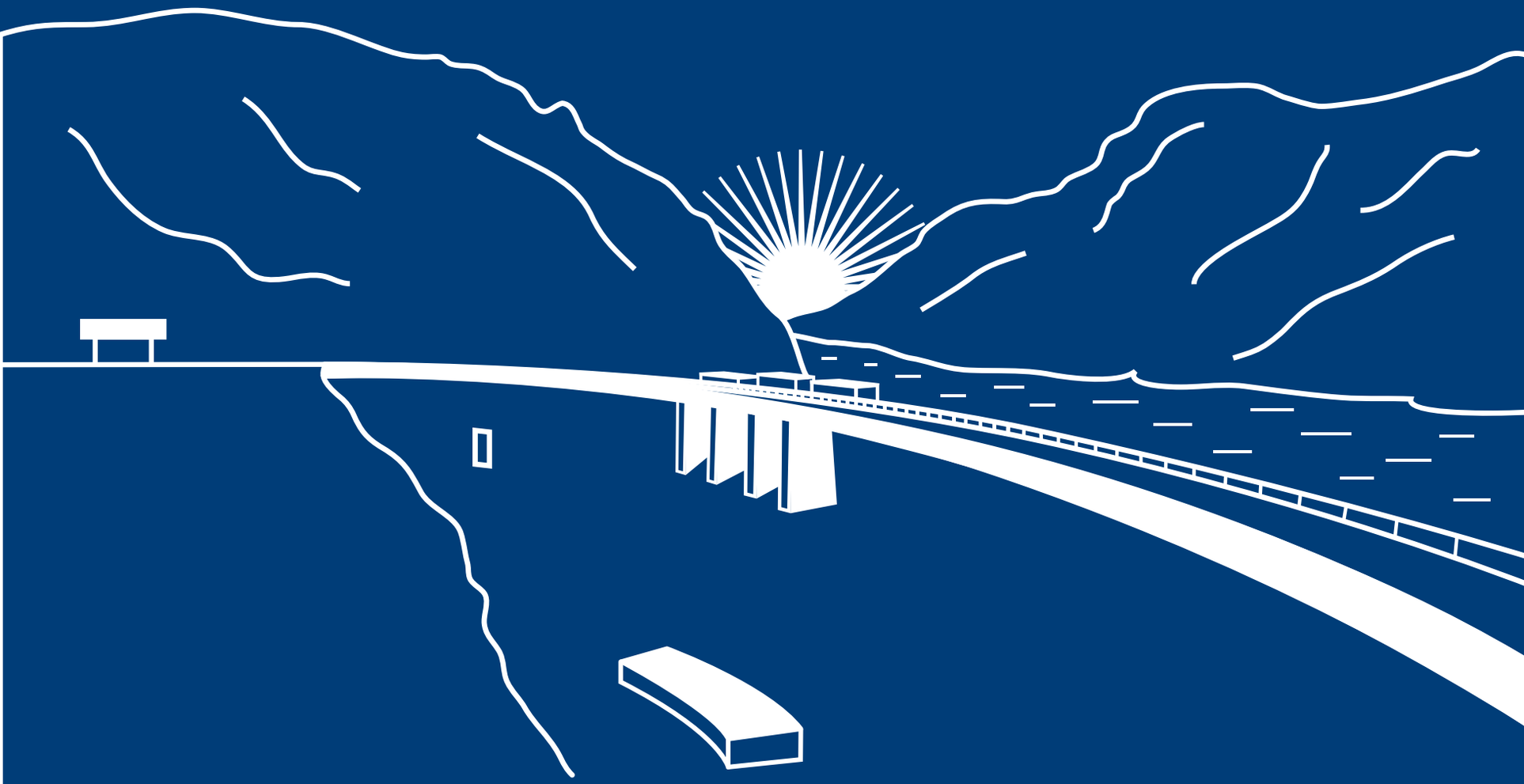

# HPP „PIVA“

Montenegrin Electric Enterprise

epcg
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# HPP „PIVA“

## CONTENTS:



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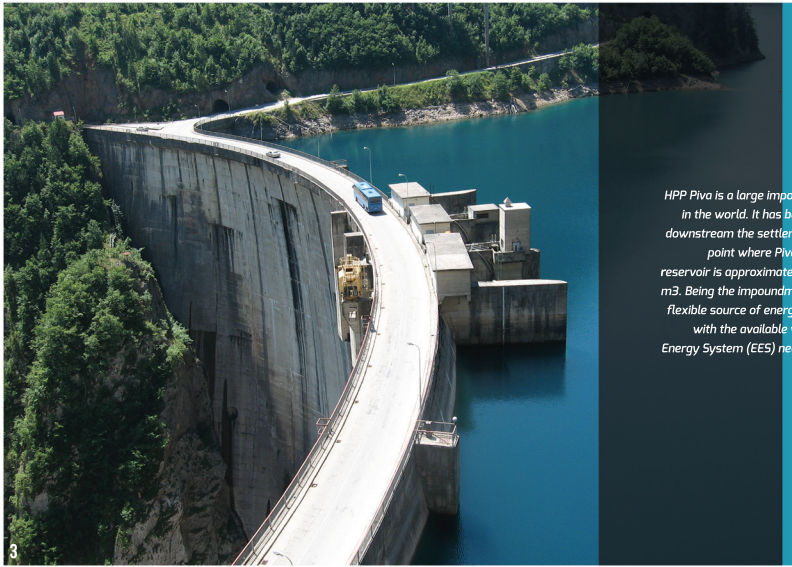
# ABOUT US

*Elektroprivreda Crne Gore A.D. Nikšić (EPCG) is the national electric power company performing its commercial activity in the area of electricity generation and supply. Portfolio of our activities also includes sale of electricity, as well as construction and maintenance of electric power facilities, designing and supervision.*

***Our ge**nerating capacity is the total installed capacity of 874 MW out of which 649 MW (74,3%) relates to hydropower plants Perućica and Piva while the remaining 225 MW (25,7%) relates to the thermal power plant Pljevlja.*

*EPCG is seated at the address no 2 Vuka Karadžića St. in Nikšić*



# HPP „PIVA“

*HPP Piva is a large impoundment facility with one of the highest arch dams in the world. It has been operating since 1976. HPP Piva is located 15 km downstream the settlement of Plužine and 10 km upstream the confluence point where Piva and Tara rivers create the river of Drina. HPP Piva reservoir is approximately 40 km long with useful storage of 746 million of m3. Being the impoundment with voluminous useful reservoir, HPP Piva is a flexible source of energy and capacity. The power plant may be started up with the available water capacity at any time and for any of Electrical Energy System (EES) needs. The entire power house was built underground due to the specific topography characteristics.*

# CONSTRUCTION

*Construction of this grandiose hydro power facility lasted for ten years, i.e. from 1966 up until 1976, and involved 4.5 thousand various vocational employees from all regions of the former-SFRY.*

*Dam was designed by Energoprojekt – Belgrade, underground facilities by Elektroprojekt – Ljubljana. Model testing and geotechnical works were performed by the Institute Jaroslav Černi and Geosonda – Belgrade, while the main civil works were performed by Hidrotehnika – Belgrade with its subcontractors.*

*Equipment was manufactured and delivered by Litostroj – Ljubljana, Rade Končar – Zagreb and Metalna – Maribor.*

*HPP Piva, previously named as HPP Mratinje, delivered its first generated kilo-watt hours into the power system from the Unit 3, on 27th of March 1976, almost a decade after its construction commencement date.*

# TECHNICAL FEATURES

*HPP Piva is an impoundment plant, storing the river water in a reservoir, and its main facilities are: dam, stilling basin, intake structure, penstocks, power house with units, tail race tunnel and HV switch yard.*

*Dam is a concrete 220 m high arch dam, with 268 m long dam crest. Dam crest elevation point is at 678.00 m. a. s. l. Dam is equipped with three spillway bays in dam crest, three middle outlets at half of dam height and two bottom outlets in case of flood and reservoir discharge. Water from the lake reservoir is being conveyed to all three units by means of three embedded headrace steel penstocks. At the intake structure i.e. at the beginning of each penstock was placed a trash rack, and downstream the trash rack a draft tube gate was placed while at the end of each penstock prior to each turbine was placed a turbine guard butterfly valve. 52 m long and 14 m wide underground power house was situated in the left abutment of the river canyon, downstream the dam. Power house accommodates the main electro mechanical equipment: turbine guard valves, turbines, generators, step-up transformers and auxiliary power supply. The plant is equipped with three generating units with Francis turbines directly connected to three vertical synchronous generators of 120 MVA capacity each. At turbines' siphon outlet point exists a surge tank which heads to the tail race tunnel and further into the riverbed of Piva. Draft tube gates are placed at exit point of each turbine as well as at the end of tail water tunnel.*

*The Plant is connected to EES by high voltage underground 220 kV switch yard located in the cavern downstream the power house on the left side of Piva River bank.*

*220 kV switch yard consists of three transformer bays, three overhead bays and single bus bars with three sections connected to two longitudinal selector switch disconnector.*



# TABLES SHOWING TECHNICAL DATA

## The main energy features important for turbine operation are:

| | |
|---|---|
| *Normal backwater elevation point* | *675,25 m. a. s. l.* |
| *Minimum water elevation point* | *616 m. a. s. l.* |
| *Extremely minimum water elevation point* | *595 m. a. s. l.* |
| *Mean annual inflow* | *77,40 m3/s* |

## Basic parameters of generating Units:

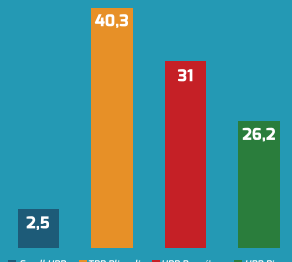
| | |
|---|---|
| *Francis turbine rated capacity* | *117,6 MW* |
| *Rated net head* | *162 m* |
| *Discharge at rated capacity* | *80m3/s* |
| *Rated apparent output of the generator* | *120MVA* |
| *Power factor cosφ* | *0,95* |
| *Generator's active power* | *114 MW* |

## Basic features of Units' generators:

| ***Unit*** | ***A1*** | ***A2*** | ***A3*** |
|---|---|---|---|
| *Commencement year* | *1976* | *1976* | *1976* |
| *Rated capacity* | *120 MVA* | *120 MVA* | *120 MVA* |
| *Rated voltage* | *15.75 kV ± 5 %* | *15.75 kV ± 5 %* | *15.75 kV ± 5 %* |
| *Rated current* | *4398 A ± 5 %* | *4398 A ± 5 %* | *4398 A ± 5 %* |

# GENERATION

*In the operating period, i.e. since commencement date till the end of 2016, HPP Piva generated 30.9 TWh of electricity. Record generation of 1 286 GWh was achieved in 2010.*




*Plant's share in 2016 EPCG overall generation*



RECORD GENERATION WAS ALSO ACHIEVED IN THE FOLLOWING YEARS: 1987, 1979, AND 2013 WHEN 1 016 GWH, 1 044 GWH AND 1 134 GWH OF ELECTRICITY WAS GENERATED, RESPECTIVELY. 2016 GENERATION ACHIEVED 792.5 GWH.


# RECONSTRUCTION AND MODERNIZATION

*Elektroprivreda Crne Gore launched HPP Piva reconstruction and modernization Project, in 2005. Within that Project, electrical equipment in HV facility was fully reconstructed and modernized, as well as significant part of electrical equipment of generating unit and minor part of hydro mechanical dam and plant's equipment. Reconstruction priority, done so far, was given to electro- mechanical equipment, parts of generating units or facilities responsible for safe and reliable operation of plant, increasing thereby operational readiness, without risk of emergency on equipment and civil facilities. In the end, the lifetime of the power plant has been extended, high operational readiness secured and the installed capacity of the power plant increased.*

*The following Companies participated in reconstruction and modernization works, either as equipment designers or suppliers: AF Consult, Swiss; Energoprojekt, Serbia; Voith Hydro, Austria and Germany; Siemens, Austria and Germany; Prointegris, Croatia; ELNOS, Serbia; Telem, Slovenia and LA&CO, Slovenia.*

# ENVIRONMENT

*Piva Lake, as artificial reservoir of HPP Piva, formed in valleys of Vrbnica, Piva and Komarnica, nowadays stands as the largest drinking water basin on the Balkan Peninsula. It is extremely rich in fish species, among which the autochthonous brook and California trout are distinguished, and recently chub species as well.*

*According to the existing legal regulations, Elektroprivreda Crne Gore, being the water user, undertakes all measures to meet its liabilities regarding fish stocking of the lake, which is paradise for picnickers, tourists and fishing fans. Thereby, we try to keep the optimum reservoir elevation point and secure full tourism valorisation of Piva Lake in summer season.*

*Implementation of Project on construction of a collector and waste water treatment plant, as a remaining part of our liabilities towards the local community, arising on grounds of flooding the land for the needs of HPP Piva construction, our Company shall devote a strong impulse to environmental protection in that north-western Montenegrin Municipality.*

*Elektroprivreda Crne Gore undertook certain liabilities on grounds of HPP Piva construction.*

*New settlement with all symbols of a municipal centre, was built at the hillside above the old Pluzine town, twenty kilometres away from Mratinje towards Nikšić. The period of construction of the power plant is to be remembered by the unusual, extremely sophisticated effort to relocate the Monastery of Piva, which stands as invaluable treasures of our medieval history. In order to preserve its authenticity, significance and historical value, the Monastery of Piva was transposed from location of Pivsko oko to a new location i.e. Sinjac village, in the similar environment.*

*Major road Nikšić-Pluzine-Scepan Polje was constructed and nowadays it has international importance and stands for an important connection with the neighbouring Bosnia and Herzegovina. Kilometres of rural and unclassified roads and water supply were constructed and electricity supply was secured in the entire area of the municipality. HPP Piva is devoted to needs of the local community, so significant funds have been allocated for cultural and educational institutions in Plužine.*

*Opening of the quarry with crushing plant and separation of sand and gravel, water supply, construction of a wastewater treatment plant, construction of a by-pass road, intersection at the entrance to the settlement, space planning in the settlement according to DUP, rehabilitation of the dock, sewerage network, reconstruction of the road to village Brljevo, are the remaining EPCG liabilities, which are being implemented in accordance with provisions of the Contract with the Municipality of Pluzine, signed in 2010. A part of the work has already been implemented, and intensive work is also being done on completing the project documentation, which is a prerequisite for implementation of the remaining part of obligations.*

## Contact

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