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SUSTAINABLE HYDRO ENERGY USE CONSEQUENTLY ON COST MANAGEMENT

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Abstract: Development of environmental awareness and ever rising need for taking environmental conditions back to the zero stage, the way they were before the construction was built, open the question of hydropower facilities removal from the a riverbed after a given exploitation period. Compromised or endangered stability of a construction can also result in need for premature removal of the facility, before the planned exploitation period is over. The aim of this paper is to present the complexity of one hydro power plant removal project towards sustainability and holistic management of environmental quality. The total cost of structure removal is calculated and compared with the total cost of its construction. There is also a discussion on question of who should bear the expenses of the removal project and recommended answer to a decision maker from a sustainable development point of view. Simulation of removal has been done on example of gravity dam and hydropower plant Paunci on the Drina River in Serbia.

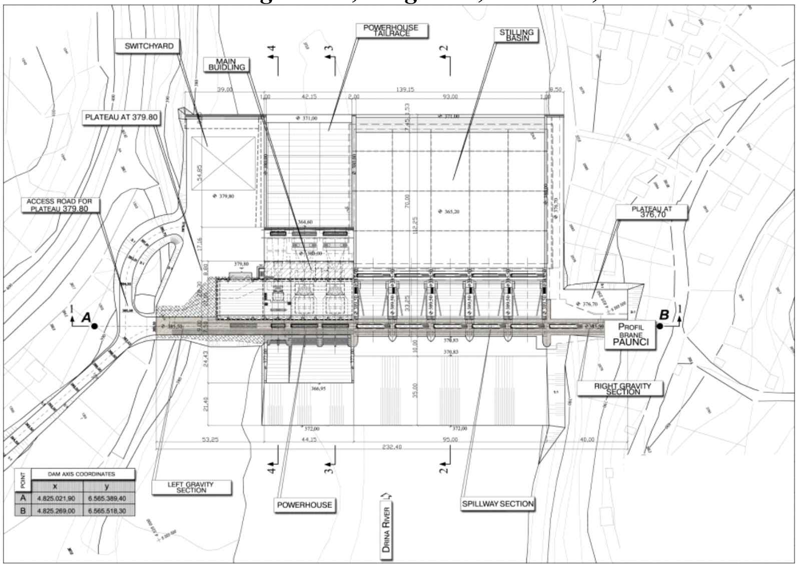
Key words: sustainable development, cost management, removal, environmental zero stage, hydro energy use.

1. Introduction

From a sustainable development point of view, it can be noticed that it is not correct that one generation build a hydropower plant facility and use the benefits of produced electrical energy but to leave the problem of its removal (Kocovsky et al. (2009)) and additional expenses due to endangered stability of construction or environmental deterioration to some future generation (O'Hanley (2011)). In order to determine real energetic efficiency and optimal concept of the watercourse usage, it is necessary to consider the time dimension of all aspects, amounts and costs that affect successful sustainable development achieving. This demands not only to take into account the building expenses considering the environmental criteria within the optimality analyses, but also to consider the removal expenses as well (Stanley and Doyle (2003)).

2. Hydropower Facility

Facility chosen for the removal simulation project management is hydro-power facility Paunci on the Drina River (Serbian-Bosnian border) because it has typical concept of the gravity dam with run-of-river type hydro power plant and the result could be used widely (Stevović et al. (2014)).



Hydropower facility consists of concrete overflow dam placed in the riverbed (Milosevic et al. (2013)). Normal water level is at 384.00 m, as well as the maximum water level, while the tail water level is at 379.51 m. Crest elevation is at 385.5 m, while the lowest foundation elevation (under the powerhouse) is 355.25 m. Powerhouse section is 52m long, while its width varies according to the tailrace width. Overflow section is 27m long, while its width is adjusted to the stilling basin width.

3. Dam and HPP removal methodology and organization

According to the existing project documentation and considering the location conditions, detailed priced bill of quantities is developed, which was afterwards used as a base for dynamic plan of removal. According to the dynamics plan, made using MS Project 2007 software, project is supposed to start with the preparation works which include the building site organization and connecting to the local electrical and water supply installations. Removal works have been divided in two basic phases: Phase 1: removal of the HPP and dismantling electrical, mechanical and hydro-mechanical equipment and Phase 2: removal of the overflow section.

In the both phases of removal, works can be generally divided into four subgroups. First one is dismantling and transport of the equipment that can be used again, which is supposed to be done the same way as during the repair process. Next subgroup includes parts of the facility or the equipment that can not be dismantled, or it would be for some reason too complicated or non-profitable. Such parts should be cut off or removed in any other way and transported to the adequate depots. Third and fourth subgroups include demolition by using appropriate machinery and explosives. Machine demolition has been brought to the highest possible level, while the explosive usage has been predicted to be as low as possible. In order to fulfil environmental demands and to avoid disturbing of the downstream deposit material, removed concrete is supposed to be concentrated within the cofferdam area, where debris recycling equipment would also be placed. In both phases, removal is supposed to be done to the terrain level.

The greatest problem that appears is deposition of such a great quantity of debris. Recycling it in grinder would produce construction material that can be re-used in surrounding towns and building sites for different construction types such as fillings, embankments, beds etc. After the completion of the removal works, building site will be removed in such a way that would leave the environment as close to the state it was in before the building of HPP as possible. Conceptual dynamic plan is developed.

Project management process for this kind of works demands constant coordination between all levels of organizational structure and that would consequently enable rise of efficiency in every scope of works. Besides that, usage of different software solutions from the scope of project management is also important because it maintains the ability to react with adequate speed to a possible changes during the works and thus to prevent effects of unpredicted situations.

4. Results and discussion

Based on the priced bill of quantities and considering all the necessary elements for this kind of works, total investment value of dam removal is calculated and it is 5.618.460,00 €, of which circa 1% is for the preparation works, circa 3% for cofferdam montage and dismantling, and 96% for equipment dismantling and construction removal. Cash-flow chart is prepared.

According to the available technical documentation, the client provided 22.510.170,00 € for the construction works, while the total investment is expected to be 52.145.695,00 €. If the removal expenses would be included in total investment value, the cost of removal would be approximately 10% of the total amount, which means that expected payback period should be proportionally prolonged (max 10 %).

Investments needed for hydropower facilities removal should be included in total account and cost-benefit analysis as the 'external cost' and thus to be the responsibility of the party that built and used the facility.

5. Conclusion and recommendation

In engineering practise, there are only a few examples where financial and technical documentation include developed design for the facility removal and estimated investments for the activities of bringing the environment to the previous condition. This part is usually left to the future user of facility and its surrounding. Simulated project of HPP Paunci removal presents all the necessary works and their investment values. Every item includes clear demands for its accomplishment. It can be concluded that project management in the field of hydropower facilities removal is at least equally demanding and complex problem as the one of the construction process, although there is much less experience in this area. In context of sustainable development and environmental quality, these investments should necessarily be included as the mandatory part of the project documentation and considered obligatory for the party that would derive the benefit from the facility. Special attention considering the size of investment and works should be paid by the decision makers when including renewable energy sources in the concession arrangements.

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