INVESTIGATION OF METHODS AND PRACTICES OF DETERMINING
THE ACTUAL ECONOMIC EFFECTIVENESS OF WATER
DEVELOPMENT SYSTEMS

G. O. Levit

Perfection of technical and economic calculation methods for complex hydro-systems can be achieved to a
great extent by study and analysis of the actual economic effectiveness of these systems, which require large capi-
tal investments. In making an objective evaluation of the economic effectiveness of such systems, it is necessary
to adopt for each of their components a precise set of the basic economic indices. There are three groups of these
indices, depending on their economic characteristics: (1) those characterizing the general effectiveness of the
systems under study (here, primarily, belong the indices showing the actual profitableness and utilization of funds),
(2) those determining the relative effectiveness in the form of a coefficient of the actual effectiveness (re-pay
period) and, connected with it, an index of the actual production cost of the components of the complex hydro-
system under consideration, (3) those evaluating the dynamics of labor productivity and related to it, the supply
of funds. In addition to these, a detailed quantitative and qualitative appraisal of the actual economic effective-
ness of the water storage as well as an evaluation of district creation within the hydro-system is necessary.

All the indices should be analyzed and determined for the whole period of operation of the system compon-
ents under examination and should be compared with analogous indices of an alternate plan for the given branch
and economic district.

Particular attention should be paid to establishing a comparison between the initial economic and branch
data. Thus, initial data of the conjugate objects (branches) must reflect the actual cost, taking into account the
reappraisals of funds and the effect of other factors as, for example, improvements in work organization, etc.

Following are outlined the methodological and practical recommendations, developed as a result of determInation
of the actual economic effectiveness of the Upper-Svirsk complex hydro-system.

The selection of the Upper-Svirsk hydro-system for this examination was determined by the fact that its
hydro-electric station (HES) has been in operation for 13 years and is performing typical hydro-electron functions
in the system such as participating in covering the peak loads and regulating the frequency. The Dubrovskoye
thermo-electric station (TES), which was built during the same years in the same power system and operated on the
local fuel at comparable capacities, can be taken as a substitute.

Construction of the Upper-Svirsk hydro-system was begun before the Great Patriotic War. However, in
August, 1941, as a result of war activities, the construction area was flooded. Construction was completed in 1952
and temporary use begun in the same year. Following the high floods of 1953, Onezhskii Lake was filled so that
electric generation reached its design level. The hydro-station is equipped with four turbines, each having a cap-
acity of 40 MW. It is connected by 220-kV electric transmission lines with the Leningrad and Karelskii power systems.

The substitute Dubrovskoye thermo-electric station was built during the pre-war years. This station (200 MW)
was the largest electric generating plant in the system, and was considered as a reliable source of power for Lenin-
grad because the fuel, consisting of local peat resources, was available. During the Great Patriotic War, the
Dubrovskoye station was totally destroyed and its restoration required approximately the same capital, labor, and
time investment as would have been required by a new station. In this respect construction of the Dubrovskoye
station was found to be on equal conditions with the Upper-Svirsk station. The first phase (200 MW) was accom-

An important factor in economic effectiveness of production is the extent of utilization of the fixed and
operational funds. The dynamics of utilizing funds in power production provides only an indirect characteristic of
the effectiveness of operation in electric stations and sometimes also in the whole power systems. This is because
practically all of the operational, technical, and economical indices are dependent on the work conditions in the

Fig. 1. Fund utilization curves at Dubrovskoye (1) and at Upper-Svirsk (2).

Fig. 2. Cost-price curves of electric power. 1) Upper-Svirsk hydro-station; 2) Lenenergo hydro-station; 3) Dubrovskoye thermo-station; 4) Lenenergo diesel-station.

Note: The cost of energy at the Lenenergo diesel-electric station is taken as 100% in 1952.

power plants, which in turn are determined by the diagrams for electric loading. Increasing fluctuation in the daily load diagrams, particularly in the north-west regions of the European part of the USSR, forces the power plants, especially the hydro-plants, to work under conditions which are considerably different from optimum from the viewpoint of utilization of fixed funds.

Much better utilization of fixed and operational funds occurs on thermo-electric stations (TES). Outstripping of the rates of growth in electric loading relative to the rates of putting into operation new power capacities increases the number of working-hours of such stations, particularly those where operation of the power equipment has been mastered. The operation of hydro-electric stations (HES) during peaking considerably improves the utilization of fixed and operational funds on the thermal electric stations.

The regular $\phi_n$ and the cost $\phi_c$ indices of fund utilization are shown below:

$$\phi_n = \frac{W_e}{K_{\text{fixed}} + K_{\text{op}}},$$

$$\phi_c = \frac{W_e T}{K_{\text{fixed}} + K_{\text{op}}},$$

where $W_e$ is the yearly output of electric energy in kW-hours; $K_{\text{fixed}}$ is the amount of fixed funds in rubles, (from data after re-evaluation of funds); $K_{\text{op}}$ is the amount of yearly operational (circulating) funds in rubles; $T$ is the average tariff in the system in kop/kW-h.

The fund utilization curves at the Upper-Svirsk hydro- and the Dubrovskaya thermo-station are shown in Fig. 1. More favorable working conditions at Dubrovskoye considerably improve its fund return.

*In power systems where electric heating is developed the electric loading imposes an additional and sometimes significant effect upon the technical and economical indices of the power plants and power systems.*