around approach to the prediction, planning and design of power administrations, the de-lopment and inspection of the optimal structural and technical solutions in the field. This insures an increase in the overall national economic and branch effectiveness of electric power engineering and intensification of this influence on the development of the effectiveness of all social production. The importance of the adopted scientific areas is confirmed by the fact that beginning in 1970, the majority of them were realized under the direction of the Energoset'proyekt Institute on an all-union scale within the framework of the state plans for the most important scientific and engineering problems.

Beginning with the known Leninist principles of electrification, the relation was discovered between the level of electrification and the development of the technological structure of social production. This served as a basis for the development of new methods of predicting electrification in which special attention has been given to the study of the main areas required for the solution of the problems of economic growth advanced by the 25th Congress of the CPSU, such as improvement of the productivity of labor and quality of production, turning to the material-economizing direction of development of the economy, the realization of structural shifts in the TEK, and making the use of power more efficient.

The characteristic feature of the study of the TEK -- one of the capital-consuming elements of the national economy -- is the systems approach by which all branches of the fuel and power industry were considered in organic unity with the development of the national economy and levels of electrification. This approach made it possible to develop a number of methods of predicting the power consumption, providing for the prediction of the TEK and its individual elements in close ralation to the overall national economic criterion of optimalness.

As a result of the studies conducted jointly with the Siberian Power Engineering Institute of the USSR Academy of Sciences and the High Temperatures Institute, basic areas of development of the TEK were opened up, and some general trends of this development consisting in improving the level of electrification and motorization of the national economy, the proportion of energy used in converted and refined form, and so on were discovered. The necessity for a large break in the structure of the TEK was substantiated, the essence of which consists in insuring the leading development of nuclear power engineering, the coal industry and broad, all-around hydroelectric power construction. All of this has permitted the Energoset'yekt Institute to solve the problems of the fuel supply for the electric power plants, the structure of the power capacities, the scales of development of nuclear power plants, hydroelectric power plants, district heating and centralized heat supply in a substantiated manner.

The studies in the field of the prospects of electric power engineering made it possible to find a long-range strategy for the development of the branch and its technological structure considering the future levels of electrification, the conditions of electric power supply to the national economy, the development of new equipment, the problems of saving the energy resources and also increasing the role of ecologic factors. The role of individual types of power sources as a whole and in the large power associations was discovered; it was demonstrated that with limited oil and gas fuel, the versions of the development of the structure of the power capacities will depend on the possibilities and the effectiveness of the development of nuclear power engineering, large power complexes based on strip-mined coal in the eastern regions and long-distance transmission of electric power. In connection with the growing role of the nuclear power plants, special attention has been given to the strategy for their development -- their internal structure, location, use for heating, the creation of specialized large-scale nuclear power complexes, the combination of nuclear power plants with pumped storage hydroelectric power plants.

The studies in the field of electrification, the TEK and electric power engineering have made it possible to solve a number of large-scale national economic problems: they have promoted the accelerated development of the nuclear power plants, the creation of the Ekibastuz and the Kansko-Achinskiy power engineering complexes, the construction of the Ekibastuz-Tsentr electric power transmission lines measures for economy of high-quality fuel as a result of displacement of it by electric power.

In the TEK area, a thrust will be made toward the study of the electric power plants for fuel considering their regime characteristics, which will permit optimal inscription of electric power engineering in the overall TEK system, and it will make it possible to make specific recommendations with respect to the structure of fuel use in the branch. In the studies of electric power engineering attention will be given to the development of the theoretical strategy for gradual conversion of the branch to a new technical level and structure of power sources.

The scientific research and the planning of the development of the power systems, including the integrated power system of the Soviet Union (YeES SSSR) have the most important significance in the activity of the institute. At the present time the integrated power system encompasses the territory from Transbaykal to the western boundaries. Only the united power systems of Central Asia and the Far East and also a number of power systems and hydroengineering complexes located in remote areas operate in isolation. The installed capacity of the electric power plants of the integrated power system of the USSR at the beginning of 1980 reached 211.5 million kilowatts, which is 83% of the power of all the electric power plants of the country; the electric power generated in the integrated power system has reached about 89% of the all-union total.

Section of a 750 kv outdoor distribution station.

A qualitatively new phase in the development of the integrated power system of the USSR was the inclusion of the united power systems and the member countries of the CEMA in parallel operation at the beginning of 1979 on the 750 kv line from Vinnitsa to the Western Ukranian substation (USSR) to Al'bertirsh (Hungarian People's Republic).

The creation and the successive development of the integrated power system of the USSR already at this time has made it possible to obtain a significant technical-economic benefit. As a result of matching the load peaks of the individual power systems located in different time zones alone, in 1979 the savings of capacity of the electric power plants reached approximately 10 billion kilowatts.

The operation of the electric power plants in a large power association permits use of them in the most economical mode, which insures an unswerving reduction in the specific fuel consumptions. In 1971-1979, the specific consumption of fuel for the electric power released from the heat of electric power plants to the integrated power system dropped by 36 g/(kilowatt-hour) (from 364 to 328), which gave a savings of more than 100 million tons of provisional fuel. More than 60% of this was provided by systematic improvement of the electric power generation structure. The possibility of operative exchange of electric power between the individual areas provided by the integrated electric network permits the fuel resources to be maneuvered and short forms of fuel to be saved.

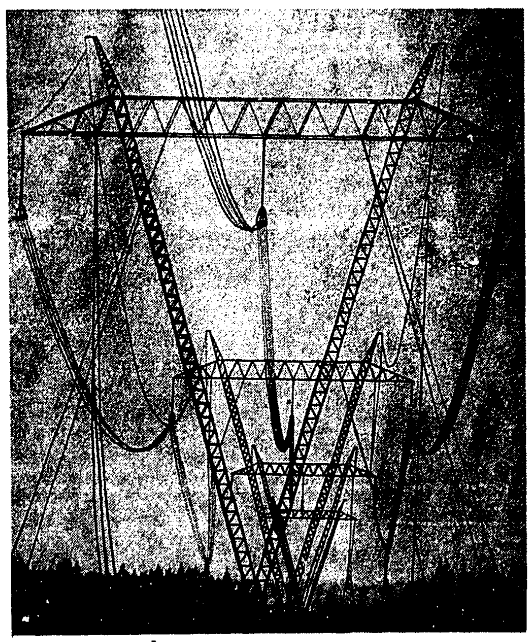
The stressed creative labor of the institute collective is aimed at finding further means of improving the efficiency, reliability and insuring the possibility of broad maneuvering of the power resources in the integrated power system of the USSR. Here the problems of increasing the carrying capacity of the basic electric network, the introduction of new 750 and 1150 kv ac and 1500 kv dc stages and also the placement and the operating conditions of the electric power plant have the greatest significance.

At the institute there is a structured hierarchical system for planning all stages of the integrated power system of the USSR from the systems for outside electric power supply to the individual hydroengineering complexes, the large industrial enterprises and other projects to the systems for development of regional and united power systems and the integrated power system of the USSR as a whole. The work that has been done is being used as the initial material for planning power construction, and it also serves as the basis for planning and design of the electric power plants, the electric network projects, relay protection, emergency automation, organization of operation and maintenance and other measures insuring reliable functioning of all elements in the power management of the country.

The length of the 35 kv electric networks and networks with higher voltage in the Soviet Union at the beginning of 1980 exceeded 735,000 km, and the installed transformer capacity exceeded 600,000 MV-A. In the Ninth and the Tenth Five Year Plans, 30,000 to 32,000 km of 35 kv lines and lines with higher voltage and about 30,000 MV·A of transformer capacity are being introduced annually.

In order to support the electric network construction, the institute is planning more than 3000 projects per year, including about 1500 electric power transmission lines and 35 kv and higher substations.

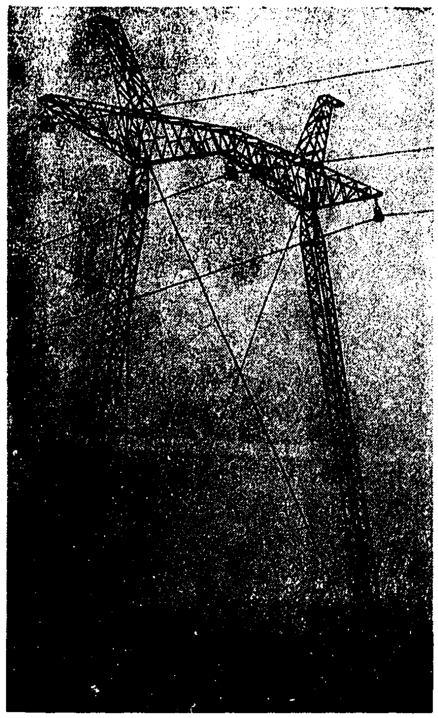
By the Energoset'proyekt Institute plans, the first electric power transmission lines and substations operating at 500 kv in the world were built, and at the present time the extent of the VL-500 [500 kv overhead electric power transmission lines] has reached more than 23,000 km. The first high-altitude 500 kv lines have been planned and built for distribution of the power from the Toktogul'skaya hydroelectric power plant, the routes of which were laid through inaccessible mountainous regions at altitudes of more than 3000 meters above sealevel. The construction of these unique lines required the solution of many scientific and technical problems and the performance of an enormous amount of planning research and construction-installation operations under exceptionally severe natural conditions.



Section of the 750 kv overhead line from Konakovo to Leningrad with intermediate supports of the Nabla type.

The planning of the 110-500 kv electric networks under the severe conditions of the North, through bogs and permafrost for support of the construction of the BAM railroad, the exploitation of the oil and gas-extracting fields of the Tyumen' oblast where the northernmost electric transmission line from Surgut to Urengoy was constructed has been accomplished. Among the largest, most important plans it is necessary to mention the first 750 kv industrial lines in Europe: Donbass-Zapad, Konakovo-Leningrad and also the Western Ukrainian substation (USSR) to Al'bertirsha (Hungarian People's Republic), which is the first line of this voltage class providing a reliable electrical coupling between the integrated power system of the USSR and the power systems of the CEMA member-countries.

In recent years plans have been developed for unique superhigh voltage ac 1150 kv electric power transmission lines, the construction of which will develop in the 11th Five-Year Plan.



Intermediate guyed support.

In order to provide for the broad construction of 1150 kv electric power transmission lines in 1973, an experimental 1150 kv unit was put into operation at the Belyy Rast substation, and the construction of an experimental-industrial 1150 kv electric power transmission line from Itat to Novokuznetsk was started.

In 1978 the TEO of the first industrial 1150 kv electric power transmission line in the world was developed. This line connects the power system of Siberia, Kazakhstan and the Urals. The creation of industrial power transmission lines has required the performance of a large amount of scientific research and design work. For the first time in the world a set of units for the new 1150 kv voltage class was built according to the technical specifications developed at the Energoset'proyekt Institute. A number of new technical solutions were developed with respect to the circuitry-regime part: single-stage voltage regulation on the autotransformers, a system for protection from internal overvoltages, devices for insuring single phase and high speed automatic reclosure (OAPV, BAPV), and so on. A theoretically new design was developed for the 1150 kv distribution station corresponding to the modern requirements of operating safety of superhigh voltage substations. When developing the plants, special attention was given to the ecologic safety of the 1150 kv lines. A phase consisting of eight wires was used for the first time for the 1150 kv overhead line.

The dc transmission lines are highly effective means of transporting large masses of energy to long and superlong distances.

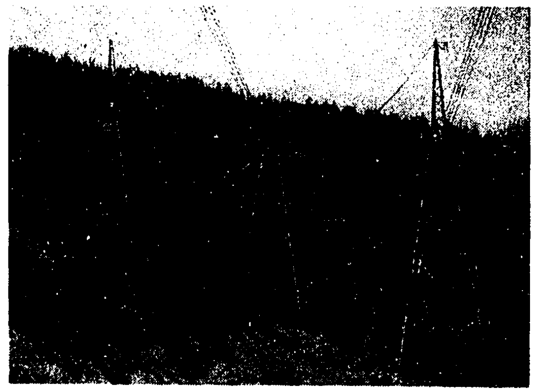
In 1962-1965, according to the ODP plan of the Energoset'proyekt Institute, the 800 kv dc electric power transmission line was built from Volgograd to Donbass, a distance of 473 km, equipped with mercury valves built in the Soviet Union. It was highly instrumental in accumulating experience in the development of the conversion equipment, the planning and design, installation and operation of more powerful and longer dc electric power transmission lines planned for construction in the near future.

For transmission of power from the regions of Northern Kazakhstan and Central Siberia rich in fuel resources, it is necessary to build superpowerful 1500-2250 kv dc transmission lines. The first of them is the most powerful and longest 1500 kv electric power transmission line in the world, which is being built from Ekibastuz to Tsentr (6 million kilowatts, 2415 km). The construction and the experience in the operation of this transmission line will have enormous significance for the further development of dc power transmission in the USSR.

The institute will perform a large amount of work for the creation and introduction of new technical solutions providing for reduction of capital expenditures, savings of basic materials and a decrease in labor expenditures during construction. Examples of these solutions are the reinforced conctrete supports developed for the first time in the world for the 220, 330 and 500 kv overhead lines. Broad application of reinforced concrete supports by comparison with steel supports offers a sharp (almost two-fold) reduction in labor expenditures for the manufacture, installation and operation of these supports along with savings of deficit steel. On the basis of the recently developed centrifuged reinforced concrete stanchion 800 mm in diameter, new structural designs have been created for the guyed and special supports for the 110-330 kv overhead lines. The introduction of these supports to replace the steel supports insures an annual savings of steel of 6500 tons, labor savings of 54,000 man-days and capital expenditures of 1.4 million rubles saved. Considering the ever-increasing volume of construction of the 750 kv overhead lines in the European part of the USSR, improved structural designs have been developed for the intermediate steel supports offering the possibility of reducing the steel consumption by approximately 10%. These structural designs have taken as the basis for the development of 750 kv standard supports. Along with the guyed supports, freestanding reinforced concrete supports for 500 kv lines installed in drilled holes have been created. This has made it possible to use them in cultivated fields with minimum loss to agriculture.

The institute has performed a large amount of work with respect to creating new structural designs of foundations for supporting the overhead lines and the structural designs of substations built under complex ground conditions. Foundations have been developed and are being introduced for permafrost and heaved ground: surface, slightly buried, in the form of screw pilings, guys, and so on.

In the plans for the 35-220 kv substations the institute considers the primary thing to be insurance of maximum industrialization of construction by the application of plant-manufactured individual elements and substations as a whole. Jointly with the Orgenergostroy and the Kuybyshev Elektroshchit plant, complete 35-110 kv substations (KTPB) have been built and are widely introduced. They are delivered to the site



Section of the 750 kv overhead line in the Carpathians.

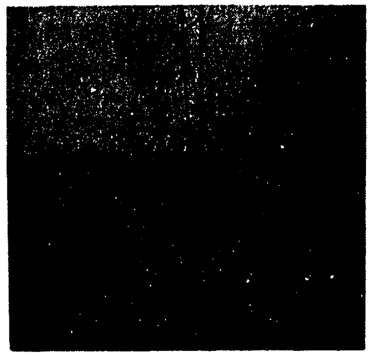
in individual prefabricated modules. The KTPB nomenclature is still limited, and further intense work is required with respect to the production of such substations for the northern areas, areas with atmospheric pollution, and so on. Jointly with the Elektrouralmontazh trust, the institute is developing and introducing large portable modules (UPB) of individual structures installed at the plant and delivered to the site in assembled form. At the present time the trust is producing modules for indoor 6-10 kv distribution stations, control panels, compressor stations, and so on.

For industrialization of the construction of buildings at the substations the institute jointly with the Energotekhprom trust has developed designs for quickly installable buildings (BMZ) assembled from individual plant-manufactured sections delivered to the site in assembled form ready for installation. A standard design has been developed with the application of the BMZ for in practice all structures of the 35-220 kv substations.

The broad application of the KTPB, UPB and BMZ offers the possibility of significant reduction of the labor expenditures for the construction and installation of the substations and also improvement of the quality of construction.

The institute is performing a large amount of work with the enterprises of the Minelektrotekhprom for the creation and the assimilation of the complete distribution stations with elegas insulation (KRUE) for substations built in large cities and also for superhigh voltage substations to 1150 kv, inclusively. According to the institute plan, the first Yelokhovskaya substation has already been built using the KRUE 110 and 220 kv of the Leningrad Elektroapparat NPO. The broad introduction of the KRUE when building the substation permits reduction of the volumes and the area of the buildings for the indoor substations in large cities by several times, and reduction of the area for the outdoor distribution stations of the superhigh voltage substations by tens of tons.

As a result of introducing the presented and other advanced technical solutions in the Tenth Five-Year Plan, 27,000 tons of steel, 10,000 to 15,000 tons of cement and 400,000 to 500,000 man-days are saved annually.



Surface foundations.

When preparing the plan for the development and introduction of new technical solutions in the 11th Five-Year Plan, a special complex program was developed at the institute. This program provided for the compiling of a list and calendar plan for the introduction of new technical solutions, compilation of technical documents with respect to each topic in full volume, including the technical-economic indexes, the problems of organizing construction and performance of operations, and so on.

The annual fulfillment of the plans for the construction of more than 3000 electric power network projects is impossible without broad application of standard plans with respect to all areas of technical activity of the institute. More than 300 standard plans for different buildings, structures, supports and foundations have been developed and are in operation at the institute. The work has begun on the creation of a new series of standardized supports for the 35-750 kv overhead lines, which must be introduced in the 11th Five-Year Plan.

In order to reduce the volume of estimate documents and simplify the calculations of the construction organizations for the performed operations, the institute has developed, agreed on an approved price list and consolidated cost indexes for constructing the various projects of the electrical networks which encompass up to 70% of all of the electric network construction.

At the institute a great deal of work is being done to improve the quality of planning and design. A complex quality control system for technical documentation (KS UKTD) has been created. In the last years of the 10th Five-Year Plan a number of plans over the limit approved by the USSR Ministry of Power Engineering with excellent quality increased and reached 52%. However, there are great reserves for further improvement of quality and improvement of the technical-economic indexes of the produced plans which undoubtedly will be implemented.

The reliable operation of the power systems cannot be insured without the use of means of improving stability and carrying capacity of the electric network and also relay protection and emergency automation. The role of these means combined into united complexes when designing, increased significantly in connection with an increase in the unit power of the power units and the electric power plants, the creation of long-range high and superhigh voltage electric power transmission lines and the integrated power system of the USSR. The institute is conducting scientific research and development of effective principles of the construction of these complexes, hierarchical structures combining them into systems and also technical means required for their realization.

One of the first results of the work in this field was the creation and introduction of such complexes on the 500 kv electric power transmission lines from Kuybyshev to Moscow and Volgograd to Moscow and later on other 330-500 kv electric power transmission lines. The work with respect to improving this complex performed on the basis of the electromechanical relays permitted significant improvement of its characteristics, and it is being used to the present time. In addition, the institute jointly with other organizations and industry has developed a new complex based on semiconductors and microelectronics, which has significantly improved characteristics.

The emergency automation as a complicated complex of hierarchical centralized systems and local devices functionally connected by means of remote information transmission channels was formed in the last 15 or 20 years, and the leading role belongs to the institute in its formation, the development of the principles and methods of calculation. The institute has developed a series of emergency control complexes using the most modern principles and technical means. According to the operating index the introduction to the operation and maintenance of the emergency control complexes has permitted an increase in carrying capacity of the intersystem couplings of the integrated power system of the USSR by 7 million kilowatts.

The work of the institute to create guidance instructions with respect to relay protection which are the basic document in the formation of the technical policy within the scales of the entire country must be noted. Along with the fulfillment of important planning operations, the problems of the institute for the 11th Five-Year Plan in the field of relay protection, emergency automation and stability are as follows: completion of the development of protection complexes and emergency automation based on using the achievements in the field of microelectronics and their introduction into design practice; studies and development of the principles of executing relay protection and emergency automation systems using microcomputers; the study of the possibility of computing protection which depends little on the operating conditions of the electric power transmission lines; the development and investigation of measures and means of increasing the carrying capacity and the stability of the electric power transmission line; the study and development of the hierarchical structure of the emergency automation system of the USSR integrated power system providing for minimimization of losses, the creation of an automated design system, and, above all, the set of problems of selecting the settings of the relay protection devices and emergency automation, batching of the control inputs and the regions of stability of the power systems.

The Energoset'proyekt Institute is the head organization for the design of the Energiya OASU [branch automated control system].

During the 9th and 10th Five-Year Plans scientific research and planning and design work was done aimed at the creation and development of:

The Energiya OASU;

Automated power system control systems (ASU ES);

Automated dispatch control systems (ASDU);

Automated technological process control systems (ASU TP).

During the same period, 43 automated power system control systems were turned over for industrial operation which had been created by the plans of the institute. The annual cost benefit from introducing the indicated ASU [automated control systems] was 16 million rubles.

The institute is developing the software and information support for the automated control systems of the power systems with respect to nine subsystems (37 sets of problems), and as the main developer of the work it is coordinating 26 other organizations with respect to 11 subsystems of the thematic (120 sets of problems).

The 11th Five-Year Plan calls for continuing the design of the control centers, the data gathering and transmission systems and the development of software and information support for the automated control systems for the power systems as applied to the highest degree of development of the methods and the means and systems of control and their integration.

An important area of activity of the institute is the creation of automated dispatch control systems (ASDU) and also the automated regime control systems with respect to frequency and active power (SARChM). The central dispatch station on the USSR integrated electric power system and the dispatch stations of the united power systems have been built in accordance with the plans of the institute, redesigned and equipped.

In the Tenth Five-Year Plan the first phases of the ASDU TsDU YeES SSSR, the 9th united and 34th regional power systems were put into operation. The SARChM providing for regulation and limitation of the cross transfer of power over the most important links were also introduced into operation, which permits their actual carrying capacity to be increased by 10-15%. In the 11th Five-Year Plan work is to be done for further improvement of the control means for the integrated power systems and separate projects of it. For this purpose an operations programmed is being implemented for the construction and the small-series production of a number of nonstandard technical means of the control systems.

In order to increase the effectiveness of performing the research, the planning and design and scientific research work at the institute, its departments and the OKP, 15 computers (YeS [integrated system] and BESM type) and 22 small computers are being used. About 500 programs are being executed. Broader and broader use is being made of plotters to construct the overhead electric power transmission line profiles. For example, at the Northwestern Department of the institute in 1979 a plotter was used to construct 1500 km of profiles for high voltage electric power transmission lines.

The technical base for the ASU and the SAPR of the institute must become the computer center network of the institute equipped with computers outfitted with plotters and displays based on the data transmission network created at the present time.

Further improvement of planning genuinely requires the creation of a network of group computer centers (KVTs) of the Glavniiproyekt Institute. At the present time the first VTs of the Glavniiproyekt organizations in Tashkent equipped with the

YeS-1052 computers has been created on the basis of a division of the Energoset'-proyekt Institute.

The implementation of the plans for the development and introduction of automatic control systems and SAPR of the institute will permit the planned production to be raised to a qualitatively higher level.

The creation of the integrated power system of the USSR, the introduction of automated and automatic power engineering control systems, including the emergency automation and relay protection systems, frequency and power control, data gathering and transmission systems, require the construction of a widely branched and reliable communications network.

In accordance with the master plan for the development of communications means developed by the Energoset'proyekt Institute, the USSR Ministry of Power Engineering has developed broad scale construction of the department cable and radio relay communication lines in practice throughout the entire territory of the country.

An important role in the work of the institute is played by the design of the high-frequency communication channels over the overhead lines. These channels are used in the 35-750 kv networks.

The base for the main communications network of the USSR Ministry of Power Engineering at the present time is the cable communications lines, the construction of which is being realized throughout the entire territory of the country.

The construction of departmental (and also by cooperation) radio relay communications lines along the superhigh voltage 750, 1150 and 1500 kv overhead electric power transmission lines is proposed.

By the initiative and with the participation of the Energoset'proyekt Institute, the multichannel communication systems over the overhead lines with the use of new types of high frequency channels -- over the split phase insulated wires and lightning-protected conducting cables -- have obtained broad development.

A significant role is played by the communications means constructed by the proposal of the institute in cooperation with other departments, especially in the regions of Central Asia, Siberia and the Far East and also in the vicinity of the BAM railroad.

The developments of the Energoset'proyekt Institute with respect to the creation of a departmental data transmission network in the USSR Ministry of Power Engineering encompassing all areas of activity of the branch have been approved by the interdepartmental coordinating council for communications.

At the same time the institute has developed new forms of cable communications using the cables suspended on the overhead electric power transmission line supports and communication cables built into the phased conductors and lightning protection cables of the overhead electric power transmission lines. The work with respect to introducing glass filament engineering, which will permit a significant increase in volumes of transmitted data, will play a special role in the future of the development of communications media.

The performance of the planning research work with respect to foreign projects plays an important role in the activity of the institute.

The institute has designed 75 110-750 kv electric power transmission lines with a total extent of more than 10,000 km and 90 substations with installed transformer capacity of 15,000 MV·A, and it has also implemented 150 other projects, including 20 schemes for the development of power systems, electric power networks and power complexes in foreign countries.

A large amount of work has been done by the institute within the framework of the permanent commission of the CEMA on electric power. The largest project in recent years is the "master plan for the prospective development of united power systems of the CEMA member countries to the year 1990."

The circle of problems encompassed by the sphere of activity of the Energoset'proyekt Institute is broad and varied.

Still more responsible and complex problems are to be solved by the institute collective in the near future. This includes primarily the development of the basic areas of development of power engineering and the integrated power system of the country in the prospective period, improvement of the planning and design of the electric power transmission lines and substations for maximum reduction of cost and labor consumption of the construction by the application of new advanced solutions, standardization and unitization of the designs.

Implementing the resolutions of the November (1979) Plenary Session of the Central Committee of the CPSU, the institute collective is using all its power to insure an economical and reliable power base for the national economy of the country.

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ELECTRIC POWER

NEW HYDROELECTRIC POWER PLANTS UNDER CONSTRUCTION AND IN OPERATION

Moscow GIDROTEKHNICHESKOYE STROITEL'STVO in Russian No 9, Sep 80 pp 45-46

[Unsigned Article]

[Excerpt] Engineers and architects of the Leningrad department of the Gidroproyekt Institute imeni S. Ya. Zhuk have completed the development of the plan for the Miatlinskaya hydroelectric power plant which will be built in the mountains of Dagestan on the Sulak River.

The builders have already crossed the river at the line of the future hydroelectric power plant and they have directed the water into the construction tunnel. In the near future earth and rock work will begin on the motor vehicle tunnel on the left bank about 650 meters long and a left-bank feeder 1750 meters long.

The first hydraulic unit with a power of 110,000 kilowatts is to be put into operation in 1983, and the second at the beginning of 1984.

In June of this year work began on the construction of a transport tunnel at the Irganayskaya hydroelectric power plant in Dagestan.

It was necessary to blast and tunnel through 250,000 m^3 of rock in order to build the entrance portal of the tunnel. A construction base was set up here: a concrete plant and other auxiliary enterprises. The builders set to work also on the opposite side of the ridge from which they will tunnel in the opposite direction. This will hasten the beginning of operation of the tunnel. The length of this transport tunnel is about 4.5 km; by 1 July more than 120 meters of the main part of the tunnel and more than 200 meters of auxiliary tunnelling had been completed.

The Irganayskaya hydroelectric power plant is the fourth electric power plant of the Sulak cascade. Its design power is one million kilowatts. It is designed for covering peak loads in the integrated system of the northern Caucasus. The hydroengineering complex will permit regulation of the flow of the Saluk River and will insure reliable operation of the hydroelectric power plant located down stream.

In the Gorno-Altayskaya autonomous oblast a plan has been made to begin the construction of the hydroelectric power plant on the Katun' River. The hydroengineering complex includes a dam, the hydroelectric power plant building next to the dam, the construction and operating spillways.

The hydroelectric power plant will be built by the Irtyshgesstroy Administration of the Glavvostokgidroenergostroy Directorate of the USSR Ministry of Power Engineering.

Completing the basic operations for the construction of the Nurek hydroelectric power plant ahead of time, the hydroelectric power plant builders have begun the construction of the Baypazinskaya hydroelectric power plant on the Vakhsh River. The drifting of the first tunnel was started here in June.

The planned height of the fill for the Baypazinskaya dam is 60 meters; the reservoir will hold 124 million m^3 of water; the installed capacity of the four hydroelectric power units will be 600,000 kilowatts.

The concrete dam of the hydroengineering complex will be built on the turbulent mountain River Chegem. This will be the headworks for the Chegem irrigation system. When it is started up, which is planned for the end of 1980, 12,000 hectares of fertile lands will be irrigated.

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END