

HPP „PERUĆICA“

Montenegrin Electric Enterprise

HPP „PERUĆICA“



SADRŽAJ:

ABOUT	1
HPP "PERUĆICA"	3
CONSTRUCTION	5
TECHNICAL FEATURES	7
GENERATION	11
RECONSTRUCTION AND MODERNIZATION	13
ENVIRONMENT	15
SOCIETY	17
CONTACT	19



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 generating capacity is the total installed capacity of 874 MW: 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 Vuka Karadžića br. 2 in Nikšić.





3

HPP 'Perućica' is impoundment derivation plant constructed not far from the Glava Zete which utilizes waters from the Nikšičko field in order to generate electricity. It has been operating since 1960, and it got its name by the spring of Perućica situated in its vicinity.

The plant's installed capacity is 307 MW, with the possible annual generation of cca 1,300 GWh. The reservoir's useful capacity contains 225 million water cubic meters. In order to generate electricity HPP Perućica has utilized water of the upper catchment area of Zeta River, which inflows by the system of channels and pipeline at favourable head at the short distance between the Nikšičko field and the Bjelopavličko field.

Water used to generate electricity is obtained through combination of natural watercourses (mainly inflows of the Zeta River) and reservoirs. Reservoirs and channels are located in the Nikšičko field, in the upper catchment area of the Zeta River, cca 550 m above the river's lower catchment area. The three dams were constructed for the requirements of the hydropower plant with spilling facilities and valve chambers; the two dams constructed on reservoirs Krupac and Slano and the third dam constructed at the retention basin 'Vrtac'.

There are five small hydropower plants operating as part of the system of HPP Perućica: 'Podgor', 'Rijeka Crnojevića', 'Rijeka Mušovića', 'Šavnik' and 'Lijeva rijeka', the overall capacity totalling 2,465 MW.

HPP „PERUĆICA“

4

By the Preliminary Design and the approved technical and financial documents, construction of HPP Perućica was planned in four phases. Each phase represents the separate unit.

All the reservoirs and water conveyance features, penstock No. I, power house with the two units (I and II), 110 kV switchyard (four parts) and tailrace for units No. I – VII were constructed during the first phase. Units I and II, operating since 1960, have the capacity of 40 MVA.

The penstock No. II, three units (III, IV and V) and 110 kV switchyard consisting of eighth switchyard bays were constructed during the second phase. Units III, IV and V, operating since 1962, have the capacity of 40 MVA each.

The penstock No. III, two units (VI and VII) having the capacity of 65 MVA each and 110 kV switchyard consisted of two switchyard bays, operating since February of 1977 and June of 1978, were constructed during the third phase.

It has been planned to install the unit No. VIII during the fourth phase, for which all the conveyance and outlet features are constructed, as well as the auxiliary and joint plants and the site is designed to install it in the power

The following participants took part in the construction:

RESEARCH WORKS, STUDIES, DESIGNING AND CONSULTING:

Energoprojekt – Belgrade, Agroprojekt – Belgrade, Srbijaprojekt – Belgrade, Institut "Joroslav Černi" – Belgrade, Institut za ispitivanje materijala – Belgrade, Elektroprojekt – Ljubljana, Kosovoprojekt – Belgrade, Institut "Nikola Tesla" – Belgrade, Zavod za građevinske materijale i geotehniku – Nikšić, Zavod za tehnička istraživanja – Podgorica, Elektroprivredni inženjering – Belgrade, Mašinski fakultet – Belgrade, Građevinski fakultet – Belgrade, Litostroj – Ljubljana, and Lahmeyer International GmbH – Germany.

CONTRACTORS FOR CIVIL WORKS:

Crna Gora – Nikšić, Niskogradnja – Sarajevo, Konstruktor – Sarajevo, Hidrogradnja – Sarajevo, Elektro-Srbija – Belgrade, Geolstraživanje – Zagreb, Elektrosonda – Zagreb, Istražno – Titograd, Geosonda – Belgrade, Jugofund – Belgrade, Bast plastik – Nikšić, and Šavnik – Šavnik.

SUPPLIERS OF THE EQUIPMENT AND CONTRACTORS FOR ASSEMBLING WORKS:

Litostroj – Ljubljana, "Rade Končar" – Zagreb, Metalna – Maribor, Energoinvest – Sarajevo, Iskra – Ljubljana, MineI – Belgrade, Hidromontaža – Maribor, Energotehnika "Južna Bačka" – Novi Sad, GV Sistem – Belgrade, Sever – Subotica, Institute "Nikola Tesla" – Belgrade, Institute "Mihajlo Pupin" – Belgrade, Termovent – Belgrade, Andino – Ljubljana, Camille Bauer – Wohlen, Switzerland, ABB – Baden, Switzerland VOITH – Austria, Voith – Siemens – Austria, Kunz – Austria, Muhr – Germany.



Water passage of HPP "Perućica" contains the following:

- Reservoir lakes;
- System of channels;
- Settlement tank with compensation basin
- Intake structure
- Headrace tunnel
- Surge tank
- Manifold and surge tank valve chamber
- Penstock
- Tailrace system

HYDROLOGY

CATCHMENT AREA SURFACE	850 km ²
ANNUAL AVERAGE PRECIPITATION	2072 mm/m ²
MEDIUM ANNUAL PASSAGE FLOW	49,74 m ³ /sec

In terms of topography, the catchment area of the Nikšićko field occupies the area of 850 km², and the surface of the catchment area amounts to 1.170 km². The main watercourse in the Nikšićko field is the Zeta River that is 20 km long, receiving on the left side tributaries: Gračanica, Mirkošnica, Grabovik, and on the right side: Opačica, Moštanica and series of minor watercourses.

Measurements of water level, i.e. calculation of a flow of the Zeta River in the Nikšićko field have been performed since 1929 at the hydrological profile 'Duklov most'. The largest flow at this profile was registered on October 12, 1964 (307 m³/s) as well as on September 25, 1984 (580 m³/s).

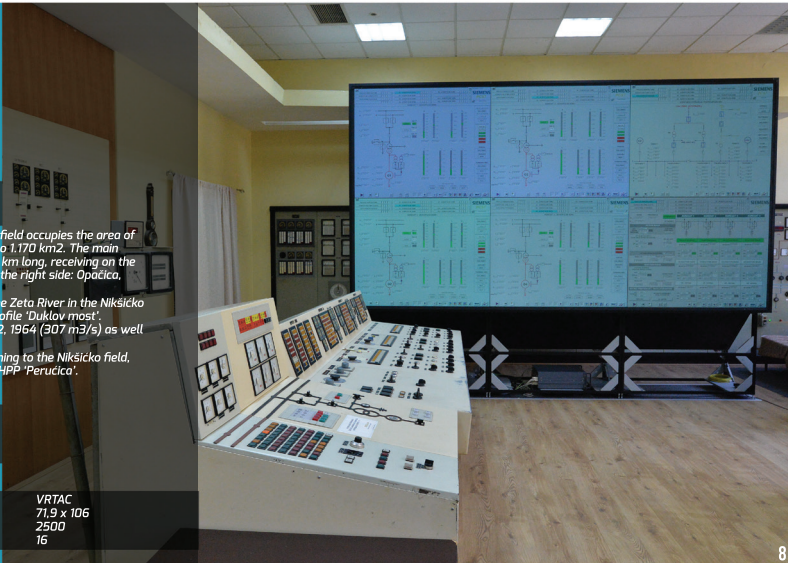
Water of the catchment area of the Gornja Zeta River, incoming to the Nikšićko field, has been used at the gross head of 550 m for operation of HPP 'Perućica'.

ENERGY DATA

GROSS HEAD	550 m
INSTALLED CAPACITY	307 MW
POSSIBLE ANNUAL GENERATION	around 1,300 GWh
PLANNED ANNUAL GENERATION	932 GWh

RESERVOIRS

NAME	KRUPAC	SLANO	VRTAC
WATER VOLUME (m ³)	42 x 10 ⁶	111,2 x 10 ⁶	71,9 x 10 ⁶
DAM LENGTH (m)	1500	1700	2500
DAM HEIGHT (m)	28	30	16



WATER CONVEYANCE SYSTEM

Channel System around 40 km

Channels	Unit measure	Zeta I	Zeta II	Opačica	Moštanica
Length (m)	(m)	6113	5380	4257	3518,5
Discharge (m ³ /s)	(m ³ /s)	80,75	51,0	51,0	12,0
Bottom elevation at the beginning	(m. a. s. l.)	601,00	610,78	603,25	607,29
Bottom elevation at the end	(m. a. s. l.)	599,36	602,01	601,34	604,52
Cross-section	(-)	trapeze	trapeze	trapeze	trapeze/ horse shoe pattern

COMPENSATION BASIN 180.000 M³

Tunnel-type penstock:

- length	3323 m
- diameter	4.8 m
- flow	80.75 m ³ /sec

PENSTOCKS

	I	II	III
Internal diameter /mm/	1800-2200	2100-2200	2500-2650
Total length	1851,4	1883,8	1919,4
Total weight /KN/	21.330	26.260	31.500
Discharge /m2/sec/	2x8,5 (17)	3x8,5 (25,50)	3x12,75 (38,26) desi. 2x12,75 (25,50) inst.
Connected units	I and II	III, IV and V	VI and VII
Commencement year	1960	1962	1977

OUTLET FEATURES

TAILRACE	No. I	No. II
FLOW (m ³ /sec)	68	12.75
CONNECTED UNITS	Br. 1-7	Br.8

Outlet features are consisted of the following components:

Turbine pits and tailrace: water released through turbines is collected in turbine pits and then forwarded to the collection channel through the turbine's tailrace. There is one channel for each turbine pit.

Collection channel: Collection channel is situated between the power house and the switchyard. Units No. 1 - 7 are connected to this collection channel, and unit Nr. 8 has its own channel.

UNITS

UNITS	Br. 1,2,3,4,5	Br. 6,7
RATED CAPACITY (MVA)	40	65

TURBINES

TYPE	Pelton	Pelton
INSTALLED DISCHARGE (m ³ /sec)	8,5	12,75
SHAFT CAPACITY (MW)	39,338	59,036
NUMBER OF REVOLUTIONS (rev./min.)	375	428,5

GENERATORS

RATED CAPACITY (MW)	38	58,5
RATED VOLTAGE (kV)	10,5	10,5
CAPACITY RATING FACTOR	0,95	0,90

STEP-UP TRANSFORMERS

RATED CAPACITY (MVA)	40	65
TRANSMISSION RATIO (kV)	10,5/121	10,5/121

SWITCHYARD

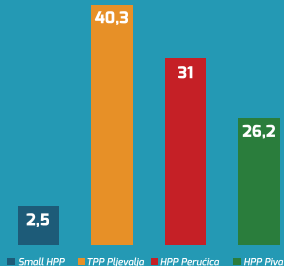
SWITCHYARD	110 kV	220 kV
NUMBER OF SWITCHYARD BAYS	18	6

AUTOTRANSFORMER 125 MVA

Transmission ratio (kV)	230/121/11
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GENERATION

In the period from March 12, 1960 until the end of 2016 HPP "Perućica" generated 49.008,93 GWh. It reached its record high generation in 2010 when 1434,9 GWh was delivered to the electric power system. The year of 1969 is an extraordinary generating year, in addition to others, when 1030,7 GWh was generated with five units, the year of 1979 with generation of 1337,4 GWh and the year of 1997 when 1356,2 GWh was generated.



Percentage of the plant's share in the total generation of EPCG in 2016



THE AVERAGE GENERATION OF HPP "PERUĆICA" IN THE PERIOD 1960 - 2016 AMOUNTS TO 898.80 GWh. HPP "PERUĆICA" GENERATES 977.00 GWh ON AN AVERAGE.



In 1992 Elektroprivreda Crne Gore began implementation of the Program on modernization, equipping and upgrade in HPP "Perućica", in order to:

- reconstruct and modernize equipment, plants and civil structures for extension of working and lifetime of the plant thus ensuring high operating readiness;
- equip all the system parts (civil structures and plants) to operate with the existing installed capacity of 307 MW. The plant's capacity, upon installation and commissioning of the sixth and seventh unit in 1979 and problems in operation of such units and the entire plant, was limited to 245 MW;
- Increase the plant's installed capacity to 365 MW through installation of the eighth unit. Out of the total seven installed units, four oldest generating units were reconstructed and modernized during the Phase I implemented so far, two auxiliary units and the plant for auxiliary consumption.

Reconstruction is completed, with increase in capacity by flow and volume for operation with the eighth unit, including portion of civil structures of the plant's tailrace and channels Zeta I, Zeta II and compensation basin.

The total investments in Phase I amounted to more than €23 million. The plant's capacity has been increased to 285 MW since November of 2008, when the fourth unit was reconstructed with previously finished reconstruction and super-elevation of the compensation basin.

Upon extensive research and measurements at the entire hydro-energy system of the plant and produced mathematical models, calculations and analysis of transitional and stationary conditions of the plant's operation, it has been defined that the plant can operate in a safe manner up to the existing installed capacity and without limitation. The plant's capacity has not been limited for several years now and the plant operates even with 307 MW when allowed by hydrological conditions, in accordance with the generation plan and the plant's planned operations.

Implementation of priority projects of reconstruction and modernization of hydro-mechanical and electrical equipment in units 5, 6 and 7 has been planned to take place within the second phase, in the period 2018-2022, together with the system of management of such units and integral information system at the plant's level, equipment of the water conveyance system and rehabilitation of super-elevation of the channel Opačica and reconstruction of Moštanica channel. The modern equipment for hydrological and hydraulic measurements will be installed. Afterwards, it is planned to reconstruct and modernize 110 kV switchyard and 220/110 kV transformer station.

More than three and a half thousands of hectares of marsh and temporary grassland in the Nikšićko field was turned into an artificial reservoir with cca 225 million of water cubic meters for the requirements of hydro energy system of Perućica. Slano reservoir, Krupac Lake and Vrtac retention were created during the midst of the last century. Situated in the west part of the Nikšićko field, reservoir lakes are mutually connected by the system of channels. The mentioned reservoirs have been fitted into the environment to such an extent that they represent today real natural reservation enriched with numerous vegetable and animal species what represents special experience for fans of hunting and fishing as well as for many fans of wild beauty and intact nature.

Clear water of the Slano Lake, very rich in underground flora and fauna, splashes quite indented coastline with many island and peninsulas.

Krupac Lake is recognizable by its clear water, plenitude of fish, organized beach and necessary infrastructure for water sports. Situated on the outskirts of Nikšić, this unique artificial lake with organized beach may receive up to 10 thousand visitors and it offers extraordinary area for relaxation, entertainment and recreation, especially during the summer months. In the summer this lake's water reaches cca 28°C in temperature, what provides great conditions for swimming, and given that the lake is rich in many types of fish, Krupac Lake represents an ideal place for fishing.

*The Zeta River, in its capacity of the inevitable part of hydro-energy system in Europe, represents the only remaining habitat of *astacus astacus*-Noble Crayfish that inhabits exclusively clean water. It contains extreme nutritional value and it is particularly valuable delicacy in the Scandinavian countries.*





In cooperation with the sports-fishing club 'Nikšić', Elektroprivreda Crne Gore stocks with fish reservoirs Slano and Krupac with the necessary quantity of rainbow trout every year. In our capacity of socially responsible company we have accepted to be the general sponsor of the rock festival Lake fest. This is the biggest domestic music festival and mostly visited cultural event in Montenegro that takes part in the area of the Krupac dam since the year of 2005. Every August it gathers between 15 thousand and 20 thousand of music fans of quality rock music from the country and the region.

Besides, there are other numerous examples of our company's social responsibility that are reflected through support provided to implementation of various programs of social protection, as well as the cultural and sports events that have significant importance for the local community and the entire country.

A large, light blue sunburst graphic with many thin rays radiating from the center, set against a dark blue background.

Contact

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