

Organizational Partnership for Building, Reconstruction and Capital Overhaul of Hydrotechnical Structures

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Abstract: Process of partnership for building, reconstruction and capital overhaul of engineering structures based on close cooperation among investors, contractors, designers and number of authorities' departments of control and expertise. The study contains general organizational algorithm of partnership in investment process in building, reconstruction and capital overhaul of hydrotechnical engineering structures, prescribed by Russian laws and building practice. Steps of cooperation algorithm are considered in details, interrelations between investors and contractors on each stage of investment project are specified. Common techniques for determining of probable harm, caused to life, health of persons and property as a result of probable accidents of hydrotechnical engineering structures had discussed according with existing legislation.

Key words: Investment and building process, hydrotechnical engineering structures, project documentation, engineering surveys, material damage, social damage, economic efficiency

INTRODUCTION

The Russian Federation is provided with water resources in volume, exceeding the critical minimum established to the UN which is necessary for satisfaction of needs of the population. Complex use of water resources is inseparably linked with requirement of construction of the Hydrotechnical Engineering Structures (HES) equipped with the necessary appliances having a great influence on the economic, ecological and social sphere of the Russian Federation in general and its certain subjects (Abdrazakov and Lazareva, 2012).

Relevance of investment in the direction of reconstruction, reconstruction and capital overhaul (ensuring technical reliability and safe operation of constructions) of new HES is proved by increase of demand for effective use of water objects including rational use of water resources at observance of interests of all water users. The importance of this statement is reflected also by basic provisions of the Federal target program "Development of a Water Management Complex of the Russian Federation in 2012-2020" accepted by the Government of the Russian Federation. The amount of total financing of the Program in 2012-2020 will make 523 billion rubles (App. 8.9 billion USD) including at the expense of means: the federal budget 292 billion rubles

(App. 4.9 billion USD); the consolidated budgets of subjects of the Russian Federation 108 billion rubles (App. 1.9 billion USD); private investment 123 billion rubles (App. 2.1 billion USD).

Thus, HES aren't only one of the most important life supporting structures but the large-scale objects of investments by means of budgetary funds. The key matters of this are well-balanced organization of HES construction process as well as optimizing of the preliminary procedures for designing and contracting, which should be based on reliable techniques for determining and estimating cost of construction and possible harms caused by exploitation of HES according with existing legislation (Abdrazakov *et al.*, 2014; Abdrazakov *et al.*, 2014).

MATERIALS AND METHODS

Main part: The full cycle of performance of necessary procedures of erection of the hydrotechnical engineering structure makes investment and construction process in the form of consecutive realization of the interconnected stages (substages) and in principle from the methodological point of view differs in nothing from operations at construction of other real estate object (Fig. 1).

Table 1: Interconnection of phases of investment and building project with process stages of HES erection

Phase of investment and building project	Stage of investment and building process	Aim	Note
Pre-investment	Pre-design	Reasoning of expedience of future project with adjustment of funding source	Making of "application about aims" in case of use of non-state financing which reflects the goals of investor in relations of future object
Investment	Design Purchasing (production) equipment Object erection	Development, coordination, implementation of design estimate documentation	Carrying out geodesic, geological, hydro-meteorological, ecological surveys Purchasing of mechanical equipment and servicing appliances of HES
Productive	Commissioning and putting structures into exploitation in full power mode	Introduction and final achievement of aims of investment building project	

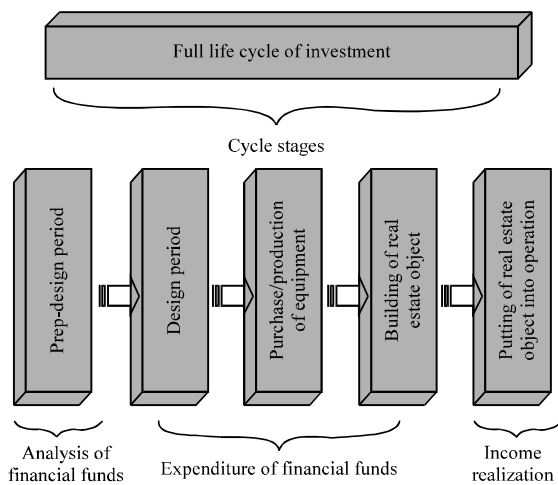


Fig. 1: Cycle of investment and building process on erection of HES

The milestone of investment and building process of HES is investment and building project, phases of which are organically combined with stages, listed above (Table 1).

We will note in details substages of predesign and design stages of the presented cycle of process (Table 1) which have basic value at construction, reconstruction or capital overhaul of HES.

Realization of a predesign stage of a cycle means detailed study of the financing of the investment and construction project. Today the arrangement of HES by a type of property is: federal property 7%, property of territorial subjects of the Russian Federation 15%, municipal property 11%, not municipal 54%, ownerless structures 9%, other types 4%.

At realization of a design stage of a cycle the greatest attention should be paid to a selection of the design organization. First not all design organizations have the mandatory certificate of the Self-Regulating Organization (SRO) on the admission to a certain type of works (former license) in particular on carrying out engineering surveys. Secondly, the less production communications there are at this stage, the less failures there are at a stage of

coordination of the feasibility study, creation of necessary design estimate documentation, acceptance of documentation and payment for work.

According to the Article # 706 of the Civil Code of the Russian Federation if the duty of the contractor to perform the work provided in the contract personally does not follow from the law or the contract, the contractor has the right to employ other persons (subcontractors) to execute the contract. In this case, the contractor acts as a general contractor. It should be noted that the duty of a general contractor follows from this formulation, first of all by own efforts to fulfill obligations under the contract and already in the second turn by means of subcontractors. Thus, existence at the design organization of SRO-certificate on the admission to implementation of functions of a general contractor both in design and engineering surveys is considered optimal because of the average cost of performance of functions of the general contractor (5-7%) and function of the construction manager (1-2% of the total cost of erection the structure). Specifics of the HES define the main set of documents regulating their design in the Russian Federation; 1) the resolution of the Government of the Russian Federation of February 16, 2008 #87 "About structure of sections of design documentation and requirements to their contents"; 2) town-planning code of the Russian Federation; 3) Construction Norms and Regulations (SNIP) 33-01-2003 "Hydrotechnical engineering constructions. Basic provisions"; 4) RD 31.3.05-97 "Codes for technological design of seaports"; 5) RD 31.3.01-93 "Guide to technological design of seaports"; 6) Construction Norms and Regulations (SNIP) 3.07.02-87 "Hydrotechnical engineering sea and river transport constructions"; 7) building codes (SP) 41.13330.2012 "Concrete and reinforced concrete hydraulic structures", etc.

According to the (1) generally HES doesn't refer to linear objects (such as pipelines, automobile and the railroads, power lines, etc.) as for linear objects dimensional length many times over (in tens, hundreds) exceeds width (Abdrazakov and Egorov, 2004). Therefore, HES refer or to objects of non-productive appointment (the building, a structure, a construction of household

appointment) as end production isn't the result of implementation of projects. However, it is possible to refer HES to objects of production purpose in a case when for example HES is a part of the hydro-power station, HES' basin used for aquaculture, etc.

Regardless of contains of the investor's requirements design estimate documentation should be developed according to (1). In case when the requirements demand developing of the section which isn't subject of (1) contractor informs investor in special letter. The investor has no right to prescribe in technical requirements the methods and volumes of the planned construction works and surveys. At the time of performing of construction investor can only recommend in special letters to contractor the preferred types of equipment and structure's parameters. In general, all relationship between a contractor and an investor is regulated in the special letters the maximum term of the answer on which is no longer than one calendar month or 30 days (by standard regulations of the internal organization of federal executive authorities, #452). Further, all letters are attached to the first or fourth section of design estimate documentation before sending it for mandatory state experts review.

Engineering surveys should be coordinated with investor, local authorities (municipal, regional or rural settlement), communication lines owners, land users and owners, gas-transporting organizations. Management of the coordination process is generally a paid service and could be provided by construction manager.

The total cost of construction, reconstruction, capital overhaul of the hydrotechnical engineering structure determines by consolidated budget calculation. For example, the total cost of construction of the hydrotechnical engineering structure in the Saratov region (earth dam, water collector, ice-protective construction, a tubular water outlet and a culvert was 114 million rubles (App. 1.9 million USD). Characteristics of this construction are: surface area 0.8 km²; volume at water top level 2.4 km³, length of a dam 1.3 km; width of a dam 4.5 m; height of a dam 11.5 m, construction volume 130000 m³. Structure of the design estimate documentation was: design 50%; engineering surveying 27%; soil surveying 7%; hydrological study 5%; state expert review 11%.

For preliminary estimation of total cost of construction of the hydrotechnical engineering structure integrated indicators' method is suitable. This method could be implemented without making design estimate documentation on a base of "Compendium of replacement cost's consolidated indices for buildings and constructions for revaluation of fixed assets and indices

for recalculation of the specific cost to current prices level. However, it must be kept in mind that preliminary estimated cost may differ to 15% from consolidated budget calculation.

State expert review (according to Article #49 of Town-planning Code) is carried out for results of the engineering surveying (which are carried out for preparation of design estimate documentation), design documentation and for consolidated budget calculation.

According to the Town-Planning Code location of the construction site is a fundamental factor of definition of the state expert reviewer. It is an executive authority of the subject of the Russian Federation or subordinated to it state (budgetary or autonomous) establishment. The minimum terms of carrying out state expert review are legislatively not regulated, however, maximum, according to the regulations of Federal Agency on Construction and Communal Services shouldn't exceeded by 60 days.

The approximate size of remuneration for carrying out state expert review depends exponentially on the consolidated budget calculation (including cost of Engineering surveying) and increases from 1% (for large projects from 10 million USD) to 30% (for small projects up to 0.2 million USD).

In the course of construction of HES the mistakes in project documentation which state expert reviewer could not notice can be revealed. In this case general contractor informs construction manager and state expert reviewer then the issue of correction of project documentation and repeating the review procedure is directly resolved. Responsibility for quality of project documentation is regulated by contract and rests with the Designer. Corrections of project documentation are carried out by the designer free of charge and in the shortest possible time. As a rule, time of responsibility and duty of free elimination of mistakes in project documentation doesn't exceed 3 years. The cost of repeated state expert review makes about a third of the cost of initial review and is paid by construction manager. If repeated procedure caused by designer's mistakes, it compensates all additional charges for review to the Construction Manager voluntarily or in a judicial proceeding. However if mistakes in project documentation don't decrease reliability and safety of main bearing structures, they could be mentioned in the positive state expert review without repeating review procedure.

The obligatory part of designing of construction or reconstruction of HES should be the calculation of harm which can be caused to life, health of persons and property as a result of probable accidents of HES.

Designing of overhaul of HES will contain the calculation of probable harm in case of significant change of design parameters and capacity of structure, e.g., volume of a basin because of a forest covering, plowing of the land, presence of lakes, etc. (Abdrazakov and Scherbakov, 2008; Abdrazakov *et al.*, 2014; Abdrazakov *et al.*, 2003). Otherwise, the calculation of probable harm will be executed only according to the investor's requirements.

Calculation of probable harm is regulated by the federal law #225-FZ "About obligatory insurance of a civil responsibility of the owner of dangerous object for infliction of harm as a result of accident on dangerous object", the Resolution of the Government of the Russian Federation #876 "About the approval of rules of determination of size of financial security of a civil liability for the harm as a result of accident of the HES" and also the federal law #117-FZ "About safety of HES". Common principles of determination of probable harm are defined by requirements of "Code of professional activity of insurers", developed and approved by the National Union of Insurers of Responsibility (NSSO) in 2011. The "Code" is more focused on an assessment of possible social damage which puts harm of life, health, property and violates the living conditions. The "Code" establishes not only a technique of definition possible victims' number but also the volumes of insurance payments. However, regarding estimating of material damage or number of persons to which property harm can be done, except for the owner of dangerous object, the "Code" gives rough estimate which doesn't fully reflect material damage to the fixed assets of the industrial enterprises, traffic and communication lines, housing stock, agriculture, forestry, fishery, etc. and also doesn't contain expenses on elimination of consequences of an accident.

RESULTS AND DISCUSSION

According to recommendations of the federal service for supervision of environment, Technology and Nuclear management, at the calculation of probable harm as a result of accident of HES additionally to regulations of "Code of professional activity of insurers" may be used procedures, listed in "Techniques of determination of harm caused to life, health of persons and property as a result of failure of navigable HES" approved by Emergency Committee and Ministry of Transportation of Russian Federation. Joint use of these documents is caused by need for painstaking determination of components of probable harm in case of accident the HES.

The "Techniques" determines all missing factors listed above on the basis of the calculated natural indicators of probable harm by means of these procedures:

- The material damage to the fixed assets of the industrial estimates by the cost method on the residual value of assets (Abakumov, 2014a; Abakumov, 2014b; Abakumov, 2013; Abakumov, 2012) taking into account their damages from accident
- The material damage to housing stock determines by a comparative method with allocation of common units of stock which cost extends on other units
- The damage to agriculture, forestry, fishery and ecological damage determines according to the land, forest and environmental protection legislation
- Other types of real damage and of consequences of an accident calculates as a percentage of the total value of damage

Definition of the general real damage is a necessary element for declaring of the HES. The declaration of safety of HES obligatory contains data on financial security of a civil liability for harm which can be caused as a result of accident of HES: the size of own means within which the owner (HES operator) accepted risk of indemnification, and also the size of the insured sum determined by the contract of insurance of risk of a civil liability (Avilova, 2007a, b; Avilova *et al.*, 2014; Avilova and Strekozova, 2012; Grabovyi *et al.*, 2014). The size of the general real damage ($D_{general}$) also allows to prove economic efficiency ($E_{economic}$) of construction, capital overhaul or reconstruction of the HES:

$$E_{economic} = \frac{D_{general}}{I_{capital}} \quad (1)$$

where, $I_{capital}$ capital investments on construction, capital overhaul or reconstruction of the HES determined by consolidated budget calculation.

The size of the general real damage in a Eq. 1 considered as the prevented damage and is explained by character of a construction, its flood-preventive function.

If financing of the project is conducted by budgetary funds, the budgetary efficiency rate characterizing expediency of capital investments of construction, capital overhaul or reconstruction of the HES has to be in range of 8-15% on average and according to some recommendations even >15%. This doesn't extend on the projects financed by non-budgetary funds, however, value of coefficient of economic efficiency anyway has to be more than a zero. In certain cases besides the size of

damage budgetary efficiency includes the size of profit on water supply of the population. The technique of an assessment of efficiency of capital investments in HES projects is focused on productivity and doesn't consider a time factor. Use of the simplified technique is based on an assumption of uniform distribution of a cash flow on project's life cycle. In that case when financing of the project is conducted by private funds, it is recommended to use the "Methodological recommendations about an assessment of efficiency of investment projects" approved by the Ministry of Economics of the Russian Federation.

The final step of the design period of a life cycle of investment is transfer by the designer to the construction manager of the demanded number of copies of design estimate documentation, according to the contract for designing and surveying (as in paper and in electronic form) and also the positive state expert review on:

- Design documentation
- Consolidated budget calculation
- Surveying, then it is possible to start erection of the HES

Summary: According to Russian legislation and codes process of partnership for building, reconstruction and capital overhaul of HES based on close cooperation among investors, contractors, designers and number of authorities' departments of control and expertise. Technical and economic matters of the efficiency of HES construction could be determined with general algorithm of partnership. Thus, all necessary steps of cooperation are considered in details, interrelations between investors and contractors on each stage of investment project are specified in Russian laws and building practice as well as common techniques for determining of probable harm caused to life, health of persons and property as a result of probable accidents of HES.

CONCLUSION

The matters, considered above, establish the general basis for balancing of organization of HES construction process and optimizing of the preliminary procedures for designing and contracting according with existing legislation. It should be taken into account, what only common principles and techniques are obligatory to perform for all participants of HES' designing and construction process. Detailed estimation and cost calculation procedures are mainly connected with the set of technical and environmental particularities of the HES which are differs a lot across the regions of the country.

But, through, the following the common principles and techniques it is possible to prove what the main duties and responsibilities of financing of the construction and indemnification of the possible harms are fairly distributed among the key participants investor, contractor and operator of HES.

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