HPP CEBREN

Prepared by: Development and Investments Department

Skopje, 2019

The dam "Cebren" is located at the River Crna Reka, 81 km upstream from its inflow in the River Vardar, near the village Manastir and about 7 km upstream of the Bridge Rasimbegov (Rasimbegov Most).

On this part there is already constructed HPP Tikves with regular accumulation level of 265,00 meters above the sea level, while for the remaining canyon part of Crna Reka there are analyzed several variant solutions for its energetic utilization, while in the preceding study phase of designing, it is accepted to be constructed two dam hydro power plants with significant accumulation space and they are: HPP Galiste with regular accumulation level of 392,00 meters above the sea level and HPP Cebren with regular accumulation level of 565,00 meters above the sea level.

The basic design for the river Crna was made in 1963 by HEP - Skopje. During the period of 1965-1966, a preliminary design for HPP Cebren was prepared, also by HEP - Skopje, the investor of which was "Electric Power Company of Macedonia" - Skopje. In 1973 - 1974 an "Engineering Study" of the dam site "Cebren" on the River Crna on the behalf of the Directorate for Coordination of the Integral Development of the River basin of Vardar - AXIOS was completed. This study was prepared by HEP - Skopje on the basis of the additional researches of the dam site. During the 1974 a basic design with investment study for Cebren dam site was prepared by HEP - Skopje, Civil Engineering Faculty - Skopje and "Yaroslav Cerni" - Belgrade on behalf of the Directorate for Integral Development of the River basin Vardar - AXIOS - Skopje.

During 1984 a techno-economic analysis was prepared by HEP - Skopje and the Civil Engineering Faculty – Skopje. This analysis resulted with selection of the optimal type of the dam Cebren - concrete arch dam, whereas it was accepted as a basis of the future designing.

In 1986, a contract for preparation of an investment technical documentation (preliminary design and investment study) for HPP Cebren on River Crna Reka, by the four designing companies: HEP - Skopje, EMO - Ohrid, Faculty of Civil Engineering - Skopje and IZIIS - Skopje (HEGI). "Energoproject" - Belgrade was assigned as a technical control revision, simultaneously with the preparation of the technical documentation for HPP Cebren. Comprehensive engineering geological researches of the dam site Cebren, required for the preparing of the preliminary design, were performed the same year. Those researches were sufficient for preparation of the main design, regarding their scope and quality. The preparation of the preliminary design with the investment study for the HPP Cebren was completed and revised at the end of 1990.

After preparation of the Feasibility Study for Investment opportunities in the energy sector - Optimization of System Crna Reka for electricity generation, prepared by Exergia SA in 2003 and funded by the PHARE program, an optimal use of the Crna Reka cascade it is proposed.

In February 2016 there was a public announcement (in the Financial Times and the web site of the MEPP) for expression of interest for designing, construction and concession of Cebren and Galiste, on which 11 techno-economic solutions from interested companies were submitted. In February 2017, the Contract was signed with Consultant for preparation of Prefeasibility study, in which as a basis will be considered received techno-economic solutions and overall project documentation so far made for the two hydroelectric plants.

Prefeasibility Study

The aim of the Prefeasibility Study:

- Selection of the optimal technical - economical way of utilizing the remaining hydropower potential with optimization of the existing profiles of HPPs or new ones,
- Selection of optimal useful volume and operating levels of future locations,
- Selection between the options for installing of conventional or reversible HPPs
- Selection of optimal values of installed capacity (flow) for each of the HPPs,
- Location of eventual reversible generators,
- Examining scenarios for construction of hydropower plants and related facilities,
- Proposing of two variants for investment and exploitation of the suggested hydropower facilities. The first variant to include draft mode of participation of legal entities in public privatepartnership (PPP) with ESM and method of construction by ESM.

The assignment of the subject Prefeasibility Study is to make a comparison of the following technical solutions:

- The Study prepared by Exergia in 2003,
- Proposals from potential concessionaires from 2016,
- An innovative solution within this Prefeasibility Study.

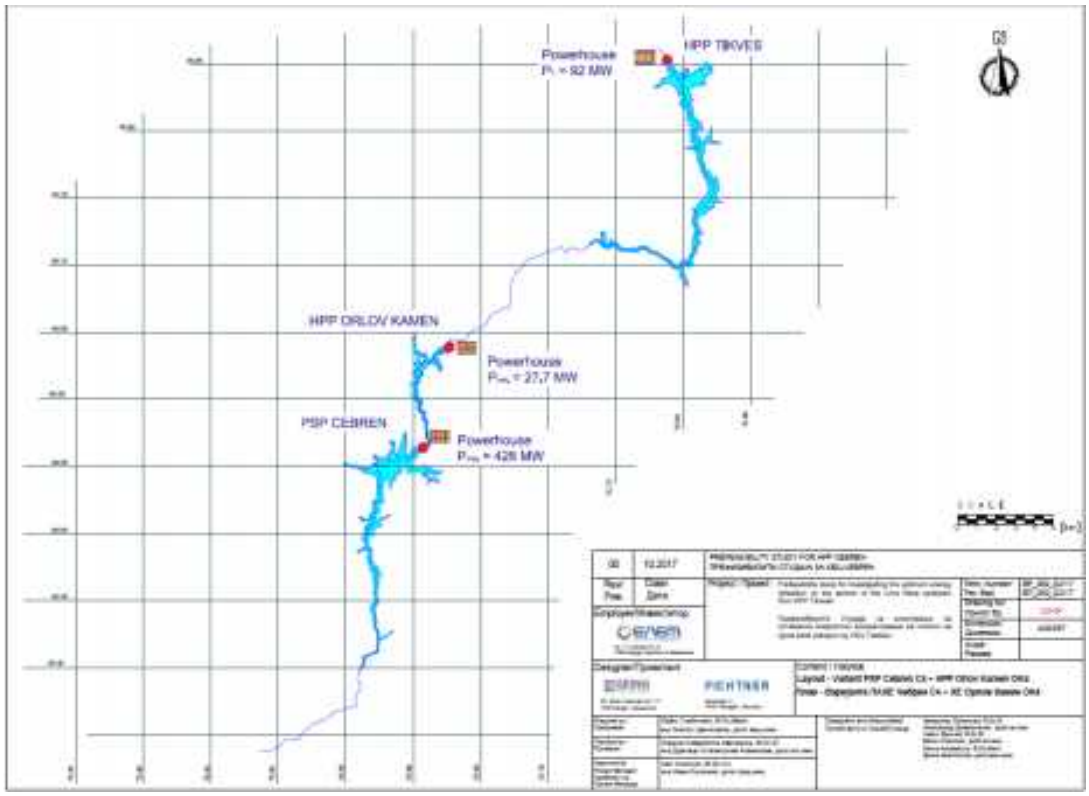
36 possible variants are being elaborated and a ranking list is provided with technical solutions, placed according to the criteria for optimization – maximization of the actualized net profits of the concessionaire. During the calculations, HPP Tikves is not taken into consideration.

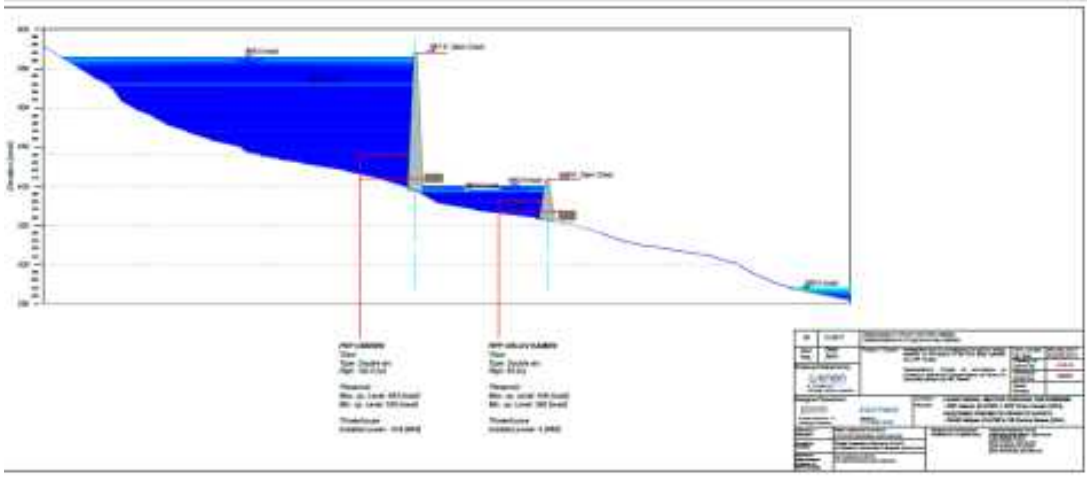
4 (four) best ranked variant solutions

Pump Storage Hydropower Plant (PSPP) Cebren + HPP Orlov Kamen

Total storage volume (Cebren):	915 mil. m^3
Useful storage volume (Cebren):	555 mil. m^3
Useful storage volume (Orlov Kamen):	14.9 mil. m^3
Installed power PSPP Cebren + HPP Orlov Kamen:	458 MW

Annual production PSPP Cebren + HPP Orlov Kamen:	1044 GWh
Annual consumption:	1011 GWh
Investment costs PSPP Cebren + HPP Orlov Kamen:	553 M€
Economic EIRR	4.31 %
Financial FIRR	- 0.12 %
Benefit/Cost	0.71

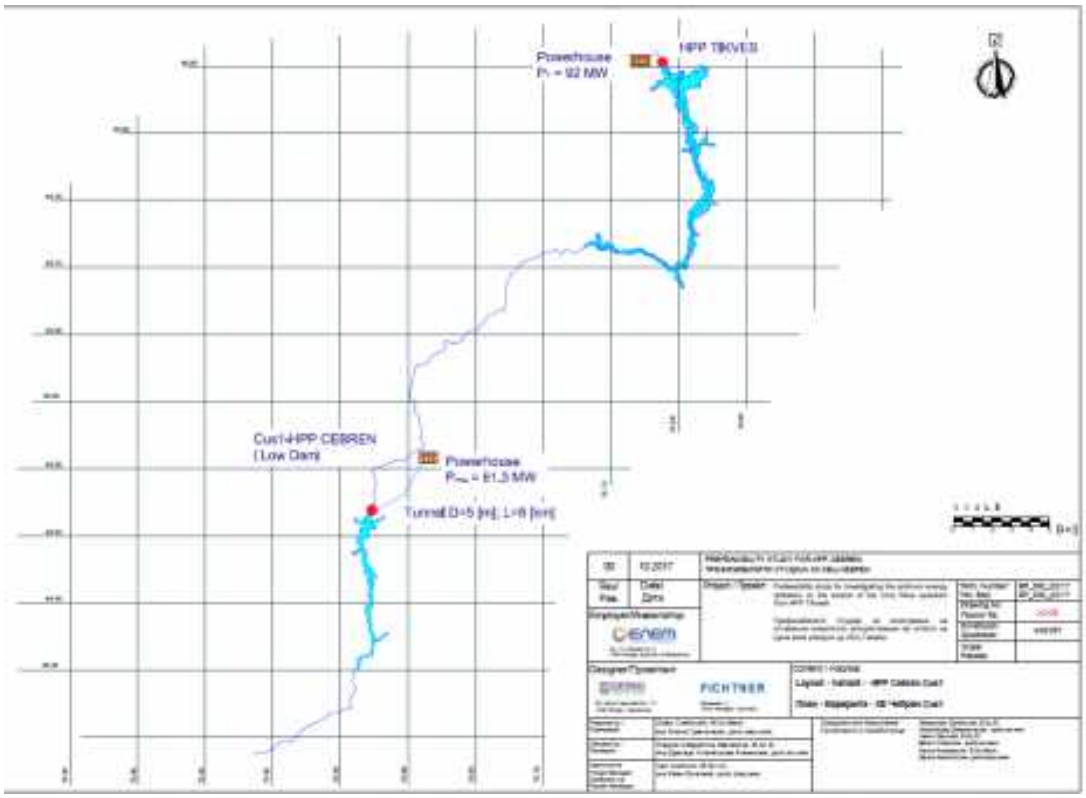


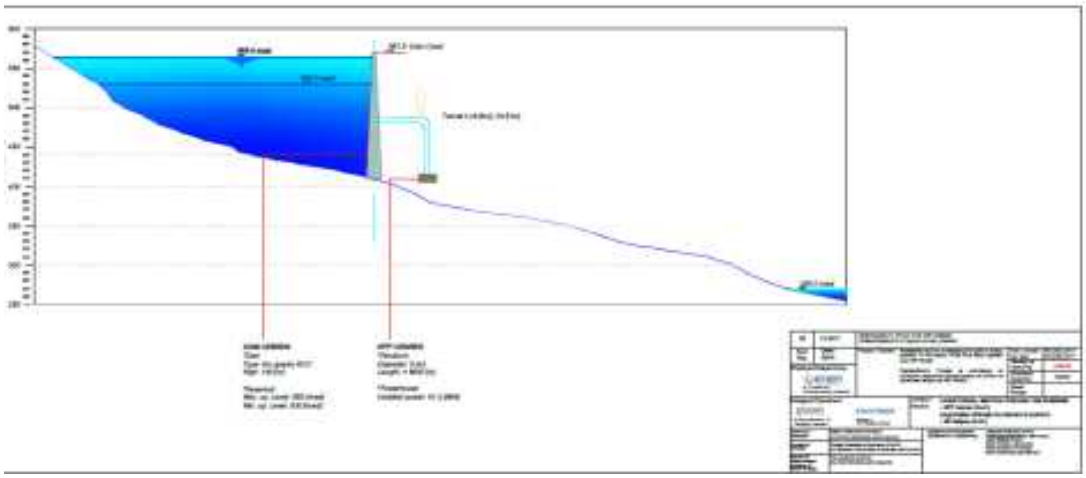


Conventional HPP Cebren (dam – downstream site, tunnel 8 km)

Total storage volume (Cebren): 250 mil. m^3

Useful storage volume (Cebren):	74 mil. m^3
Installed power:	61.3 MW
Annual production:	183 GWh
Investment costs:	189 M€
Economic EIRR	3.85 %
Financial FIRR	- 0.48 %
Benefit/Cost	0.52

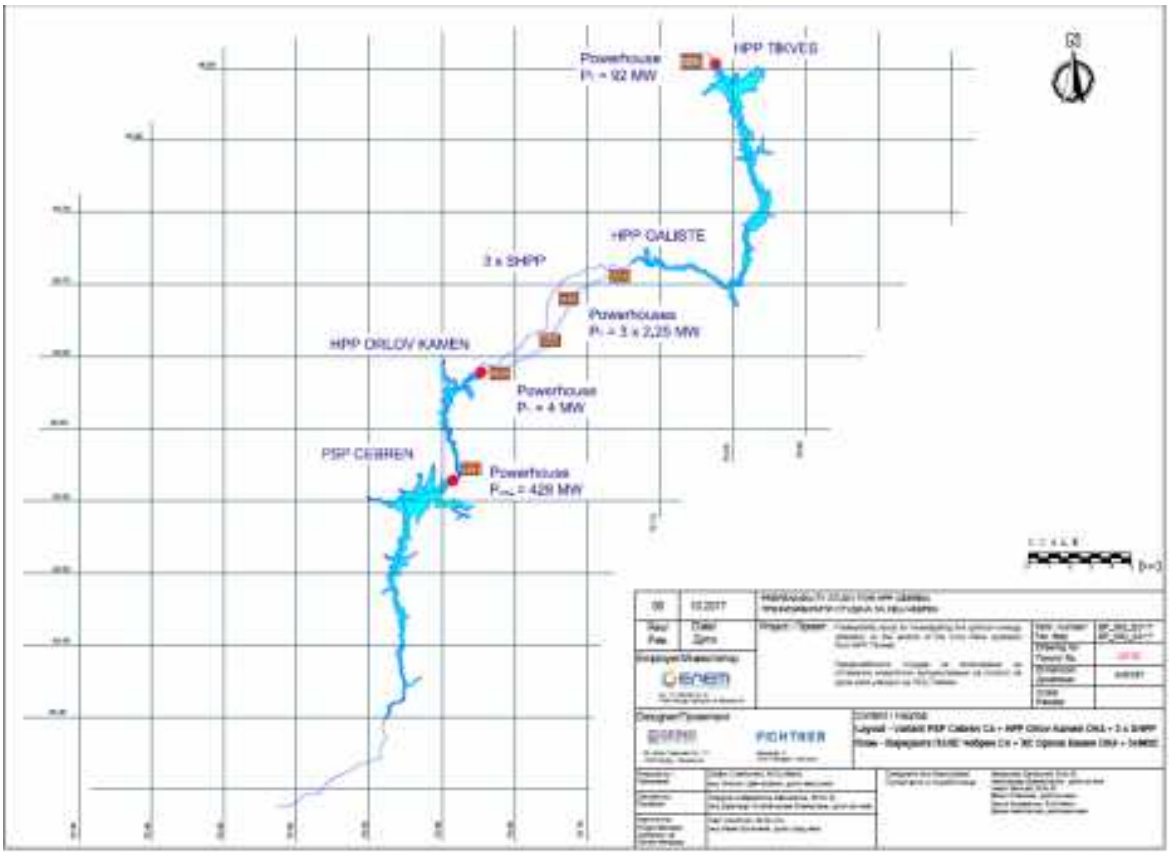


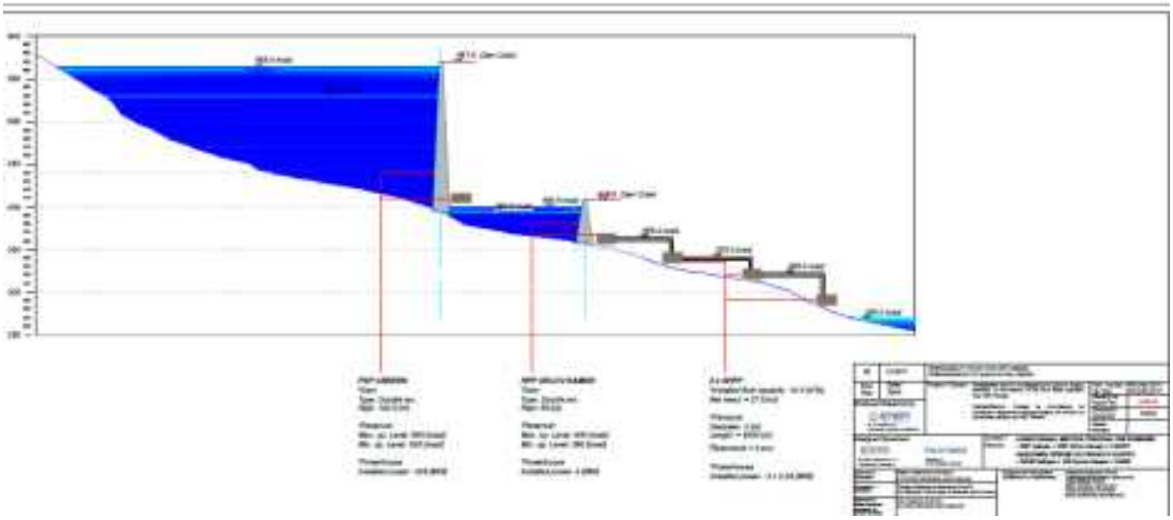


Pump Storage Hydropower Plant (PSPP) Cebren + HPP Orlov Kamen + 3 SHPP

Total storage volume (Cebren):	915 mil. m^3
Useful storage volume (Cebren):	555 mil. m^3
Useful storage volume (Orlov Kamen):	14.9 mil. m^3

Installed power PSPP Cebren + HPP Orlov Kamen + 3 SHPP:	458 + 6.75MW
Annual production PSPP Cebren + HPP Orlov Kamen + 3 SHPP:	1044 + 53.3GWh
Annual consumption:	1011 GWh
Investment costs PSPP Cebren + HPP Orlov Kamen + 3 SHPP:	553 + 9 M.€ = 562 M.€
Economic EIRR	4.31 %
Financial FIRR	1.49 %
Benefit/Cost	0.8





Conventional HPP Cebren (dam – downstream site, tunnel 8 km) + dam Orlov Kamen + 3 SHPP

Total storage volume (Cebren): 250 mil. m^3

Useful storage volume (Cebren):	74 mil. m^3
Installed power:	61 + 6.75 MW
Annual production:	183 + 53.3 GWh
Investment costs:	189 + 9 + 33 M.€ = 231 M. €
Economic EIRR	3.85 %
Financial FIRR	0.70 %
Benefit/Cost	0.6