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TRANSLATIONS ON USSR RESOURCES
(FOUO 11/79)

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ELECTRIC POWER AND POWER EQUIPMENT

UDC 621.311.4.002.2:65.027

ENGINEERING EQUIPMENT CHANGES IN ELEKTROSTROYPODSTANTSII TRUST

Moscow ENERGETICHESKOYE STROITEL'STVO in Russian No 3, Mar 79 pp 20-23

[Article by engineer M.I. Grabel'kovskiy]

[Text] The Elektrostroypodstantsii [Electrical Substation Construction Administration] trust, created in 1966, is a large specialized enterprise which constructs 110 - 750 kilovolt substations in Moscow, the Moscow oblast, as well as in eight oblasts in the European part of the USSR (Bryansk, Orlov, Kursk, Belgorod, Lipetsk, Kalinin, Ivanovo and Tambov). The volume of construction and installation work performed over 10 years (1967 - 1977) has grown from 11.1 up to 22 million rubles. All of the work at construction sites (with the exception of electrical installation and communications facilities) for 220 KV and higher substations was carried out by the trust using its own personnel: in 1978, the volume of construction and installation work amounted to 2.4 million rubles, and 3.2 million KVA of transformer capacities were placed on line.

The performance of such volumes of work requires the refinement and even a fundamental change in the existing system for material and technical supply.

In the USSR Ministry of Energy, special attention is being devoted to the question of providing construction with prefabricated high quality industrial material resources: a large capacity base has been created for the construction industry, which is being periodically expanded, and administrations have also been created for the centralization and distribution of material resources (Energostroykomplektatsiya, Energozhilkomplekt, Energotekhkomplekt, etc.), and progressive structural designs and materials are constantly being introduced into production; the "Temporary Technical Specifications for the Comprehensive Supply of Steel Reinforced Concrete Structures to the Enterprises of the Main Power Engineering Construction Industry Administration" have been approved, and a number of other measures have been implemented, which have specifically improved the material and technical supply system.

Moreover, at the present time given the large number of suppliers and the diversity of structures, materials, equipment and products, it is an extremely complicated matter to provide for their comprehensive supply, and sometimes, even impossible. The Industrial Production Comprehensive Support Administration (UPTK) was created for this purpose in the trust in 1973.

The tasks, obligations and rights of the UPTK, as well as the forms of its interrelationships with the subdivisions of the trust were defined by the "Temporary Statute", as well as by a special directive for the trust.

The primary task of the UPTK is the improvement of the existing material and equipment supply system.

The following basic factors were taken into account in working out the organizational structure of the UPTK: specialization (a territorial criterion), the volume of work being performed, the number of existing subdivisions and their dislocation, the current and long term plans for the construction of facilities, etc. Taking into account that presented here, a combined administration system for comprehensive equipment package supply, a centralized and decentralized system, was adopted.

All forms of steel reinforced concrete, concrete, metal and other structures and the basic materials for facilities being built in Moscow and in the Moscow oblast are supplied in a centralized manner by motor vehicle transportation from the comprehensive production equipment package bases of the UPTK, which are located in Noginsk, or depending on the remoteness of the facility from the base, located in Moscow. Non-metallic, bricks, readimix concrete and mortar, as well as separate materials, are trucked in a centralized fashion from the suppliers.

Only the suppliers provide the remaining facilities with all types of structures. The cargos arrive at the nearest railroad stations. The production preparation sections of the trust subdivisions are responsible for their delivery directly to the construction sites, moreover, these sections provide the construction sites with local construction materials, set aside through the municipal or oblast planning organizations.

In accordance with the products list approved by the trust, allocated scarce materials are delivered only by the UPTK from its bases.

The following major functions of the UPTK were defined in accordance with the recommendations of the Scientific Research Institute for Construction Economics of the USSR Gosstroy:

—The planning of material and equipment and supply in the trust, the arrival of complete industrial structural packages, assemblies, parts, products, and materials at construction sites, the comprehensive supply of material and equipment resources to industrial enterprises and other subdivisions of the trust, as well as the comprehensive output of products by industrial enterprises and the transportation shipments of structures, products and materials;

--The organization of efficient mangement links to plants and suppliers and supply-marketing organizations, decentralized procurement and purchasing, providing comprehensive industrial production packages, the arrival of complete industrial structural packages, assemblies, products and materials in accordance with the schedule for the execution of construction and installation work at each construction site, centralized transportation shipments of structures, assemblies, products and materials (where possible, in containers and packages) to the working area of the construction site, providing industrial enterprises and other subdivisions of the trust with materials, tools, equipment, etc., and receiving and storing material and equipment resources at the bases.

--The production of nonstandard and non-series-produced structures and products, increasing the construction readiness of materials, semimanufactures and products;

--Operational accounting for and monitoring of the industrial supply packages for construction sites, the arrival of complete packages of structures and products from plants and industrial enterprises of the UPTK, the realization of allocations and quotas, the movement of stocks, as well as the utilization and storage of material and technical resources in all of the trust subdivisions;

--Operational regulation of the comprehensive industrial supply of construction sites with structures, products and materials, as well as the regulation of transport shipments;

--Technical and economic planning, and the analysis of the production management activity of the UPTK and its subdivisions;

--The organization and execution of the calculations for the comprehensive package deliveries;

--Material incentives for the workers of the comprehensive industrial production supply system;

--Economic sanctions for the violation of deadlines, volumes, the failure to observe complete package supply and low quality of deliveries and shipments, as well as for failure to meet other agreement obligations;

--The implementation of statistical accountability for material and equipment supply;

--The planning and organization of measures to boost the efficiency of the comprehensive industrial production package supply system.

The performance of the enumerated functions is assured by the operational production department, the departments of comprehensive equipment packaging and realization, the economic planning department, as well as the bookkeeping and flow line production section.

Particular attention was devoted to the technical economic indicators for the activity of the UPTK. Prior to the changeover of the trust and the UPTK to the new system of planning and economic incentives, indicators were used which did not reflect the essence of the activity of the comprehensive equipment supply organization. Under these conditions, goods turnover (warehouse and transit), procurement and warehousing expenses, price markups, the personnel force and salary funds were all taken into account.

The indicators authorized at the present time promote the execution of the plan for construction and installation work and the timely placement of transformer capacities on-line, and permit the analysis and evaluation of the activity of the entire collective. At the same time, these indicators take into account the nature and specific features of the production management activity of the UPTK.

The trust approves the indicators in the form of plan assignments in terms of the major activity (the volume of complete equipment packages being delivered to the construction sites and the works stages being completed in the planning period), in terms of labor (the overall annual salary fund), and in terms of finances (the assignment for the reduction of the costs for comprehensive industrial production equipment package supply).

The basic indicator is the volume of complete equipment package deliveries. It is directly related to the indicator "volume of construction and installation work for the construction sites and work stages, being completed in the planning period and subject to turnover to the customer" for the mechanical supply columns and is responsible for the major assignment of the trust: assuring the placement of the facilities on-line within the plan periods.

The outlay indicator for the comprehensive industrial production equipment packages is a cost indicator which reflects the expenses of the UPTK in moving materials from the supplier to the construction site.

The use of structures with a high degree of plant readiness and the necessity of making the deliveries in the form of complete industrial or supply sets necessitated refinements in the warehousing and delivery system. Flow line (central and auxiliary) complete production package sections for a territory were organized for this purpose.

The central base of the flow line production section, which is located in Noginsk close to the motor vehicle transportation enterprise of the trust, consists of the following complexes: a warehouse complex with a group for putting together complete equipment sets, containerization and centralized shipments; a production complex with a group of shops for the fabrication of nonstandard (non-series-produced) metal structures; sanitary engineering and ventilation systems of all kinds. Moreover, included in the complement of the base are a mechanization section with a group for the operation and repair of machines and mechanisms, as well as a construction subdivision for the repair of buildings and structures.

An auxiliary territorial complete equipment packaging section, which is located in Moscow, provides for the reception and centralized delivery of sets of steel reinforced concrete and metal structures, supplied from the plants of the Main Power Engineering Industrial Construction Administration and the Power Engineering Steel Structures Association.

Thus, the flow line production section is a multipurpose, highly mechanized management unit, which performs the following functions to refine the material and equipment supply system for construction and the entire construction production industry as a whole:

--The concentration and active maintenance of the scarce materials being allocated with their subsequent synchronized delivery to particularly important construction sites, figured on a per site, stage or construction start basis;

--The receiving, accumulation and combining into complete industrial sets of various structures, and their centralized delivery to construction sites;

--The fabrication of nonstandard (small series production) metal structures with a weight of up to 50 kg, and their centralized delivery in containers to construction sites;

--The fabrication of components for sanitation engineering and ventilation systems, noise suppression systems and their centralized delivery in complete sets together with the equipment to the construction sites;

--The organization of centralized shipments, using special rolling stock, the container and pallet fleet, and the execution of loading and unloading operations;

--The control of residues of material resources, and assuring their preservation.

An important role in the UPTK is assigned to the system of centralized shipments of structures and materials from the production packaging basis to the construction sites, as well as from the supplying plants which are located in Moscow. The plan for centralized shipments is worked out for the planning year and approved by the trust. The monthly plans, which are coordinated with the consumers and the motor vehicle transportation enterprise of the trust, are approved by the operational production department of the UPTK on the basis of the annual plan.

The introduction of the centralized delivery system has permitted a significant improvement in the utilization of motor vehicle transportation, as well as providing for a uniform technological flow of material resources, the implementation of specialization of motor vehicles, and improving the system of accounting for, monitoring and the mutual responsibility of the subdivisions which carry out the construction.

Billing calculations between the UPTK, suppliers and subdivisions of the trust are also of no small importance. In this regard, a decision was made to introduce a single payer (the UPTK) for the complete sets of structures and basic materials being supplied, something which simplified the accounting system. Moreover, this has permitted having an operationally timely influence on the system of deliveries, and controlling their flow.

However, it is necessary to assure the permanent solvency of the UPTK to further refine the system of technical and material supply.

In the opinion of the author, the most practical approaches to the solution of this problem are as follows:

--Transfer the current account of the UPTK a portion of the totals set aside by the buyers in the form of advance payments to the subdivisions for the stages of the work being performed, with the subsequent liquidation of these totals by the suppliers of the materials and structures;

--The introduction of a system of plan payments, i.e., transfer to the current account of the UPTK by the subdivisions of the trust the current accounting sums for the volume of the plan period deliveries;

--The systematic utilization of bank loans through on-call accounts and loans for the plan stock of materials.

The difficulties related to assuring the completeness of the supplied structures are explained by the fact that there is no chief supplier with which the UPTK could have accounts. At the present time, the UPTK pays to the account of each plant when it delivers a part of a complete set. Such a system does not exert a substantial influence on accelerating the delivery of the entire complete set. In this regard, it is expedient to introduce a statute concerning the system of supply for the electrical power network facilities with industrial complete sets.

The creation of the UPTK, and of the flow line sections in its complement, permits concentrating the allocated funds something which in turn makes it possible to route materials to the facilities being brought-in, including severely scarce materials, in accordance with the quota charts and departments putting the packages together. This fact is of substantial significance, since the funds and quotas are, as a rule, allocated in August-September of the year preceding the planning year, while the plan and the technical documentation are officially drawn up and finally authorized in September-December.

Thus, the UPTK permits combining the efforts of the collectives of the staff of the trust, the construction subdivisions, and the motor vehicle transportation enterprise, and directing them to curtail the construction timeframes, to bring the facilities in on time, finish the stages of the work, deliver the facilities with a high level of quality, as well as transform the substation facility into a construction site during the process of the high speed, flow line assembly of the individual blocks, assemblies and components. The UPTK allows for the concentration and centralized distribution of material resources of an improved factory readiness, as well as assuring the delivery of all types of structures, materials and equipment to the construction site in complete industrial sets.

The UPTK organization has made it possible to free the collectives of the production subdivisions of the determination of the need for funds, registering, legalizing, specifying and concluding agreements in accordance with the allocated funds, selling, shipping, receiving and warehousing stocks at the bases of the subdivisions, payments to various suppliers for the received structures and materials, as well as the fabrication at the construction site of various structures, products, systems, etc. The subdivisions which are located in the zone of immediate activity of the UPTK can dispense with their own warehouse managements and significantly reduce expenditures for this outlay item.

To further refine the industrial production system for supplying complete packages, in the opinion of the author, is expedient to implement the following measures:

--Change the time periods for the presentation of the technical documentation by the planning organizations, linking them to the timeframes for assigning quotas and placing orders for structures and materials;

--Refine the technical documentation, taking into account the breakdown of the entire complex of construction and installation work into complete industrial sets, linked to the payment stages;

--Change the ratio of the quotas allocated between the biennia in the direction of an increase in the first biennium;

--Organize a single organization for putting complete construction packages together, which is invested with the functions of planning, distribution and supply of steel reinforced concrete and metal structures, and joiner's products, taking into account the complete industrial set, within the system of the USSR Ministry of Energy;

--Within the USSR Ministry of Energy, approve a statute on a system for supplying complete industrial sets, including the drawing up of structural and organizational forms, the definition of management functions for suppliers of complete sets, establishing the interrelationships between industrial, complete package assembly and electrical power network organizations, as well as refining the procedure for mutual billing calculations based on centralized and strengthened billing calculations for a complete delivered industrial set;

--Work out a system of accounts between the UPTK and the production subdivisions of the trust, where this system assures the solvency of the UPTK;

--Work out a single standardized normative and technological documentation (UNTD) for putting together complete packages;

--Work out project plans for standard production and complete package assembly basis of the UPTK of the electrical power network trusts and allocate funds for their construction in a centralized manner;

--Convert the UPTK to a cost accounting subdivision, which participates in generating the plan and above-plan income for the trust;

--Work out and approve a single statute in the USSR Ministry of Energy on providing bonus awards to UPTK workers from the economic incentive fund, as well as for the placement of facilities on-line;

--Incorporate the UPTK into the list of organizations which participate in the socialist competition between the organizations of the USSR Ministry of Energy.

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ELECTRIC POWER AND POWER EQUIPMENT

UDC 621.311.22.002.51

INSTALLATION OF INDUSTRIAL EQUIPMENT OF BEREZOVSKAYA GRES-1

Moscow ENERGETICHESKOYE STROITEL'STVO in Russian No 3, Mar 79 pp 27-31

[Article by engineer M.Ya. Borts]

[Text] The Berezovskaya GRES-1 with an overall capacity of 6,400 MW (eight power units of 800 MW each) which is the largest in the USSR, is the chief electrical power station of the southern group of the Kansko-Achinsk fuel and power engineering complex (KATEK).

The unit length of one power block is 72 m. A repair opening with a width of 12 m is provided after each power unit with an even number. The overall length of a main housing of the Berezovskaya GRES is 696 m, the diameter through the A-J section is 242 m, and the bottom mark of the roof trusses of the boiler compartment is 117.5 m. The framework of the main housing is executed in metal. Two smokestacks (one for each four power blocks) with a height of 360 m each will be erected at the electric power station.

The following main equipment is included in the complement of a power block:

--A P-67 ZiO boiler plant (pilot model) with a steam generating capacity of 2,650 t/hr (25.5 MPa; 545/545° C), in a T-configuration, single stage, with a square boiler of a gas tight design;

--A single shaft, five cylinder condensation K-800-240-3 LMZ steam turbine with a capacity of 800 MW (steam pressure of 24 MPa, temperature 540° C);

--A TVV-800-2 generator (the "Elektrosila" All-Union Association) with a capacity of 800 MW in a closed-loop design (a provision is made for cooling the rotor with hydrogen and the stator with hydrogen and water).

In considering the engineering project plan for the GRES, the Scientific and Engineering Council of the USSR Ministry of Energy adopted the following basic conditions for its construction:

--The start of the first power block should be accomplished 37 months following the start of the construction of the main housing;

--The spacing in placing the blocks on-line was taken as six months;

--The pace of construction for the underground portion of the main housing should amount to two sections of the cross-sectional diameter per month; the ground section of the main housing should go at a rate of 1.3 sections of the cross-sectional diameter per month;

--The installation of the first power block should be accomplished from the side of the stationary end face.

The basic principles for the organization of the equipment installation of the Berezoskaya GRES-1 were developed taking into account the advanced experience in the installation of the equipment of the 800 MW capacity power blocks at the Uglegorskaya and Zaporozhskaya GRES's as applied to the specific conditions for the construction of the Berezovskaya GRES-1, determined by the Scientific and Engineering Council of the USSR Ministry of Energy. In this case, the presence of a construction flow for no less than three GRES's with a capacity of 8 x 800 MW was taken into account, where these stations comprise the southern group of the KATEK GRES's.

The basic statutes governing the adopted organization for the equipment installation of the Berezoskaya GRES consist in the following:

--The construction and installation of the equipment should be carried out using the high speed slow line method in accordance with a single directive network schedule, which is obligatory for the execution of the construction of the GRES by all participants, including the supplying plant for thermal mechanical equipment; the financing and technical material support of the construction should be coordinated with the indicated directive schedule;

--The planning of the performance of the construction work to erect the GRES should be completely subordinated to the requirements for the installation technology of the equipment, since this stage is the final one in the process of erecting the GRES and determines the timeframes and rate at which the capacities are brought on-line;

--The performance of the construction and installation work will be realized separately with respect to time and site, something which is a basic condition to assure the requisite pace in bringing the capacities on-line, and curtailing the duration and labor intensity of the installation work; the installation work should be accomplished only in an enclosed and heated building;

--The assembly and completion of the consolidated equipment blocks should be realized at the thermal installation base, which is included in the complement of the regional comprehensive production base (RPKB) for the construction of the southern group of KATEK GRES's; in this case, a provision is made for the assembly of the block in a closed housing, equipped with special industrial rigging which assures a high level of work mechanization;

--It is planned that the GRES equipment installation work be carried out using longitudinal specialized flows with the introduction of the appropriate organizational structure for the thermal installation complex.

The construction pace of the main housing and its readiness in the final analysis determine the rates at which the capacities are brought on-line and the duration of GRES construction as whole. The organization of the erection of the main housing has a substantial influence on the duration of the installation of the thermal mechanical equipment, as well as the labor intensity and quality of the work.

The scheme adopted in the erection of a GRES with 200 and 300 MW power blocks where the construction of the main housing leads the course of the installation of the equipment by a minimum of one element of a power block was primarily determined by the necessity of organizing the installation area for the execution of the pre-installation operations (the slinging of the blocks of the boiler being installed, bringing them into a vertical position, and the installation in the design position). In this case, a provision was made for the possibility of bringing the bridge cranes out into the indicated area beyond the limits of the unit of the boiler being installed and installing a temporary face beyond the limits of the installation area. This scheme corresponded to the traditional installation technology for boilers by building up from the bottom upward and provided for the site separation of the construction and installation work flows within the confines of one main housing. The transportation scheme which was worked out taking into account the adopted pace for bringing the capacities on-line (one to two power blocks per year) provided for supplying the construction structure and equipment without mutual interference.

When organizing the high speed flow line installation of equipment at some GRES's with a spacing in bringing three and more power blocks on-line annually with a capacity of 300 MW each (the first stages of the Ladyzhinskaya, Zaporozhskaya and Uglegorskaya GRES's) required a greater separation of the construction and installation work flows not only in terms of the work site, but also in time, something which was achieved by alternating the work in the erection of the main housing and the installation of the thermal mechanical equipment. In this case, the duration of the installation of the main housing and the installation of the equipment was curtailed.

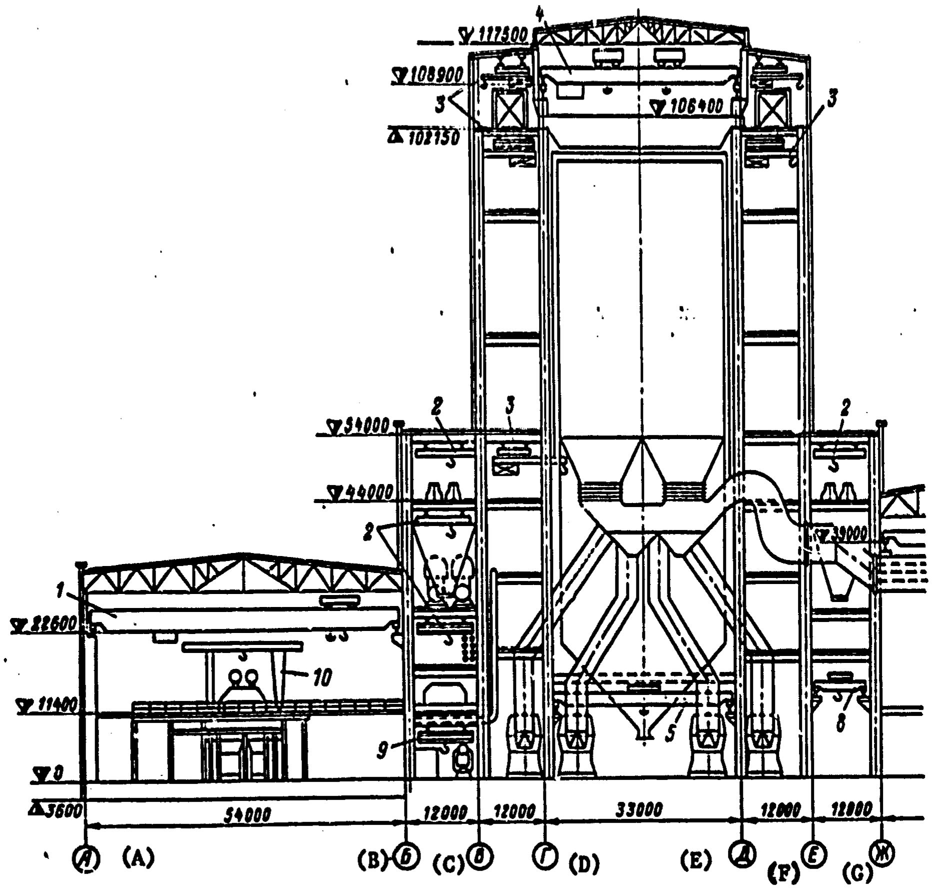
In the case of the flow line installation of high productivity boilers, which are suspended from the structures of the main housing, one can simultaneously install no more than two boilers, while when the first boiler is in the finishing stage (the installation of attachments, the welding of the bypass system, alignment, etc.), the heavy blocks are being installed in the second boiler.

The duration of the high speed flow line installation of a boiler when bringing two power blocks per year on-line should not exceed 12 months. The possibility of achieving such a duration of installation work for a power block is confirmed by calculations, the basis for which were the actual data on the duration of the installation of the equipment of gas-fuel oil power units with a capacity of 800 MW at the Zaporozhskaya GRES. Of the number of critical conditions which assure the attainment of the design timeframe for the installation of the power units and placing them on-line within the set deadlines, both the organization of the triple shift work in accordance with a sliding schedule and the absence of superposition of the construction and installation operations should be cited.

Since the volume of the main building of the Berezovskaya GRES (for eight power blocks of 800 MW each) precludes the practicability of completing its construction prior to the start of equipment installation, the most optimum solution which provides for nonoverlapping performance of the construction and installation operations is the separation of the main building into a minimum of two sections. The layout of the main cargo crane, used for the installation of the construction structures of the main building, has a substantial influence on the organization of the supply of the equipment for installation. The narrow feed front in the case of large volumes of the equipment being installed, the structural design solution and the overall dimensions of the support gantrys of the new SKR-2200 and SKR-3500 rail-mounted jib cranes with a base of 15 m place specific requirements on the arrangement of these cranes.

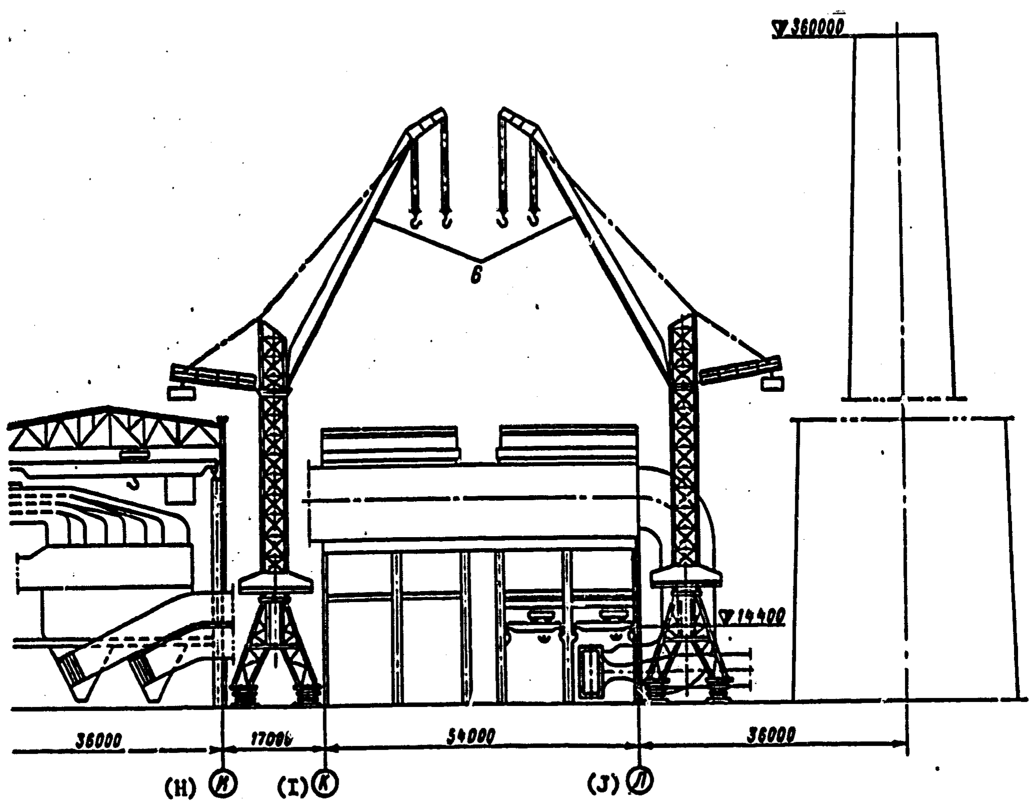
With the separate performance of the construction and installation work within the confines of the main building, or in an independent part of it, the construction cranes should be brought out of the installation area at the start of the equipment installation. For this reason, the choice of their location during the period of erection of the main building or its independent portion should not be linked to the organization of the feed of equipment being installed into the main building. When the construction and installation operations are combined within the confines of the main building, it is necessary to place the construction cranes outside the boiler room, i.e., in the spans of the main building, which are stressed to a lesser extent in terms of the load flow. The installation of the construction cranes in the boiler room leads to an increase in the step of the flow line.

The production program for the thermal installation base was determined from design figures for the placement of two power units with a capacity of 800 MW



Schematic of the comprehensive mechanization of the equipment installation in the main building of the Berezovskaya GRES-1.

Key: 1. KM-125 bridge crane with a load capacity of 125/20 t (3 units);
2. Jib crane with a load capacity of 10 t (14 units);
3. KPP-10 revolving suspension crane with a load capacity of 10 t (10 units);
4. KM-100B bridge crane with a load capacity of 100 + + 100/10 t (3 units);
5. Bridge crane with a load capacity of 50/10 t (4 units);
6. BK-1000 tower crane with a load capacity of 50 t (2 units);



[Key to figure from preceding page and above]:

7. Bridge crane with a load capacity of 30/5 t (8 units);
8. Bridge crane with a load capacity of 20/5 t (2 units);
9. Jib crane with a load capacity of 5 t (4 units);
10. Gantry crane with a load capacity of 3.2 t (2 units).

*

each on-line annually (in accordance with the adopted step of the flow line installation of the power units at the GRES's of the KATEK southern group). The base consists of three main sections. The first section is set aside for the storage and package assembly of thermal installation package equipment. The equipment is stored in closed warehouses, under canopies and in open areas, equipped with gantry cranes. The blocks of installation equipment are put together in complete packages from the elements included in the different assemblies in the same section in specially set aside areas. The equipment is consolidated into installation blocks in the second section, in the closed production building. Following assembly, 30% of the blocks are delivered for lining and insulation.

In view of the possible discrepancy in the assembly and installation cycles of the blocks, a portion of the finished blocks are dispatched directly for installation, while the remaining portion is forwarded to the third section - the finished block warehouse.

The annual production program of the thermal installation base for the assembly of equipment blocks for two power units with a capacity of 800 MW each amounts to 75,890 tons. The throughput of equipment blocks from one square meter of the production building amounts to 4.3 tons per year, which is ten times greater than for the case of block assembly in an open area.

The overall staffing at the thermal installation base was set at 1,120 persons, including 1,038 workers.

Taking into account the specialization of the installation operations and the specific layout of the equipment, the entire complex of thermal installation work for the case of the high speed flow line installation of the equipment of the Berezovskaya GRES-1 can be broken down into eight independent specialized flows:

—The complete packaging and assembly of the equipment (the thermal installation base in the complement of the RPKB);

—The installation of the boiler room equipment;

—The installation of the equipment of the dust handling system and tubular air preheater equipment;

—The installation of the electrical precipitator equipment and the KVO [expansion unknown] of the exterior installation;

—The installation of the BDO and BOU [expansion unknown] equipment;

—The installation of the equipment of exterior facilities;

—Mechanization and organization of operations (this flow is organized for the purpose of excluding any kind of auxiliary and repair services from the primary production flows).

The thermal installation complex manages all installation operations. The structure of the complex provides for the coordination of operations performed by independent flows (each of which takes the form of a cost accounting specialized installation section), the supervision of the thermal installation work and its quality control, as well as the resolution of questions of complete equipment packages, external links, economic and financial estimation questions. The thermal installation complex performs none of the work with its own personnel in the erection of the GRES.

The necessity for the introduction of such a scheme for the control and management of operations in the construction of such projects as the Berezovskaya GRES-1 is explained by the considerably increased annual volume of installation work being performed by the high speed flow line method.

The weight of the thermal mechanical equipment of one power block with a capacity of 800 MW of the Berezovskaya GRES-1, including the center girders and metal technological support structures amounts to 52,700 tons (according to preliminary data), and taking thermal insulation, included in the installation blocks, into account, about 60,000 tons. Thus, working from the rate at which the capacities of the Berezovskaya GRES-1 are brought on-line, the weight of the equipment being installed in the main building in one year amounts to 120,000 tons. It is interesting to note for comparison that the weight of the thermal mechanical equipment (with the insulation included in the blocks) being installed over the course of a year in the main buildings of the Zaporozhskaya and Uglegorskaya GRES's with gas-fuel oil power blocks of 800 MW, amounted to about 30,000 tons, i.e., four times less than at the Berezovskaya GRES-1.

In contrast to existing layouts, in the boiler room of the Berezovskaya GRES-1, along with the main span having a width of 33 m a provision is made for two additional ones with widths of 12 m each, used for housing the steam heat exchanger (in the upper part of the boiler room), the station piping, the mills-blowers (at the zero level mark), the fuel feed channels, as well as for the organization of boiler repair. Such a structural design of the boiler room, given the considerable height and weight of the boiler, assures a minimal span of the center girders for suspending the boiler and the placement of the rigid disk in the supplemental spans outside the boiler.

The scheme for the complex mechanization of the equipment installation at the Berezovskaya GRES-1 (see the figure) and the selection of the main load lifting mechanism were determined taking the following factors into account: the specific features of the equipment layout in the main building, the overall weight of the equipment being installed annually, the weights and overall dimensions of the assemblies and installation blocks of the equipment (including the insulation), the production technology for the installation work, and the technical characteristics of the series produced and special load lifting mechanisms. The unusual overall dimensions and weight of the boiler, as well as the structural configuration of the triple span cross-section of the boiler room required designs of new load lifting mechanisms for the equipment installation: the KM-100B bridge crane of the boiler room with a load capacity of 100 + 100/10 t and a lifting height of 109 m; and the

KPP-10 rotating suspension crane with a load capacity of 10 t and a lift height of from 50 to 110 m.

The load lifting cranes for the installation of the equipment were distributed as follows.

Three installation and repair bridge cranes with a capacity of 125/20 t each were placed in the turbine room, one of which is an assembly and disassembly crane installed at the temporary end face. The installation of the generator stator with a weight of 322 t is executed by these cranes using a system of cross-pieces.

Gantry cranes with a load capacity of 3.2 t are used as the auxiliary cranes for installation and repair work on the turbine and feed sets.

The installation of repair and installation suspension jib cranes with a load capacity of up to 10 t and a lifting height of up to 36 m was provided in the deaerator-hopper and hopper rooms at each of the markers.

Special suspension, rotating, installation and repair KPP-10 cranes with a load capacity of 10 t and a lifting height of 110 and 50 m respectively are installed in spans C-D and E-F at the 115.70 and 102.15 m markers and in span C-D at the 54.00 m marker. The cranes are intended for the installation of equipment (primarily piping), arranged in the rows indicated, as well as inside the columns of rows D and E and partially within span D-E, as well as for the repair of the boiler room equipment. A provision is made for the installation of installing cranes with a load capacity of 50 t and a lifting height of up to 52 m at the 54.00 m mark on the C-D and E-F lines for the installation of the mill-blower assemblies and other equipment, where these cranes are arranged along the line of installation ahead of the suspension, rotating cranes at the same marker.

Three KM-100B special bridge cranes (with two self-propelled carriages) are installed in the main span D-E of the boiler room, where these cranes are used to install the P-67 boiler and the center girders.

Experience with the installation of suspension, large capacity boilers using special bridge cranes of a high load capacity (up to 100 t) has confirmed the effectiveness of the utilization of these cranes. Thus, at the Zaporozhskaya and Uglegorskaya GRES's, the rate of installation of the heavy components of the TGMP-204 boiler reached 3,000 t per month using two bridge cranes under very constrained conditions for the work area of the bridge cranes (the length of an element is 48 m in all). One boiler department for several boilers, when organizing flow line installation, will assure a broader working front for the bridge cranes. Along with this, the fact that the height of the boiler will be significantly increased in this case should be taken into account.

The installation and repair of the equipment in the room for the air preheaters in span G-I is accomplished using bridge cranes with a load capacity of 30/5 t and a lifting height up to 40 m. The precipitating filters and gas-air pipes outside the bounds of the main building are installed by means of two BK-1000 power cranes.

A provision is made for moving the BK-1000 power cranes, regardless of the state of the structural part and the equipment installation, where one of these cranes is installed in a corridor 17 m wide between the TVP [expansion unknown] room and the precipitation filters, while the second is installed between the precipitation filters and the smokestack.

The installation of flue gas extractors, positioned below the precipitation filters, is accomplished using bridge cranes with a load capacity of 30/5 t.

Taking the height of the boiler and the building of the boiler department into account, as well as the volumes of installation work performed at the marker levels of the boiler room, considerable attention must be given to the vertical transportation of installation personnel. For this purpose, besides the operational cargo elevators with a cargo capacity of 3.2 t and the passenger elevators with a capacity of 1 t, a provision is made for the installation of GNEZNO-1000 (manufactured in the Polish People's Republic) installation personnel elevators with a load capacity of 1 t (the weight of 12 passengers).

A provision is made for 10 lifts and elevators for two paired boilers. GNEZNO-1000 installation elevators are installed in the place of operational lifts where these are absent at the start of the installation work.

The project design labor intensity for the installation of the equipment of the Berezovskaya GRES-1 was determined on the basis of preliminary data on the weight of the equipment and the average specific labor intensity (per 1 t of equipment) of the installation work, figured from the data on the actually achieved specific labor intensity of the equipment installation for the 800 MW gas-fuel oil power blocks (Nos. 5 and 6) of the Uglegorskaya and Zaporozhskaya GRES's. These GRES's can be considered analogous for the following reasons:

--Because of the high level of engineering organization for the performance of the installation work, the labor intensity of the equipment installation of the gas-fuel oil 800 MW power blocks of the Uglegorskaya and Zaporozhskaya GRES's is at the optimal level;

--The gas-fuel oil 800 MW power block equipment is similar in terms of its structural design to the equipment of the Berezovoskaya GRES-1.

Because of the organization of the assembly of the blocks in the production building of the thermal installation base, the specific labor intensity of the assembly, in accordance with the calculations which were carried out, was reduced by 1.5--2 times as compared to the labor intensity of the assembly at the Uglegorskaya and Zaporozhskaya GRES's.

The average number of installation workers at the construction site of the Berezovskaya GRES-1, where the step spacing in bringing the capacities of two power blocks of 800 MW each on-line annually, amounts to 3,330 persons, including 1,038 persons for assembly and 2,292 persons for installation.

Conclusions

1. The following are necessary for the realization of the principles set forth above for the organization of the installation of the technological equipment of the Berezovskaya GRES-1, with a flow line step of two power blocks per year:

--The erection of the thermal installation base in the complement of the RPKB (with a closed assembly building), the capacity of which will assure the consolidated assembly of two power blocks of 800 MW per year;

--The organization of the separate execution of the construction and installation operations within the confines of the main building, and the separation of the main building into two sections for this purpose;

--Providing for the comprehensive supply of equipment, and in this case, the time required for the delivery of a complete equipment set for one power block should not exceed the flow line step for placing the capacities on-line;

--The organization of equipment installation "right off the wheels" with the predominant use of railroad transport for supplying large blocks of equipment for installation.

2. The equipment installation technology developed on the basis of the principles indicated above will permit:

--Curtailing the time required for the installation of a standard pulverized coal power block with a capacity of 800 MW from 14 months (according to norms) down to 12 months;

--Reduce the specific labor intensity of the installation work (per 1 t of equipment) by approximately 25% as compared to that actually attained in the installation of the equipment of the gas-fuel oil 800 MW power blocks at the Uglegorskaya and Zaporozhskaya GRES's (the specific design figure for the labor intensity of the equipment installation at the Berezovskaya GRES-1 is 9.9 man-days/t, and the actual specific labor intensity of the installation of power blocks Nos. 5 and 6 at the Uglegorskaya and Zaporozhskaya GRES's was 12.5 man-days/t); in this case, just by virtue of assembling the equipment blocks at the thermal installation base, the total force of installation workers over the entire period of the construction of the southern group of KATEK GRES's will be reduced by 480 men.

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ELECTRIC POWER AND POWER EQUIPMENT

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FEATURES OF P-67 BOILER OF AN 800 MW POWER BLOCK OF BEREZOVSKAYA GRES-1

Moscow ENERGETICHESKOYE STROITEL'STVO in Russian No 3, Mar 79 pp 31-34

[Article by engineers Yu.D. Sologub, I.G. Olevson and P.Ye. Sheryshev]

[Text] The coals of the Berezovskiy deposit of the Kansko-Achinsk coal basin will be used as the main fuel for the first electrical power stations of the Kansko-Achinsk fuel and power engineering complex (KATEK), as well for the head Berezovskaya GRES-1. Berezovskiy coals are distinguished by a low ash content (4-12%), moderate moisture content (33%), an insignificant sulfur content (0.3%) and the predominance of calcium oxide in the ash (40-60%). The calcium oxide content in the ash of these coals increases with a reduction in the ash content, the ash temperature in the liquid state increases at the same time (1,270-1,630° C), and consequently, the slag forming capability of the fuel increases significantly.

As is well known, Berezovskiy coals were not mined prior to 1975, and industrial experience in burning them is lacking, something which causes certain difficulties in designing boilers intended for operating with this fuel.

At the present time, the Podol'sk Machine Construction Plant imeni Ordzhonikitze (ZiO), in conjunction with the organizations of the USSR Ministry of Energy (VTI [the All-Union Red Banner of Labor Heat Engineering Institute imeni F.E. Dzerzhinskiy], the Special Design Office of the VTI, the Thermal Electrical Power Engineering Planning Administration and the Power Engineering Installation Planning Administration) are developing the manufacturing plant for the Pp-2650-255 (P-67) boiler for the 800 MW block of the Berezovskaya GRES-1.

The P-67 boiler is a single housing, suspension type, straight-through gas tight boiler with a T-layout of the heating surfaces. The technical data on the boiler are given below:

Steam productivity	2,650 t/hr
Steam pressure:	
of the live steam	25.5 MPa
superheated reheat steam	3.7 MPa

Temperature:	
of the superheated steam	545/545° C
of the feed water	275° C
of the exhaust gases	160° C

The furnace chamber of the boiler has dimensions in the plan view between the centers of the water walls of 23,080 x 23,080 mm. Installed in the furnace in four tiers are 32 tangentially oriented straight-through burners (tiers of two burners each on each wall).

The height of the furnace chamber from the center of the cold hopper funnel to the bottom of the shield surfaces is 60 m. The marker of the centers of the crown pipes of the boiler was taken at 90.1 m.

The configuration for the steam-water channel of the boiler provides for two nonmixing and independently controllable flows of working medium, which flow to the left and to the right relative to the axis of symmetry, perpendicular to the front of the boiler.

An economizer manufactured from pipes with dimensions of 42 x 6.5 [?mm?] (20 steel) is positioned in the path of the steam-water medium, where the economizer has longitudinal ribbing with strips welded on having dimensions of80 x 4 mm. The economizer is supplied in 64 blocks. Thereafter, the medium is fed to the shields of the furnace chamber, which are broken down over the height into lower and upper radiation sections (NRCh and VRCh). The front and back shields are vertical shields and extend out beyond the limits of the crown shield. The side shields form an aerodynamic projection of the furnace and the sloped shield of the connecting gas duct. The steam exhaust pipes of this shield, having dimensions of 89 x 14 mm, pass through the gas duct and participate in taking up the weight loads from the pipes and shields of the convective shaft.

Each wall of the furnace is broken down over its width into 10 panels. The NRCh panel incorporates four delivery blocks in its height. Following their monitored assembly, they are welded in the welding area at the 18.3, 31.3 and 47.1 m markers. At the 62.2 m marker, the NRCh panels are joined to the VRCh panels by a special connection (Figure 1a). The panels, which are made of finned pipes with dimensions of 32 x 6 x 48 mm (12Kh1MF steel) have a width of 2,256 mm. The overall number of delivery blocks is 164 for the NRCh and 116 for the VRCh.

Following the VRCh, the medium successively passes through the so-called festoon of the side walls of the furnace and the crown shield. The festoon consists of pipe with dimensions of 42 x 11 mm and strips of 24 x 6 mm welded between them.

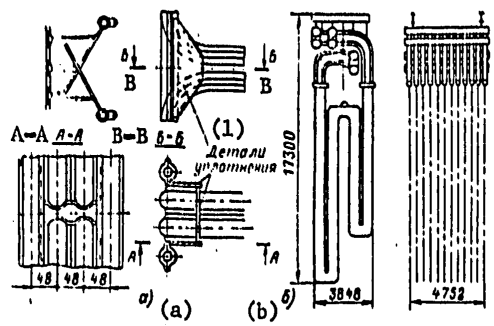

Figure 1. The assembly for joining the shields of the upper and lower radiative sections (a), and an installation block of the shroud type steam superheater (b).

Key: 1. Details of the seal.

The strips of festoon pipes, which are run with a spacing of 576 mm from the aerodynamic projection to the crown shield, in conjunction with the front and rear walls of the VRCh, take up the load from the weight of the furnace and the cold hopper funnel. The panels of the crown shield, which are fabricated from finned pipes with dimensions of 32 x 6 x 48 mm (12Kh1MF steel), are supplied in the amount of 216 pieces. During assembly, they are welded together at 10 points.

Then the medium passes through the shields of the convective shafts and the separating gas intake baffles positioned parallel to them. The baffles which are heated on both sides are made similar to the furnace shields from finned pipes with dimensions of 32 x 6 x 48 mm.

The shields of the side wall of the convective shaft are subdivided into 10 panels over their width, while the shields of the front and rear walls, as well as the walls of the gas intake, are broken down into four panels. Each panel is is supplied in two blocks comprising the height. The blocks are welded during the assembly. The welded joint on all panels is positioned at the 76.7 m marker. The overall number of supplied blocks of shields for the walls and gas intake is 144 pieces.

Further, steam-steam heat exchangers (PPTO) follow in the primary steam channel, where these are intended for regulating the superheated reheat temperature by means of bypassing at the secondary steam side and which consist of 160 standard sections from Zi0. A spray type desuperheater with a built-in gate valve is connected to the pipe following the PPTO. Kindling separators are positioned parallel to them. Thereafter there run three stages of the shielded steam superheater and the outlet convective packets.

The shrouds of stage II (Figure 1b) made of finned pipe with dimensions of 32 x 6 x 48 mm (12Kh1MF steel), the shrouds of stage III made of pipes with dimensions of 32 x 5 mm (12Kh18N12T steel) and the shrouds of stage I made of pipes of the same size (12Kh1MF steel) are placed in the line of gas flow in the horizontal gas duct. The overall number of shrouds is 228 pieces.

The outlet convective superheater consists of two sections. The first section is made of pipes with dimensions of 38 x 7 mm (12Kh1MF steel), while the second is made of pipes with dimensions of 38 x 6.5 mm (12Kh18N12T steel). The steam superheater is supplied in 32 blocks.

The secondary superheater incorporates two stages. One stage, which is placed in the convective shaft, is made of pipes with dimensions of 57 x 4 mm (12Kh1MF steel) and is supplied in 96 blocks. The second stage is the shroud portion which is placed in the horizontal gas duct, manufactured from pipes with dimensions of 57 x 4 mm (12Kh18N12T steel).

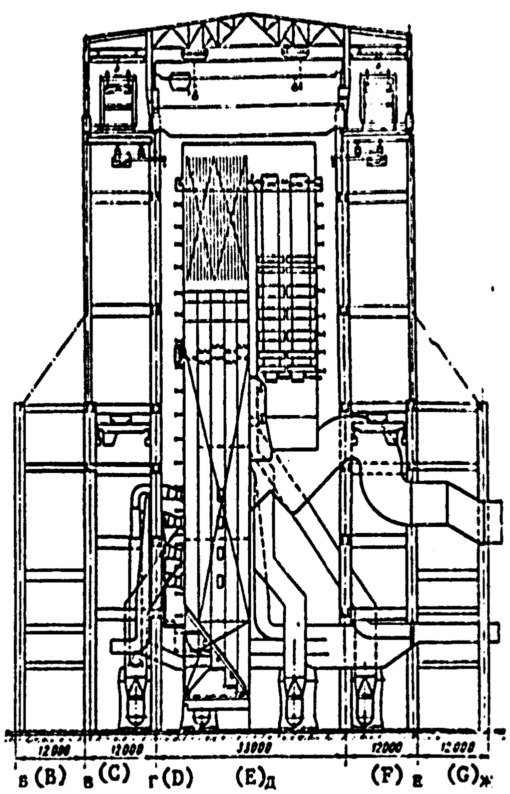

Figure 2. Transverse section through the boiler.

The structural design of the boiler provides for the free suspension of all of the heating surfaces and the bypass system from the roof cover.

The suspension system of the convective shaft, which is manufactured from pipes with dimensions of 42 x 11 mm (12Kh1MM steel), is supplied in 32 blocks and 640 individual pipe elements.

To take up the internal pressures in the furnace and the convective shaft (during thumping and rarefaction), stiffening beams are installed around their perimeter.

The stiffening beams, which are located in the region of the VRCh, are suspended from the roof cover of the building on "cold" hangers and fastened to the shields with hinges. The stiffening beams, placed in the region of the NRCh, are suspended on one side with "hot" hangers, and on the other, with the shields. The stiffening beams of the front, rear and side walls of the furnace and convective shaft are welded. The height of a beam is 1,000 mm, while the width of the boom is 400 mm.

The tubular air preheater is composed of large block sections of considerable height (6.6 m), which are installed in two tiers with the upper tier resting on the lower one.

The thermal insulation of the boiler consists of three layers of limestone-siliceous panels with a thickness of 5 mm each and an outer metal coating 1.5 mm thick. To insulate the places of passage of chambers and coils through the panels, fire resistant and thermal insulated concretes are employed for the heating surfaces.

Eight mills-blowers of the MV type with overall dimensions of 3,300 x 800 x x 490 mm are provided to pulverize the fuel. The nominal productivity of each mill when pulverizing Berezovskiy coal is 70 t/hr, and the ventilation capacity is 200,000 m^3/hr at a head of 125 mm Hg.

The fuel is fed from the raw coal bunkers to the feeders, and then into the pipe-drier, and then along with the drying agent into the mills-blowers. The feeders are positioned at the ceiling floors at the 22.0 m mark. A provision is made for the use of the smoke gases at a temperature of 680° C for drying the fuel, where the gases are taken off at the input to the rotating chamber of the convective shaft and fed via the shield channel of the gas intake, positioned in the center of the convective shaft. The temperature of the air mixture is regulated by the addition of gases at a temperature of 360° C from the recirculation channel.

The recirculation gases are taken off from the gas ducts following the water economizer at a temperature of 360° C, pass through the ash cleaner and are transported by four flue gas extractors into the upper part of the furnace chamber and the burner. A provision is made for the installation of three DOD-43 flue gas extractors and two VDN-36x2 forced blowers to assure the requisite steam productivity and reliable operation of the boiler.

The boiler plant is housed in a building with a cell width of 72 m and a depth of 57 m. Bunker levels with spans of 12 m each (B-C and F-G) are built on to the three span boiler building (spans C-D, D-E and E-F are 12, 33 and 12 m respectively). The frame of the building is executed in metal.

The boiler itself is housed in span D-E. The boiler is suspended from eight center girders (the girder height is 6 m, the length is 33 m, and the weight is 85 t), which rest on the girders of rows D and E below the center girders.

The mills-blowers are positioned two each on each side of the furnace chamber of the boiler in spans C-D, D-E and E-F. The heat exchangers are installed at the 106.4 m mark in spans C-D and D-F.

A special feature of the structural design of the framework of the boiler building is the colocation of the boiler and building frames. The building frame takes up all kinds of horizontal and vertical loads both from the building and from the boiler. The columns of rows D and E are as close as possible to the boiler. Span D-E, in which the boiler itself is placed, was taken equal to 33 m. This structural design of the framework and building layout permit curtailing the consumption of metal in the erection of the boiler room.

The spatial structural configuration of the boiler building, formed from the columns of rows C-D and E-F, and which are positioned about the perimeter of the boiler cells at the 54.0 and 102.0 m markers of the horizontal plane trusses makes it possible prior to the start of the boiler installation to completely finish the construction of the building without installing the center girders of the roof cover. The installation of these girders is accomplished in conjunction with the installation of the boiler blocks, something which significantly simplifies the installation of the large boiler blocks in the position called for in the plan.

The following load lifting mechanisms are placed in the boiler room:

--Three bridge cranes with a load capacity of 100-10 t each in the D-E span at the 110.0 m marker for the installation of the boiler, the auxiliary boiler equipment, the metal structures of the roof, and the center girders of the roof covering with an overall weight of about 15,000 t;

--Two fully rotating, suspension cranes each in the upper section of spans C-D and E-F at the 114.0 m marker having a load capacity of 10 t each for the installation of the heat exchangers and the piping within the confines of the boiler with an overall weight of about 450 t;

--Two fully rotating, suspension cranes each in spans C-D and E-F with a load capacity of 10 t under the horizontal truss at the 101.0 m marker for the installation of station piping, as well as piping within the confines of the boiler with an overall mass of about 2,200 t;

--One bridge crane each in spans C-D and E-F at the 54.0 m marker with a load capacity of 50/10 t for the installation of the auxiliary boiler equipment (dust-gas-air pipes, mills-blowers, etc.) with an overall weight of 5,000 t;

--Two bridge cranes with a load capacity of 30/5 t each (in the span D-H) for the installation of the structures of the tubular air preheater and the auxiliary boiler equipment in this area with an overall weight of about 3,000 t.

The appropriate openings will be left in the ends of the building to move the bridge and fully rotating cranes from one cell to the other, while overhang brackets are installed in the last end face for the capability of disassembling the cranes.

Three installation openings are provided in the boiler room for supplying equipment: one with a height of 16 m and a width of 23 m between rows D-E on the axis of the furnace, the second with a height of 14 m and a width of 9 m between rows C-D and E-F, and the third with a height of 13 m and a width of 12 m in the end wall of the air preheater building.

In working out the installation technology for the boiler*, its specific structural design features, the layout of the boiler building and the presence of two bridge cranes in it having a capacity of 100 t each were taken into account.

It is provided that the assembly of the installation blocks be carried out at the Regional Comprehensive Production Base (RPKB).

Installation Blocks	Number of Pieces	Total Weight, tons
Lower radiative section shields	8	906
Upper radiative section shields	8	394
Connecting gas duct shields	8	541
Convective shaft shields	12	934
Shields of ceiling over the furnace	5	35
The cold hopper funnel	5	886
Gas intake shaft shield	2	296
Shrouded steam superheaters	24	1,577
Steam superheaters and the economizer of the convective shaft	32	2,780
Heat exchangers	20	208
Total	124	8,497

A schematic showing the breakdown of the boiler heating surfaces into installation blocks is shown in Figure 2, and the number and weight of the blocks are indicated in the table.

* The questions of organizing the installation of the main technological equipment of the Berezovskaya GRES-1 are treated in more detail in the article of M.Ya. Borts, which is published in this same issue.

The total weight of the metal part of the boiler amounts to about 18,000 t.

The total number of welded joints is 43,700, and the length of the welded seams along the fins of the pipes and the seals is 18,000 m.

All of the blocks of furnace and convective shaft shields (Figure 3) are brought out in a vertical position in the furnace space by one bridge crane using a tilting cradle (the railroad flatcars are delivered by a diesel shunter). In this case, the hook of the second crane with the freely hanging slings is connected to the upper part of the block, suspended on the bracket projection of the tilting cradle. The second crane removes the block from the tilting cradle and installs it in the planned position. Then, by using the first crane and the railroad flatcar, the tilting cradle is set in the transport position.

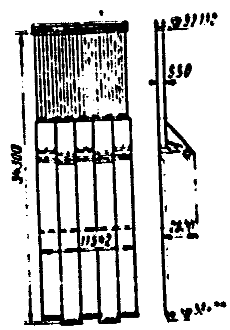

Figure 3. An installation block of the convective shaft heating surfaces.

The blocks of the shroud steam superheater (see Figure 1b) are delivered to the assembly zone and brought into a vertical position in containers. The tilting of these blocks is accomplished by two cranes.

The installation of the blocks in the planned position is performed by means of the inventory cross member-triangles, installation beams and other attachments.

In accordance with the adopted technology, the construction and installation work in the boiler building should be completed within the limits of the boiler cell prior to the start of boiler installation, with the exception of the installation of the metal structures of the ceiling cover, which is performed simultaneously with the installation of the boiler blocks.

The production sequence for the installation of the blocks is:

1) The metal structures up to the 43.0 m mark, the pulverized coal burners, the dust-gas-air ducts, the shot bunkers, exhaust gas and gas inlet cases up to the 56.9 m mark;

2) The BT-1 center girders above the convective shafts (KSh), the piping of the suspension system of the stiffening beams of the outer side walls of the KSh, and the stiffening beams of the outer shields of the KSh side walls;

3) The BT-2 center girders, the metal structures of the roof cover in the region of the KSh's, the blocks of the KSh side shields, and of the front and rear walls of the KSh's, the blocks of the heating surfaces and crown pipes of the KSh's, the blocks of the side shield with festoons, and the blocks of the stiffening beams of the internal side wall of the KSh's;

4) The metal structures of the truss at the 70.0 m mark under the horizontal gas ducts, the pipes positioned between the furnace and the KSh, the suspension pipes of the stiffening beams of the internal KSh wall, the blocks of stiffening beams and shields of the NRCh of the furnace, the blocks of the VRCh shields of the side walls of the furnace and the blocks of the hearth of the horizontal gas duct;

5) The BP-3 center girders, the front and rear blocks of shields of the horizontal gas duct, and the blocks of the shrouds of the stage II secondary steam superheater;

6) The BP-4 center girder, the blocks of the stage I shroud steam preheaters with festoons, the blocks of the VRCh and NRCh shields of the side wall of the furnace, the blocks of the shield with the aerodynamic projection, the blocks of stiffening beams for the front and rear walls of the furnace, the blocks of the VRCh of the front and rear walls of the furnace, the blocks of the stages II and III shrouded preheater, and the blocks for the cold funnel hopper and crown pipes.

Conclusions

1. Placing the building columns of rows C and D close to the boiler makes it possible to shorten the span of the boiler room down to 33 m, and reduce the weight and geometric dimensions of the center girders, something which significantly simplifies their installation in the plan position with one crane.

2. Combining the boiler and boiler room building frames permits the maximum mechanization of the installation operation. The placement of the installation frames in the spans of the boiler room makes it possible to organize the installation operations in independent flows.

3. Bringing the blocks into a vertical position, and placing them in the plan position are accomplished by means of special inventory accessories, something which significantly reduces the metal consumption in the installation of the boiler.

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FUELS AND RELATED EQUIPMENT

METHODS FOR COPING WITH OIL AND GAS SPOUTERS, WELL FIRES TOLD

Moscow FORMIROVANIYA GRAZHDANSKOY OBORONY V BOR'BE SO STIKHIYNYMI BEDSTVIYAMI in Russian 1978 pp 139-143

[Section 4 of chapter 9 of the book, "Formirovaniya Grazhdanskoy Oborony v Bor'be so Stikhiynymi Bedstviyami" [Civil Defense Formations in the Fight Against Natural Disasters]: "Peculiarities of Overcoming Emergencies at Oil and Gas Fields"]

[Text] Large oil and gas field industry enterprises include wells that are being drilled or operated and the necessary equipment. Because of the presence at almost every production facility of easily inflammable and combustible liquids, oil and gas fields are extraordinarily dangerous with respect to fire.

Emergencies at wells arise most frequently during the concluding phase of drilling, as a consequence of a violation of the operating regulations or the effects of reservoir pressure. As a result of these factors, the drilling tool may be ejected (or the operating equipment may be broken off) with an intense gushing of oil or gas. Emergencies that combine fires, explosions and the forming of lateral burning craters are of an especially dangerous nature.

Considering the serious danger of such emergencies, definite organizational, engineering and technical measures for dealing with them must be called for in advance. Services for preventing the occurrence of and for eliminating gas and oil spouters and support centers for extinguishing fires are created, special coaching for personnel is organized, and so on.

Emergencies at oil and gas fields are eliminated by the joint efforts of the local agency's service for the prevention and elimination of gas and oil spouters, the oilfield's civil defense units, and the oblast's (or rayon's) firefighting service. In the case of large fires, the forces and resources of neighboring oblasts and other services are used. In order to develop preparatory measures and to work on the elimination of spouters, a staff is created that ordinarily includes engineers and technicians of the oil or gas field, representatives of the services for preventing and eliminating oil and gas spouters, Gosgortekhnadzor [State Committee for the Supervision of Industrial Safety and for Mining Inspection] organs, the oblast's civil defense staff, and firefighting and other services and and organizations that are involved in eliminating gushers. The chief of the staff is named from the field's administration and is the supervisor of operations. Responsible line personnel, who are deputies of the chief of the staff, directly supervise the actions of personnel.

When a spouter occurs, the chief of drilling (the drilling foreman) is required to quickly report the event to the field's management and call the subunits of the service for the prevention and elimination of gas and oil spouters, the firefighting service, and medical first aid.

In the danger zone, prior to the arrival of help, work ceases and an evacuation of personnel is organized. With a view to preventing ignition of the gusher, internal combustion engines are stopped, power and lighting lines are switched off, open flame sources are extinguished, and transport movement is stopped in the adjacent grounds. Wetting down of the flowing stream and of the metal structure that comes in contact with it is organized, for which purpose all production units and fire-extinguishing resources are used. Where necessary, measures are taken to prevent the oil from spreading. If there is danger that gas will invade neighboring facilities, their operations also cease.

The chief of the staff, on arriving at the scene of the fire, organizes a reconnaissance for data that will establish: the circumstances and causes of the oil gusher, the condition of the well bore and the blowout preventer, the gusher's parameters, and so on; the extent of spread of the gas, taking into account the prevailing winds and places where gas could accumulate; directions of the oil's spilling, identification of the facilities that are threatened in this case, and the measures for restricting the oil's overflow (levees, oil traps and so on); and the availability and status of the water supply.

The amount of urgent emergency work is specified. The places and periodicity for sampling air for toxicity and risk of explosion are determined. Warning signals are defined in order to prevent access by outsiders to the danger zone, and traffic-control points manned round-the-clock by the facility's workers are established. The danger zone is surrounded by signs that warn and that restrict movement.

Communities and economic facilities that can be jeopardized by the presence of gas are identified. On obtaining such information, the appropriate civil defense chiefs specify a plan of action, organize CD staffs in round-the-clock watches, and establish and maintain continuous communications with the emergency-elimination staff.

Based upon an evaluation of the situation that exists, an effective plan of operations for eliminating the emergency is developed. This plan reflects: methods for eliminating the spouter; the sequence for performing the operations, the volume of the operations, and the disposition of forces and resources; requirements for equipment, tools and attachments, according to the method chosen for eliminating the emergency; and measures for providing safety for the operations.

Where there is an emergency with the simultaneous occurrence of fire, first of all the danger of spreading the fire is eliminated and the protection of neighboring structures is organized. On obtaining the required information from the chief of drilling, the commander of the firefighting subunit issues an instruction to deploy the firefighting forces and equipment.

After this the firefighting supervisor, jointly with the chief of the staff, make a reconnaissance, during which they determine: the reliability of the protection of neighboring structures; the possibility of evacuating valuable equipment from the danger zone; the status of the well head and the equipment installed thereon; the nature of the flow; and the source of the water supply and the availability of water reserves.

As experience indicates, much time is taken up with preparatory work when extinguishing gushers. This includes clearing the scene of the fire, establishing water reserves, deploying the extinguishing equipment, and coaching the personnel.

When clearing the fire scene, personnel and equipment operate, as a rule, under the cover of a water curtain because of the intense radiant heat. Simultaneously with clearing the well head, work proceeds on organization of the roads and sites for installing firefighting equipment and making levees at the scene of the emergency.

Water reserves are established, based upon an analysis of needs for extinguishing the fire and cooling the zone after the fire is out. Water at the fields is usually inadequate for this purpose. Therefore, artificial water impoundments are built and water pipe is laid to them, pumping units are set up, and so on. Places for water impoundments are chosen no closer than 100 meters from the fire site and on the side of it opposite the direction of the prevailing winds. Sites for installing automatic firefighting pumps about the impoundments are stipulated.

Deployment of the extinguishing equipment starts, as a rule, with the arrangement of firefighting vehicles at the water sources and laying of hose lines to the scene of the fire. In order to reduce the length of hose lines and to use pumps at full capacity from the impoundments, metal pipelines usually are laid to the scene of the fire. When there are not enough firefighting vehicles at the water impoundments, special pumping units are established.

Coaching of the personnel commences after the necessary reserves of water and equipment have been established and appropriate measures that relate to extinguishing and shutting off the gusher have been taken. The main purpose of the coaching is to perfect the chosen method of extinguishing the fire and to achieve coordination in the actions of the personnel of the formations under high-temperature situations. The supervisor of fire extinguishing, jointly with the appropriate representatives of the oil-field, organize and conduct the coaching.

Methods for extinguishing the fire depend upon the nature of the oil gusher, its intensity, the local situation, and the availability of fire-extinguishing resources. These methods include: shutting off the master control gate; killing the well; disposing of oil and gas from the well; using dispersed water sprays; detonating explosives; and using turbojet installations.

Shutting off the master control gate is the simplest method of extinguishing the fire. This is used in the initial state of the fire when the well-head equipment is present. A group of firemen equipped with compressed-air apparatus and shielding clothing advance on the well under protective water sprays and close the master control gate. Combustion ceases as a result of eliminating the flow.

Killing the well is used when equipment remains at the well head that will enable the killing units to be switched on. The essence of this method consists in the fact that when water or clay mud is injected into the well through the drill pipe or the tubing, a pressure is created therein that exceeds the reservoir pressure, as a result of which the flowing ceases and the flame is interrupted (snuffed out). Even if the injected liquid is completely ejected by the gusher's stream and does not succeed in extinguishing the flame, the temperature of the burning gusher is reduced, enabling the use of other methods for extinguishing it.

The withdrawal of oil and gas from a well is executed, as a rule, by arrangements for draining. Bulldozers make a ring levee around the well so that the burning oil will not spread. Simultaneously, pipes with hydraulic valves on the ends are laid under the levee at a slope from the well. Then the levee is gradually constricted about the whole perimeter. In so doing, the oil descends along the pipes to a safe place. When the burning area is reduced, drainage is constructed. For this purpose metal and rubble are thrown up behind the levee and perforated pipe is laid for the removal of gas and oil. When a drainage layer of the required height is formed above the pipes, the fire zone is covered with steel sheets and clay is piled on. Burning gas which seeps through the drainage layer is extinguished by dispersed water sprays. Moreover, the oil and gas can be removed through slant-drilled wells, through a cap with withdrawal pipe that is slipped onto the well head, and so on.

Dispersed water sprays extinguish gushers that have diffused flares, as well as burning craters that are small. The essence of this method is this: after an earthen levee has been erected around the well and it is heated, all the dispersed water sprays simultaneously are moved gradually from the base of the levee to its summit. The steam that is formed during evaporation of the water enters the fire zone and stops the combustion. The advantage of this method is the comparatively small water consumption.

Compact streams of water, as a rule, extinguish gushers of small or moderate intensity whose streams are entirely vertical in direction. The extinguishing of a gas gusher with compact streams is based upon the use of the stream's dynamic force: it "pierces" the gas gusher and separates (isolates) the burning flare. The formation of steam, which reduces the temperature and the oxygen content in the combustion zone, also helps to put out the fire.

Turbojet installations are widely used to extinguish gas and gas-and-oil gushers. The fire is extinguished by means of a fire-quenching stream that consists of a mixture of the turbojet engine's exhaust gases and sprayed water. The essence of this method is the fact that the fire-quenching stream from the installation is placed under the base of the burning gusher in order to separate the gusher's combustion zone from the well-head equipment.

After the fire is extinguished, a second and no less complicated task is resolved--that of capping the gusher, for which purpose the methods described above for closing the master control gate, killing the well, and removing oil and gas are used, and also underground nuclear explosions are used.

Operations directly at the well head for eliminating a gusher are performed by personnel of special subunits with the participation of the firefighting service. The personnel of other services and formations for preparatory operations in the danger zone are involved only after they are given special instructions and provided with protective equipment and special clothing.

Operations at the well head and on adjacent ground are performed under the observation of firefighters, who provide water protection to the workers and continuous feed of water into the gushing stream and to the surrounding metal structure.

The extinguishing of gusher fires involves serious danger for people. Therefore, in solving organizational and practical questions for eliminating emergencies, measures are defined that will provide for people's safety and also protect firefighting and other equipment. In addition to the general safety measures, personnel are given an "acclimatization" for work in a high-temperature environment. For this purpose, the time that people spend continuously in the zone of the fire's heat effects is increased gradually, and continuity in extinguishing the fire is achieved by working the personnel in two or three shifts.

Prior to the start of operations at the head of a spouting well and in the zone adjacent thereto, the surrounding air is analyzed for the presence of gases that are potentially explosive or toxic. On this basis, means for protection are determined, and routes for people to approach the well and to leave the danger zone are established.

All operations in the zone where gas is present are performed by personnel dressed in individual means of protection (the staff establishes the types of protective means) and only with supernumeraries. The supernumeraries should know the initial symptoms of toxic effects, know how to extend first aid, and also know the routes for evacuating victims.

During operation in a zone where there is a risk of a gas explosion, only sparkfree tools should be used, and the workers' shoes should not have metal reinforcements or steel nails.

In establishing work periods and rest periods for personnel in an environment where there is gas, consideration is given to the degree to which gas is present, the nature of the work and climatic conditions. Rest time should be no less than the length of time spent working in the protective equipment. It is reduced only when necessary to rescue people. The period for continuous work at a spouter should not exceed 15 minutes.

People who work in a high-temperature area should be dressed in special clothing. Moreover, the workers' clothing must be sprayed continuously. Water cannon are allocated for this purpose.

Metal or wooden shields padded with asbestos fiber are used to protect people from stones and rock thrown by the gusher. Moreover, temporary awnings are constructed and, for protection against radiant heat, shields are provided. Special earmuffs are used to protect the hearing organs from the noise made by the stream of gas.

The use of VV's [explosives] must be guided by the appropriate instructions. Work on preparing the charge, placing it in the case, installing the electrical detonators, and suspending it should be carried out only by explosives specialists.

In order to extend urgent medical assistance to the injured, a medical post is organized close to the place where the fire is being extinguished.

With the coming of darkness, during fog or snowstorms, and also during thunderstorms, all operations at the gusher head and in areas where gas is present cease, except for work connected with rescuing people.

Safety measures during the preparation for and conduct of operations for extinguishing and capping gushers are set by special instructions, the contents of which should be known to all personnel. The chief of the staff names one of his assistants to be responsible for insuring operating safety and for observing safety measures.

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