SMALL HYDRO POWER PLANT AT THE COOLING WATER STREAM OF THE THERMAL POWER PLANT “NIKOLA TESLA B“

Zoran Stojanovic), Nemanja Banjalic*),*
*Vladimir Stevanovic**),*

**)Thermal Power Plant “Nikola B”*

TWO SMALL HYDRO POWER PLANTS (SHPPs) UTILIZE ENERGY OF COOLING WATER FLOW AT THERMAL POWER PLANTS (TPPs) IN SOUTH KOREA

Total annual reduction of carbon emissions by 22500 tons.

TPP "Younghung", 3 MW SHPP , in operation since 2008

TPP Samchonpo, 6 MW SHPP, in operation since 2006

SHPP AT TPP “MELNIK” IN CZECH REPUBLIC

0.6 MW MHPP, in operation since 2010

Kaplan turbine installation

Powerhouse

SHPP AT NUCLEAR POWER PLANT “KOZLODUY”

7/22/2015 Print - Kodzloduy Hydropower Plant Starts Functioning in NW Bulgaria - Novinite.com

novinite.com
Sofia News Agency

Print article | Print article without photo

Kodzloduy Hydropower Plant Starts Functioning in NW Bulgaria

September 16, 2013, Monday // 04:47

Photo by the Kozloduy NPP

The Kozloduy Hydropower plant has been connected to Bulgaria's power grid.

The launch operations for the facility started in the early hours of September 16, according to reports of the BGNES news agency.

The HPP has two turbines with a total capacity of 5 MW powered by a 7.5m water column.

To set the turbines in motion, water from the hot canal of the Kozloduy nuclear power plant (NPP) is used, which returns to the Danube River.

In end-August, full-capacity tests were conducted at the HPP.

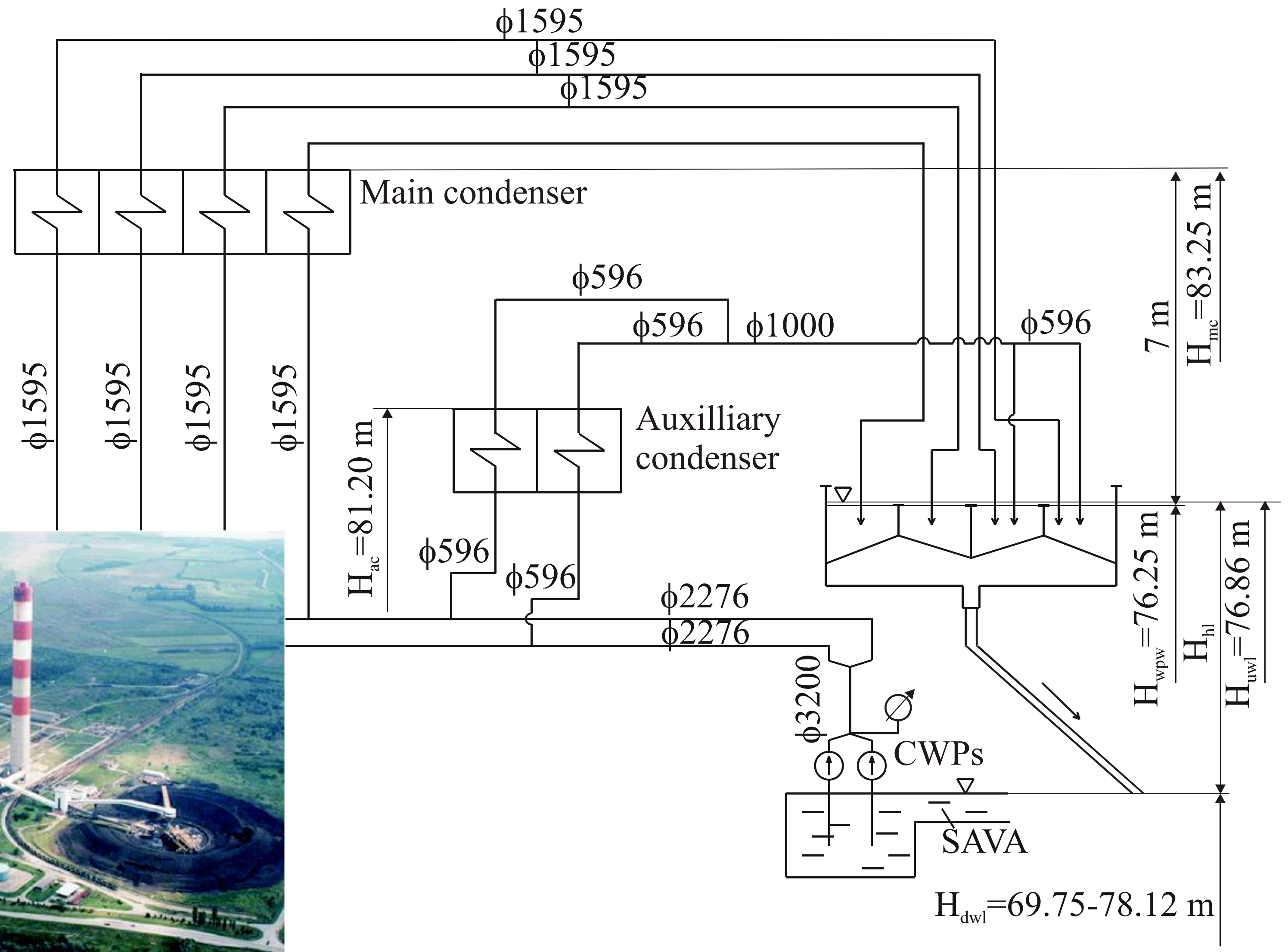
A state acceptance committee conducted an inspection on September 4 – 5, and on September 13, the company received an exploitation permit by Bulgaria's National Construction Control Directorate (DNSK).

The hydropower plant will make an extra contribution to zero-carbon electricity generation in Bulgaria.

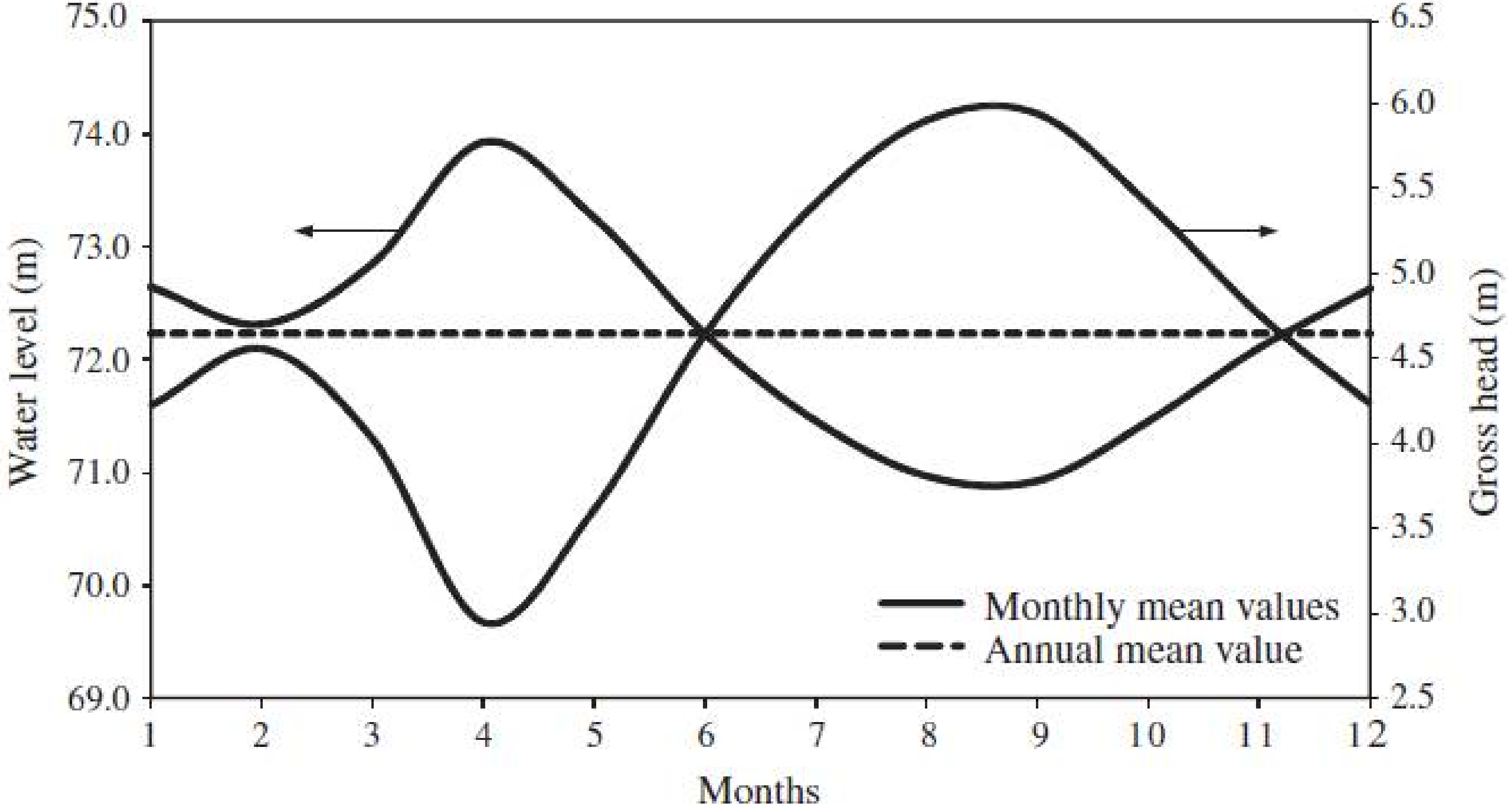
The sole shareholder of the HPP is Kozloduy NPP EAD.

http://www.novinite.com/newsletter/print.php?id=153695 1/1

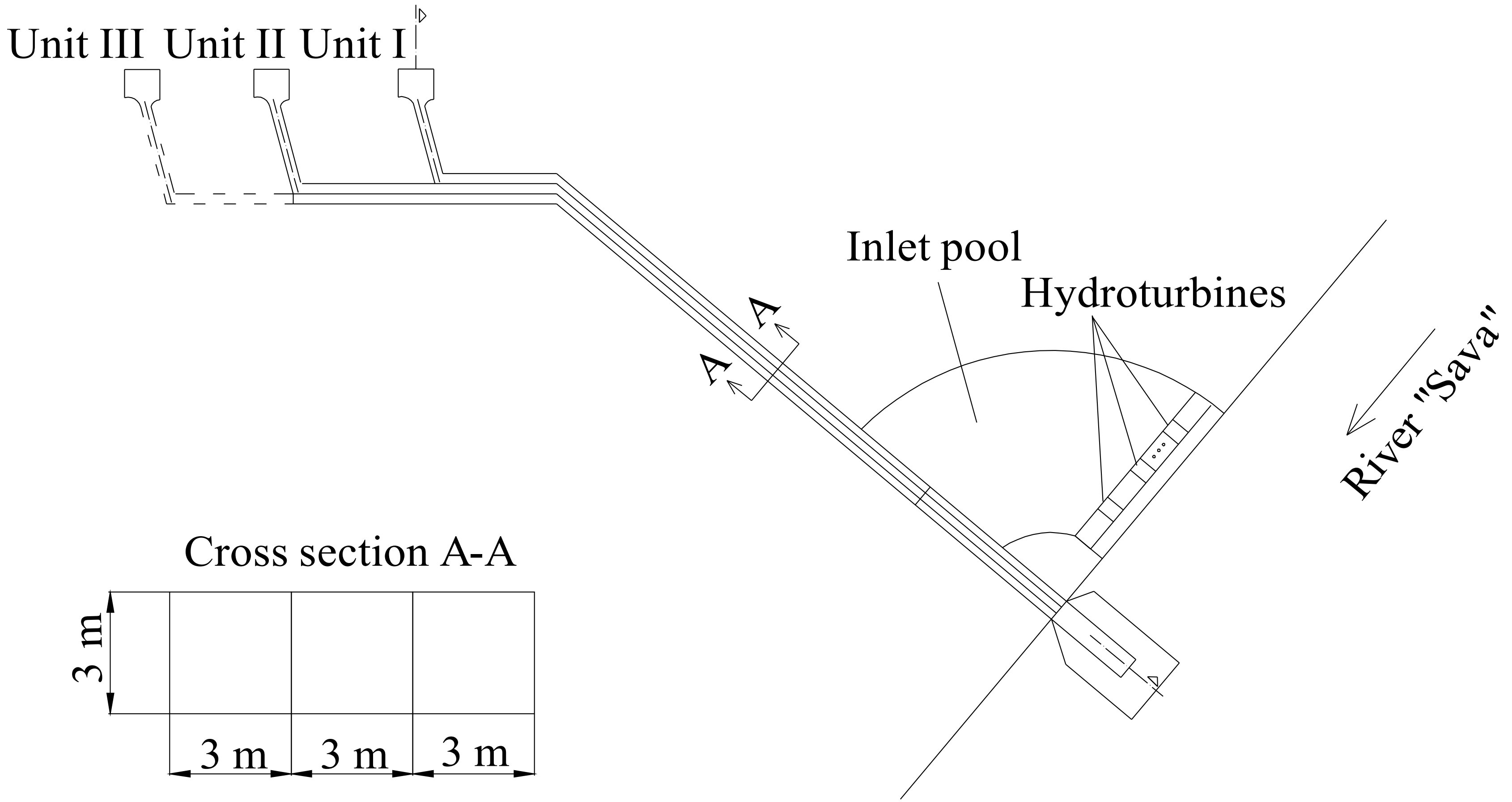
THE COOLING WATER SYSTEM AT THE UNIT OF TPP “NIKOLA TESLA B”



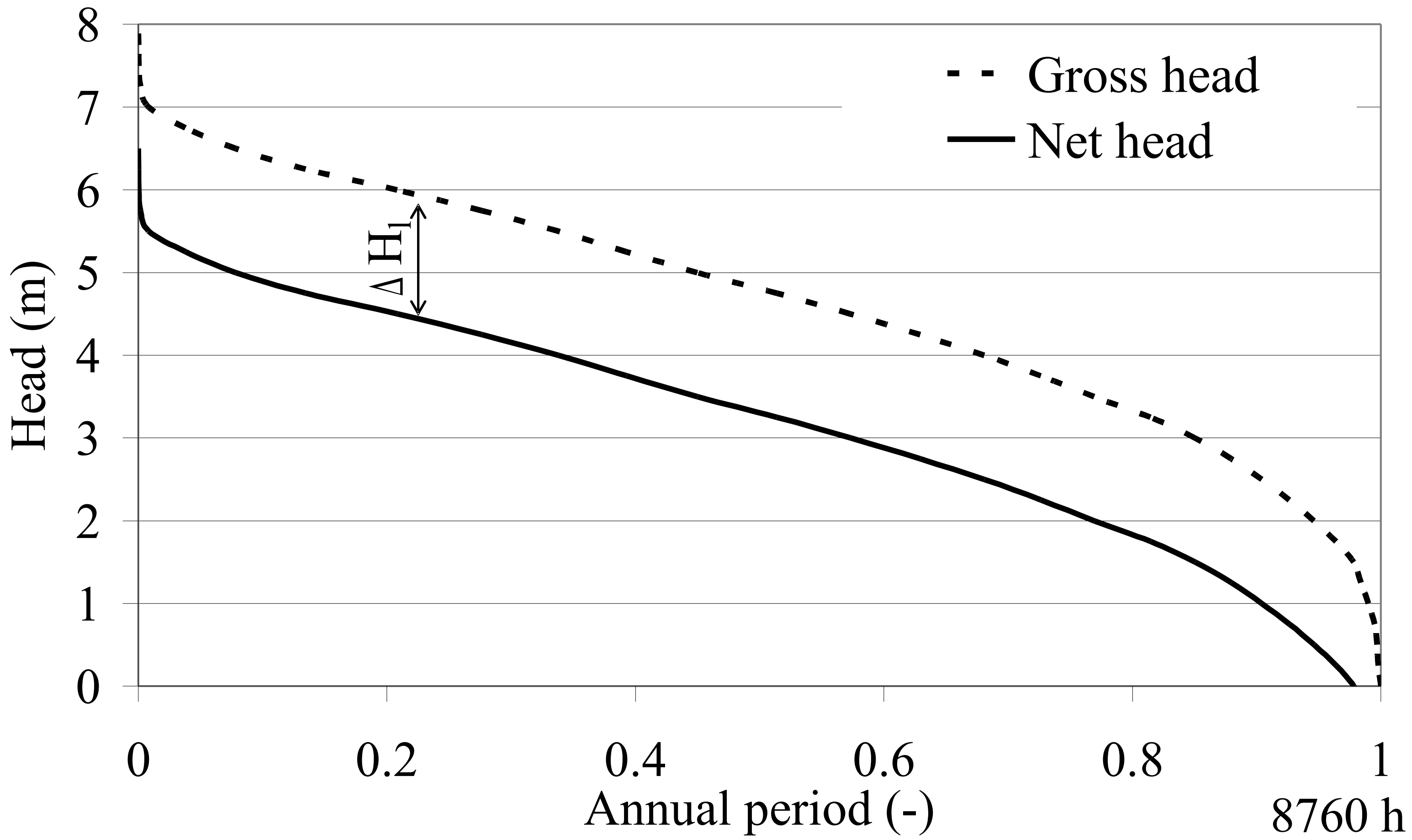
AVERAGED WATER LEVEL OF THE RIVER SAVA AND THE GROSS HEAD BASED ON THE 20 YEARS DAILY RECORDS (FROM 1986 TILL 2006)



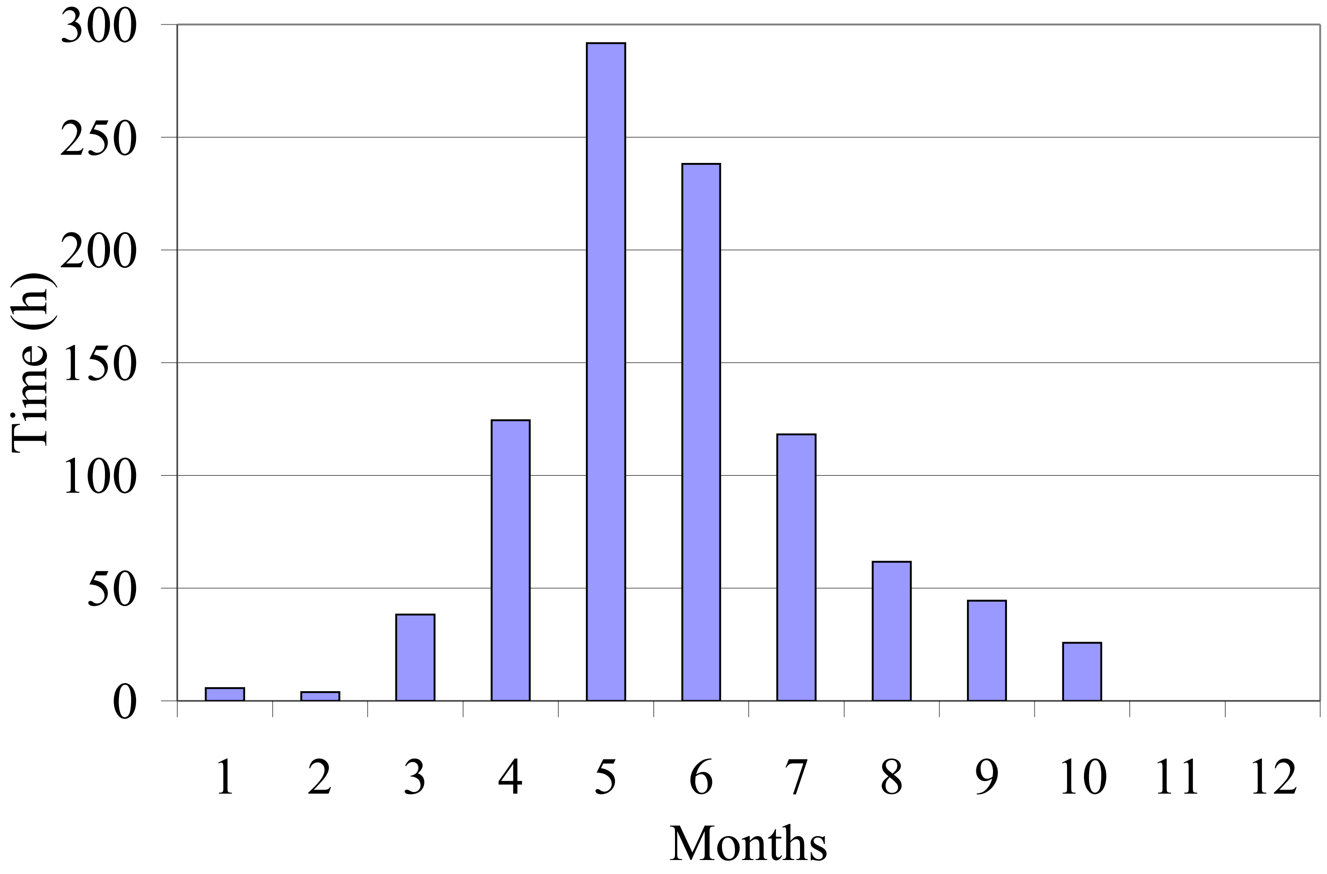
DISCHARGE COOLING WATER CHANNELS FROM POOLS AT TPP UNITS TILL THE RIVER



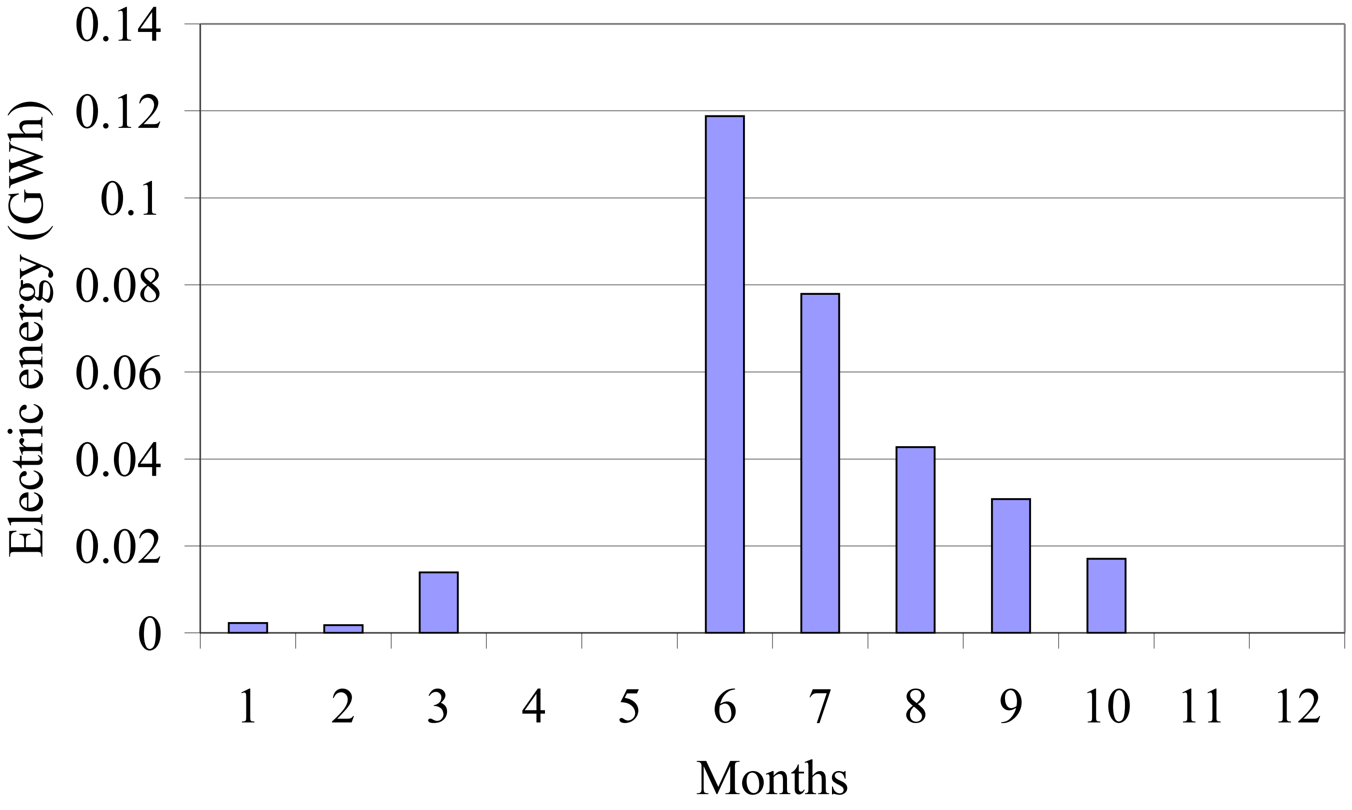
DURATION CURVES FOR THE GROSS AND NET HEADS FROM WATER POOLS IN TPP UNITS TILL SHPP AT THE RIVER SAVA BANK (AVERAGED PERIOD 1986 - 2006)



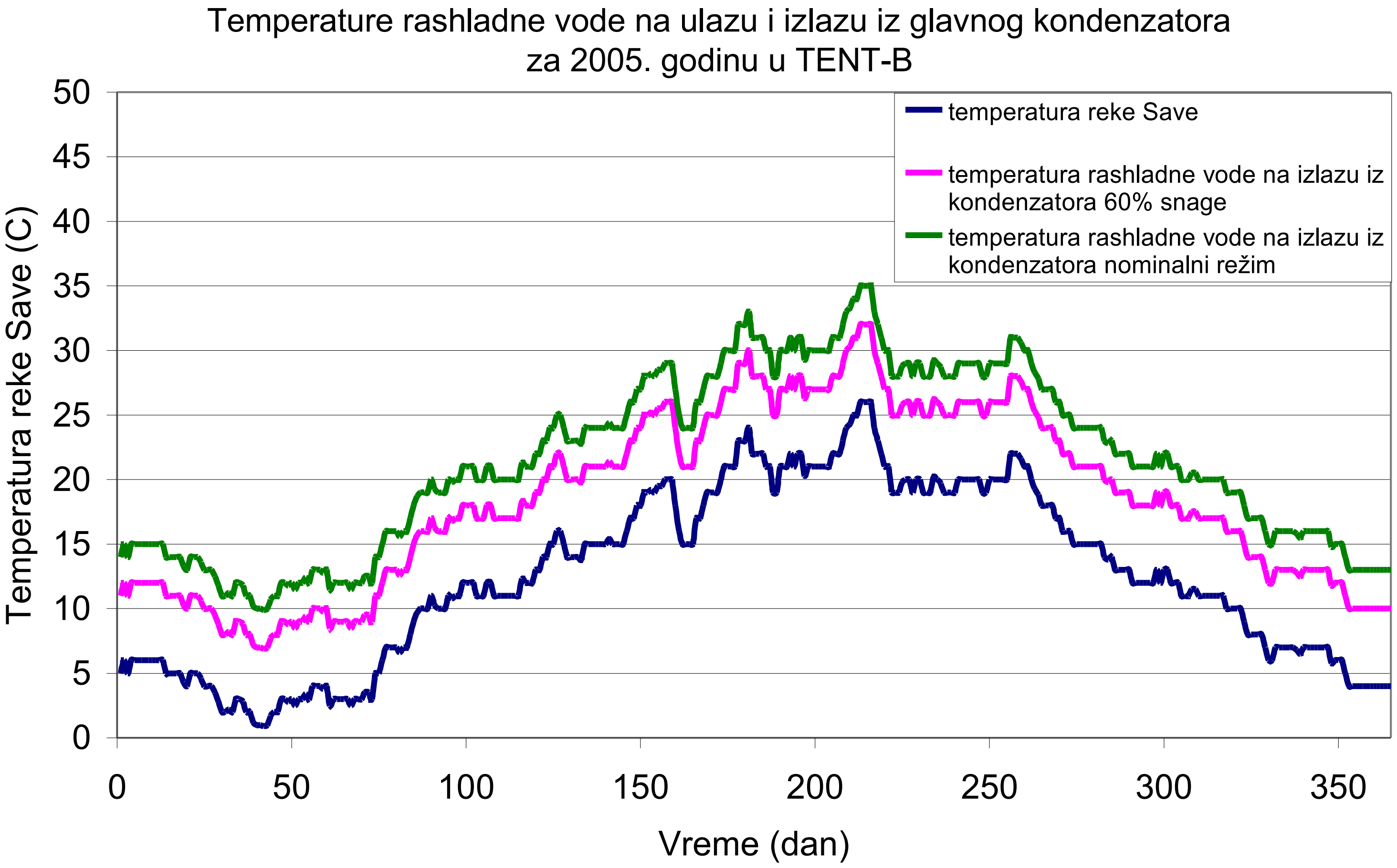
AVERAGE MONTHLY OVERHAUL PERIODS AT TPP "NIKOLA TESLA B"



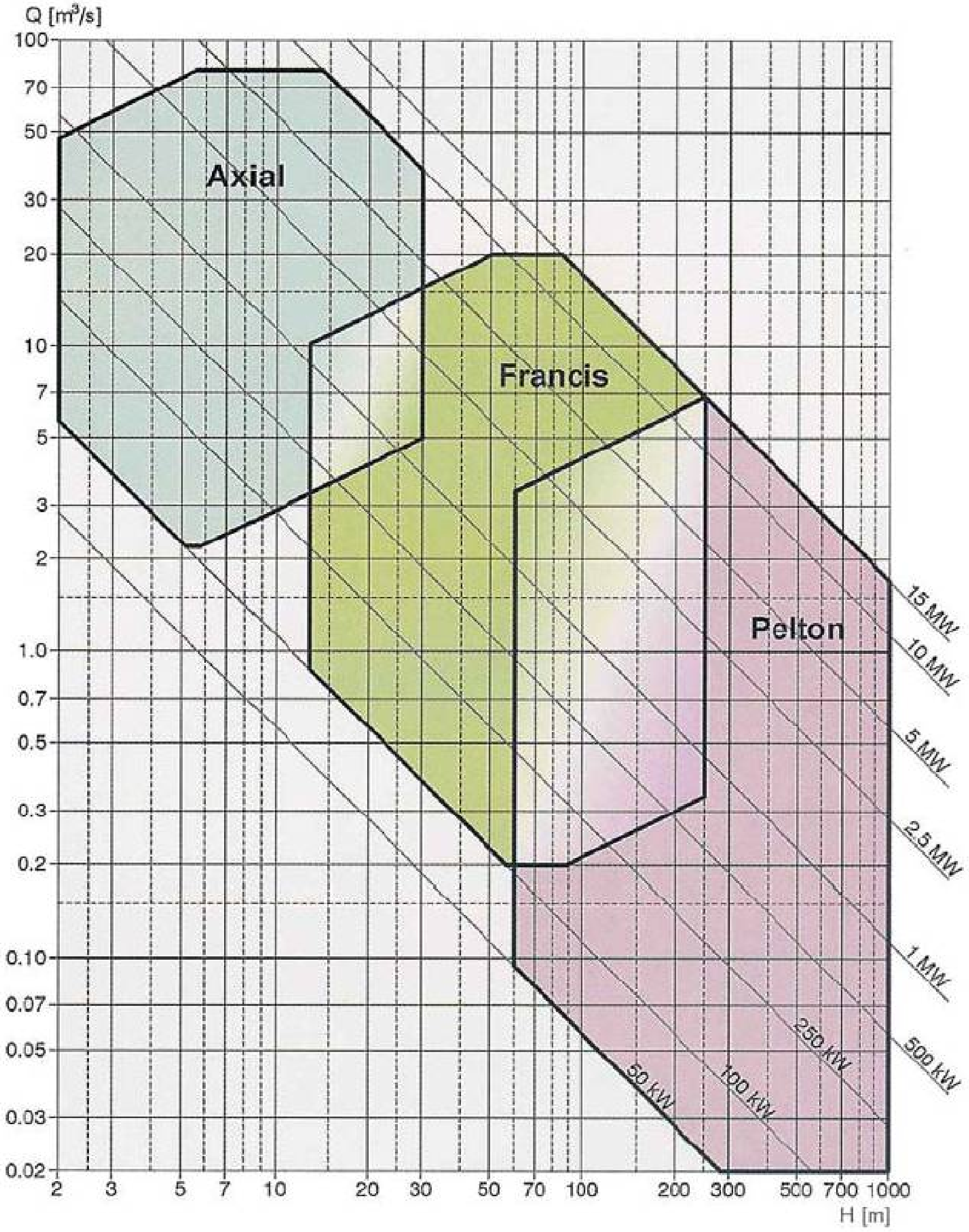
THE REDUCTION OF ELECTRICITY PRODUCTION AT SHPP DUE TO OVERHAULS IN ONE UNIT OF TPP “NIKOLA TESLA B”



WATER TEMPERATURE IN THE RIVER AND AFTER HEATING IN THE TURBINE CONDENSER

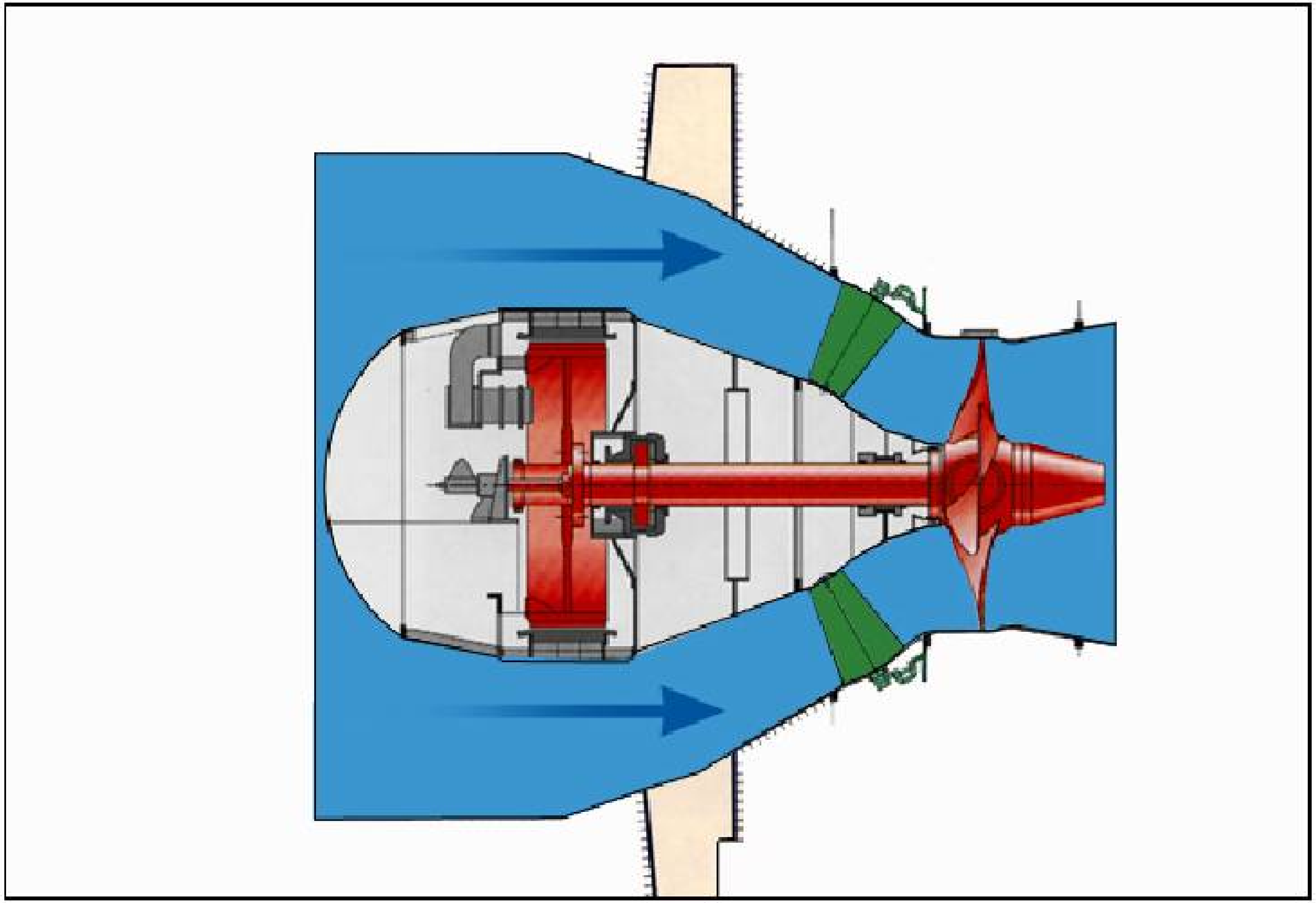


TURBINES' APPLICATION

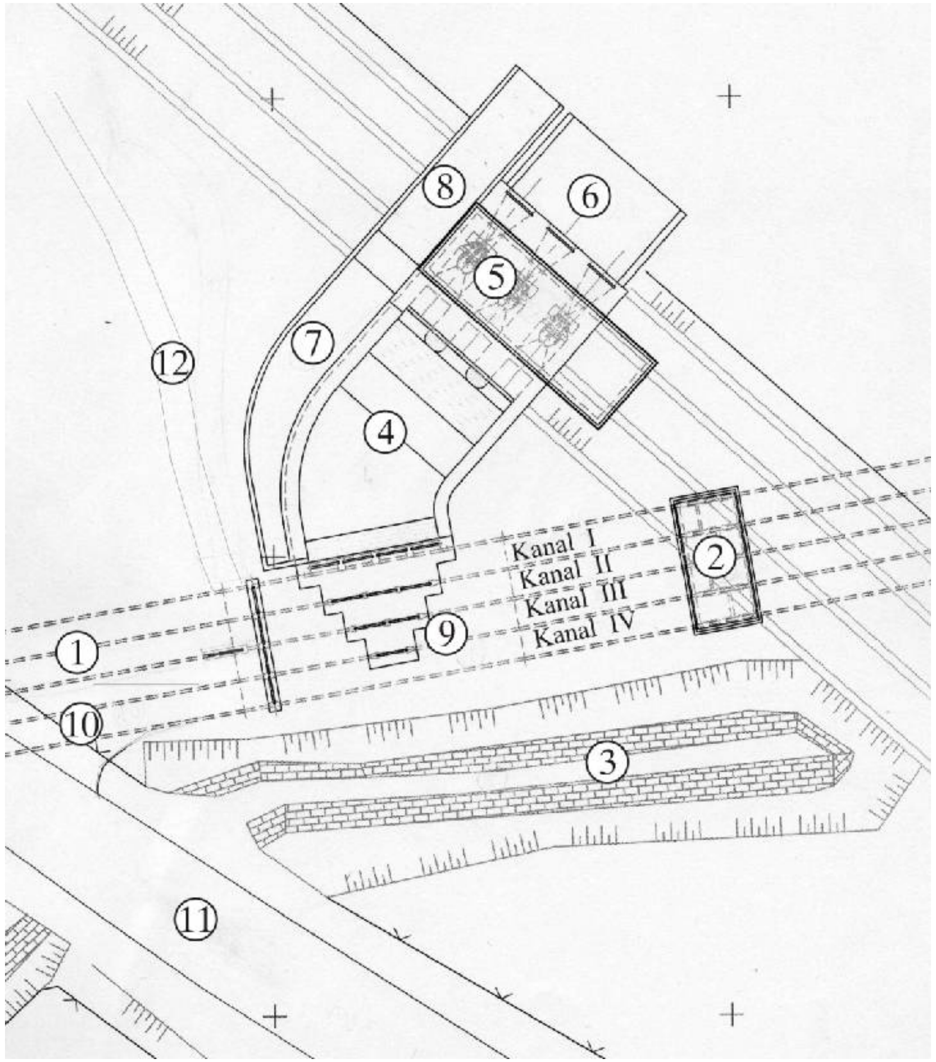


Reference: Guide on How to Develop a Small Hydropower Plant, European Small Hydropower Association - ESHA, Brussels, Belgium, 2004.

BULB TURBINE

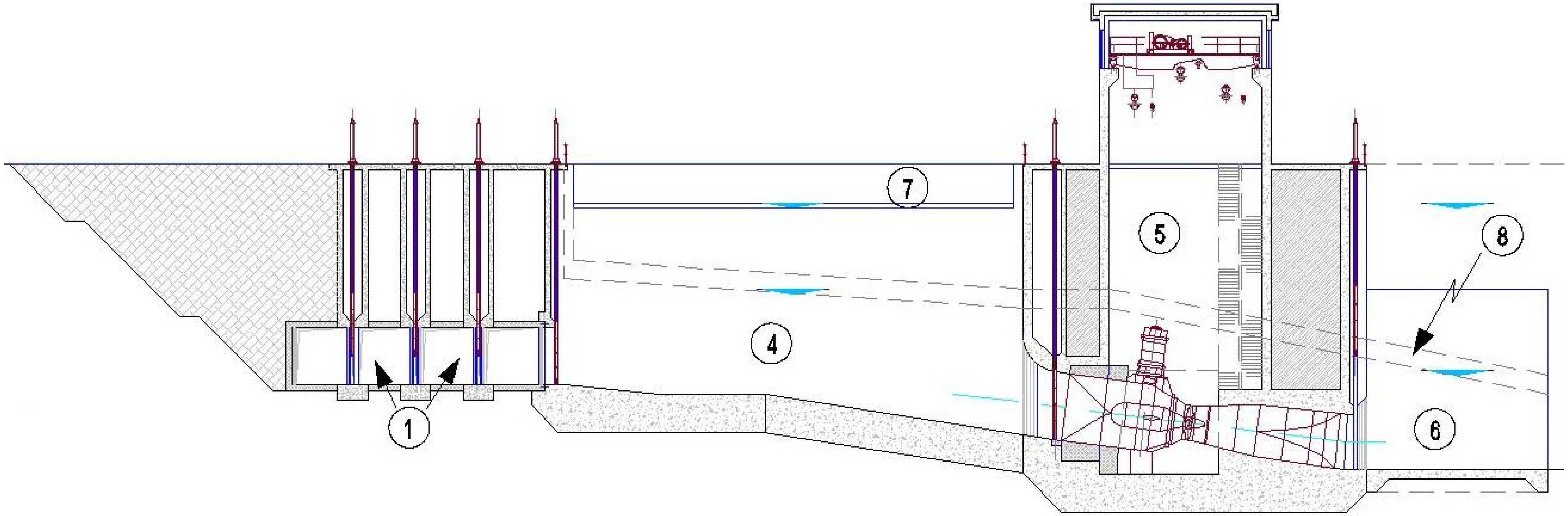


HYDRO POWER PLANT LAYOUT



Legend:
1. Cooling water flow
2. The existing outlet structure
3. The existing earth channel
4. The intake structure with the chamber
5. Power house
6. Tail water
7. Emergency spillway
8. Chute
9. Gate plateau
10. Access to powerhouse
11. The existing road
12. A pipeline for the heating of equipment in the cooling water intake station during extremely cold winter days.

HYDRO POWER PLANT CROSS-SECTION



SMEITS

DOIEE

ANNUAL ELECTRICITY PRODUCTION

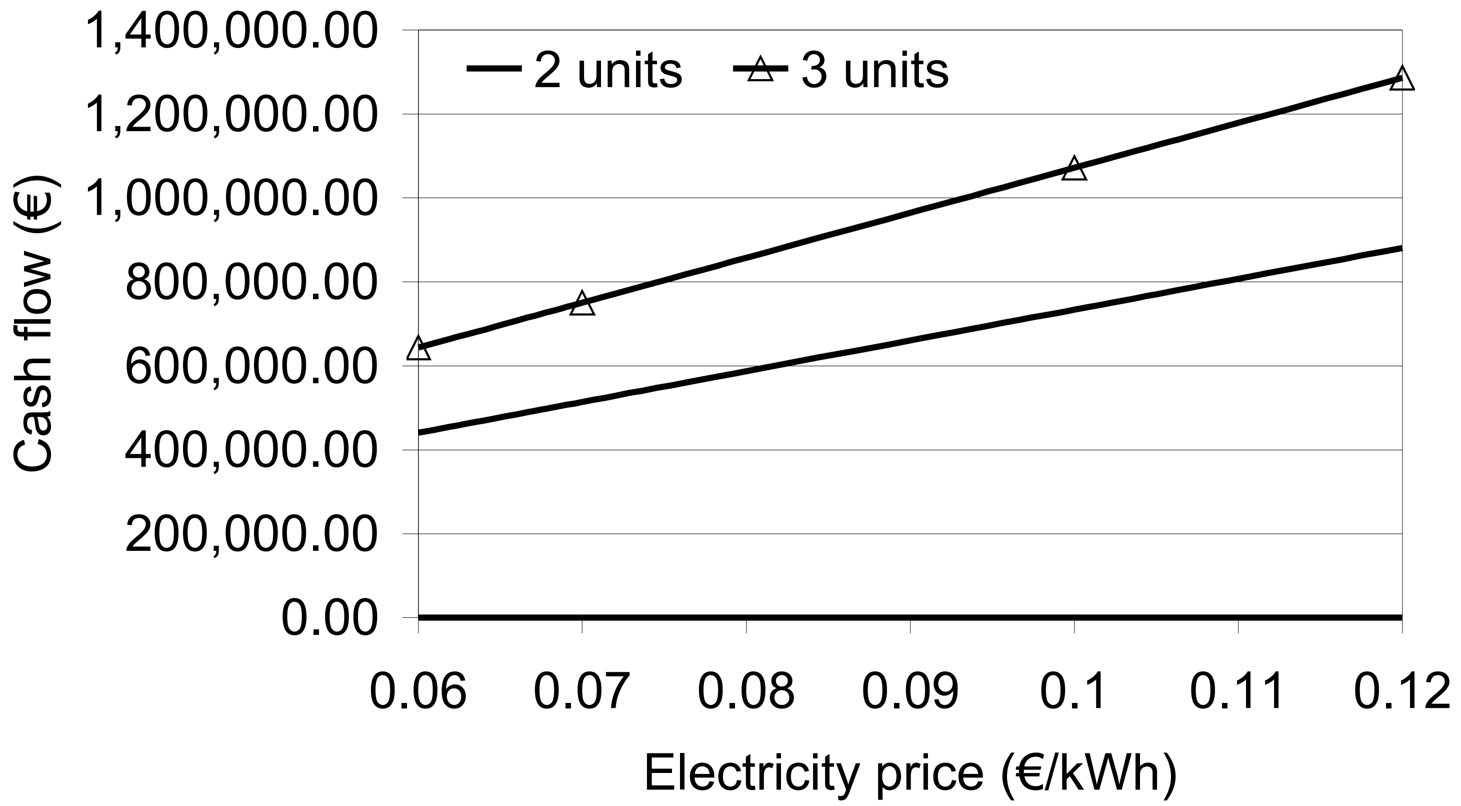
$$E_{el} = 8.76 \cdot \rho \cdot g \cdot \dot{V} \cdot \eta_{HE} \cdot \int_0^1 H(x)\,dx - \Delta E_r \ (kWh)$$

$$H(x) = \begin{cases} H_{n,\max}, & H_n(x) > H_{n,\max} \\ H_n(x), & H_{n,\min} \le H_n(x) \le H_{n,\max} \\ 0, & H_n(x) < H_{n,\min} \end{cases}$$

ANNUAL ELECTRICITY PRODUCTION IN SHPP DEPENDING ON THE NUMBER OF UNITS IN OPERATION

Units of Thermal Power Plant in operation	**Unit 1**	**Unit 2**	**Units 1+2**	**Units 1+2+3**
Annual production of electricity *Eel*, (GWh/god)	**3.88**	**3.78**	**7.45**	**10.83**

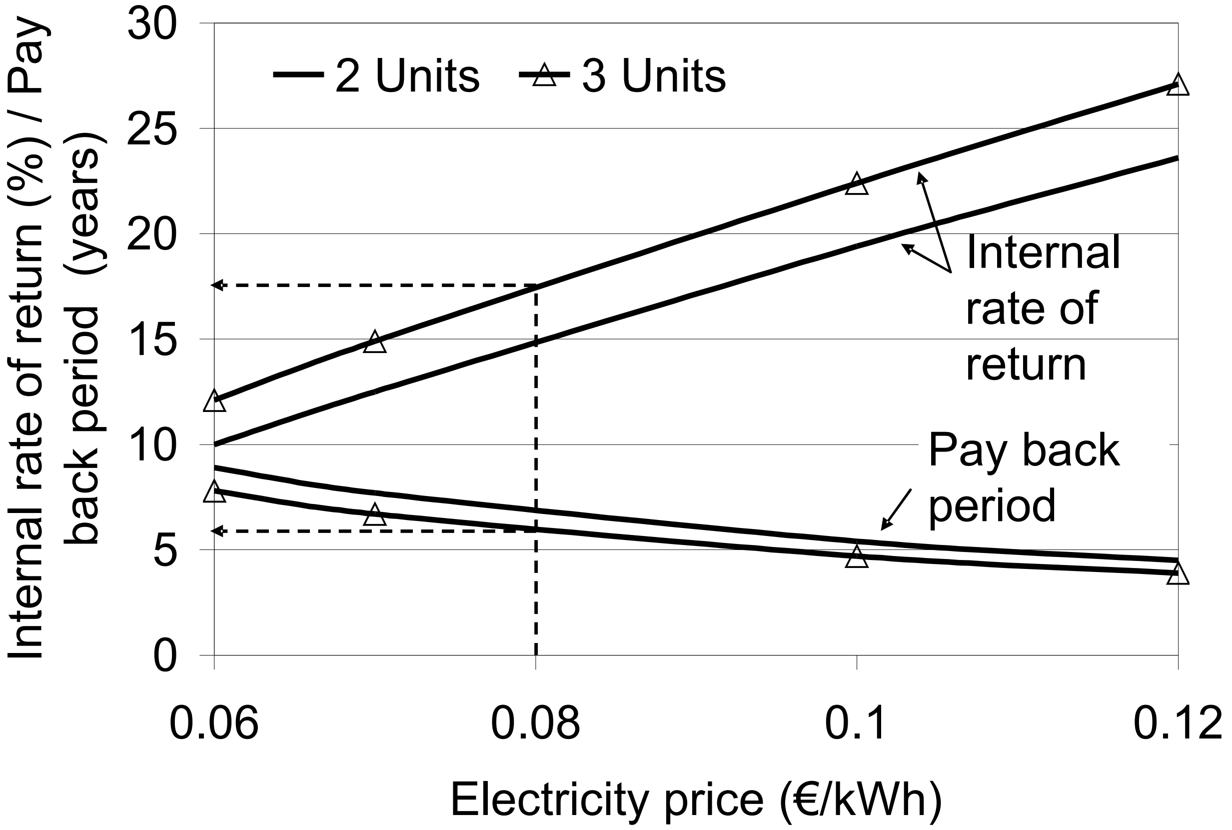
VALUE OF ANNUAL ELECTRICITY PRODUCTION IN SHPP VERSUS ELECTRICITY PRICE



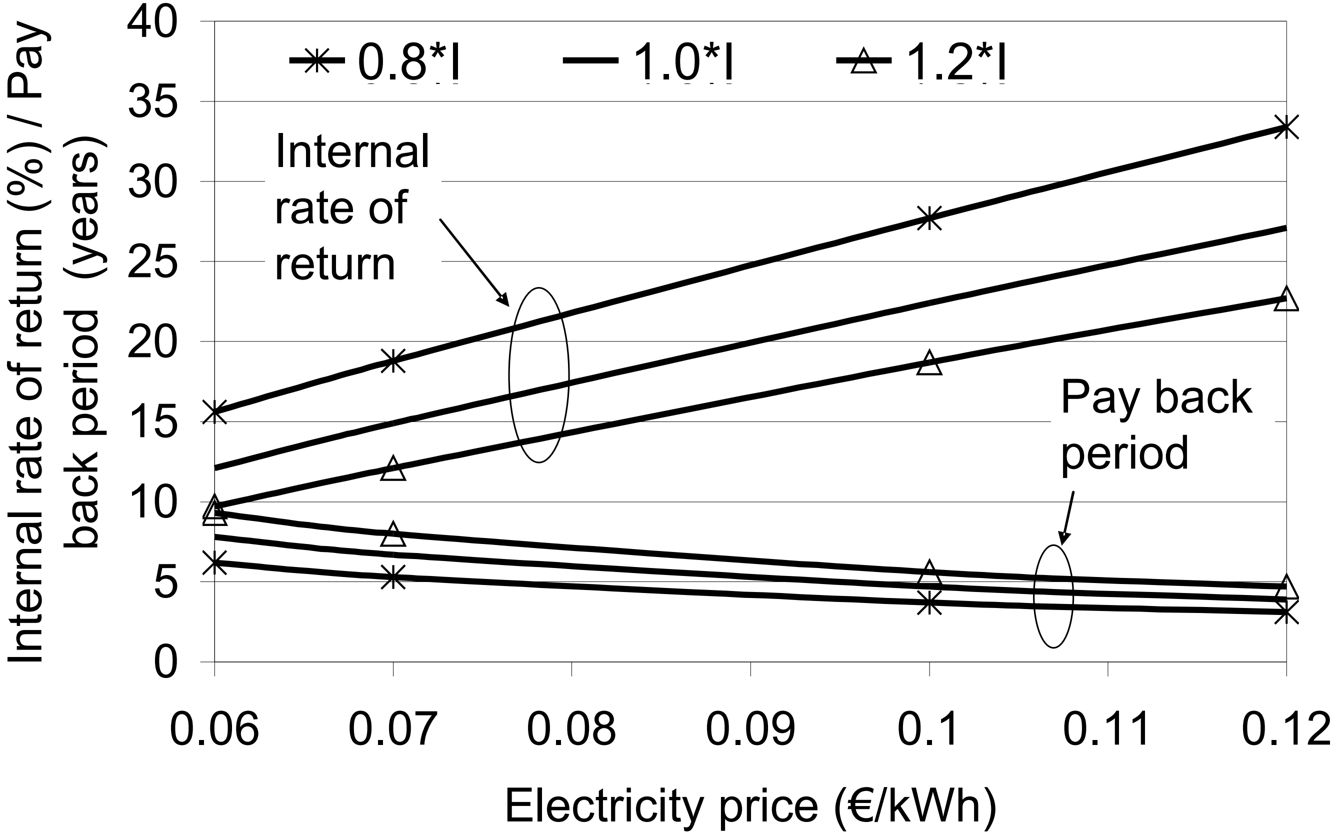
PRESENT VALUE OF COSTS

	Power per unit, P_n (kW)	Total power, zP_n (kW)	Specific cost of equipment, I'_{EM} (€/kW)	Total cost of equipment, $I_{EM}=z\, I'_{EM}\, P_n$ (€)	Cost of civil works, I_{CV} (€)	Total investment, I (€)	Present value of O&M costs, C_{OM} (€)	Present value of total costs C_T (€)
Two turbines, z=2	800	1600	1245	1.992.000	1.670.000	3.936.650	944.425	4.881.075
Three turbines, z=3	800	2400	1245	2.988.000	1.670.000	5.007350	1.258.600	6.265.950

INTERNAL RATE OF RETURN AND PAY BACK PERIOD



INTERNAL RATE OF RETURN AND PAY BACK PERIOD DEPENDENCE ON THE TOTAL INVESTMENT COSTS



CONCLUSION

The project is economically attractive, and it can be realized with standard matured solutions of hydro turbines available at the market.

Thank you for your attention!