THE DNEPROGES-II HYDROELECTRIC PLANT—PROJECT
OF THE NINTH FIVE-YEAR PLAN

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The increase in the consumption of electric energy in the unified power system of the South, with a steady
tendency toward further relief of the daily load graphs, makes it necessary to put into operation large thermal
and nuclear electric plants, as well as hydroelectric and pumped-storage plants for covering the peaks.

The search for possibilities of fuller utilization of the hydropower resources of the Dnieper River, the main
waterway of the Ukraine, disclosed the convenience of increasing substantially the installed capacity of the V. I.
Lenin Dneprovsk hydraulic development. The premises for this conclusion are the following: a) the large number of
hours of utilization of the existing hydroelectric plant (5810 h/yr); b) the high degree of regulation of the Dnieper
River flow by means of the upper reservoirs, in particular the Kremenchug; c) the incomplete utilization of the
available energy during the passage of spring floods, representing a possible additional output of 500 million kWh/yr
(the operating regimen of the reservoir system on the Dnieper River, subject to satisfying the demands of all the
water consumers, leads to the need for idle overflows at the hydraulic developments during years of average runoff);
d) a sufficiently high head of the hydraulic development (24.2 m); e) favorable conditions at the downstream side
of the hydraulic development, which permit increasing the amplitude of the water-level fluctuations, without doing
appreciable damage to the bank zones.

As a result of design and of water-management and technical-economic analysis, the feasibility of constructing
at the site of the hydraulic development a second powerhouse with a capacity of 828,000 kW was demonstrated
(Fig. 1).

The water-management and hydraulic analyses indicated that 21 overflow openings in the existing dam could
be used to supply water to the turbines in the new powerhouse; the remaining 26 overflow openings ensure the pas-
sage of the design regulated flood, without additional heads upstream. The construction of a second hydroelectric
plant at the site of the V. I. Lenin Dneproges plant, with an additional mean long-range annual output of 500 million
kWh, was highly effective. According to the design
data, the cost per kilowatt of installed capacity was
105 rubles, which is substantially below the cost
per installed kilowatt at other hydroelectric plants
in the Dneprovsk system. The prime cost of elec-
tric energy for the second stage of the Dneprovsk
hydroelectric plant is 0.44 kopeck/kWh. With
respect to the pay-off period, the hydroelectric
plant is fully satisfactory.

Simultaneously with the development of
recommendations for construction of the second
stage of the Dneprovsk hydroelectric plant, the
problem of increasing the discharge capacity of the
present three-chamber navigation lock at the site
of the hydraulic development was also studied.
In connection with the development of freight
traffic in the Dnieper River, already by 1960 the
existing lock ensured the passage of vessel with a
freight capacity exceeding by a factor of 1.3 the
design freight capacity (1.9 million tons). In the
future, the volume of freight should increase to
20 million tons /yr. Moreover, the clear dimensions of the existing lock do not permit operating in the Dnieper River basin the more economical types of vessels already being used in other basins of the USSR. Thus, there arose the need and desirability of constructing another navigation lock system simultaneously with construction of the second stage of the hydroelectric plant. Design data were used for justifying the technical-economic advantages of constructing a single-chamber, single-stage lock. The adopted alternative has excellent technical-economic indices. The pay-off period for the second lock is 3.4 years.

The reconstruction of the Dneprovsk hydraulic development involves great difficulties, the main ones being: a) the need for properly incorporating the new structures into the existing complex, since in view of its layout and architectural solution the V. I. Lenin Dneprovsk hydraulic development is a classical example of enlightened coordination between engineering design and technical, constructional, and architectural requirements; b) the limited extent of free areas for location of the new structures; c) a lack of exact data on the present state, strength, and stability of the concrete spillway and lock; d) the need for maintaining the normal operating conditions of all structures in the existing hydraulic development during construction of the new one; e) the need for conserving the existing transport and other engineering communications passing through the structures of the existing hydraulic development during construction of the second stage; f) the need for carrying out the construction work by using an organizational scheme and methods which will disturb to a minimum possible degree the living conditions in the city, which is divided into two parts by the hydraulic development.

The V. I. Lenin Dneproges hydroelectric plant is an architectural monument, recognized in the Soviet Union and in foreign countries. For this reason, an especially complex problem for the designers was the development of a layout and architectural-planning solutions for the new structures which would not lead to a loss of the prestige of the hydraulic development.

In the preliminary project, prepared by the Ukrgidroproekt during 1967-1969, several alternatives for location of the new powerhouse and lock were developed. As a result of the technical-economic analyses and of numerous discussions held by the engineering and architectural departments on the alternatives then being considered, the alternative of locating the second powerhouse adjacent to the dam on the left bank was adopted and is now being carried out. The second navigation lock is located parallel to the existing lock, at a distance of 115 m from it, toward the left bank. The second powerhouse, with a lowered generator room, is constructed as close as possible to the left bank and is curved in plan, thus following the contour of the spillway (Fig. 2).