

# **LUKOVO POLE RENEWABLE ENERGY PROJECT (LPREP)**



**Prepared by: Development and Investments Department**

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## INTRODUCTION



The Storage "Lukovo Pole" and Intake of Korab waters (referred to as Lukovo Pole Renewable Energy project – LPREP) brings the Korab waters to the storage "Lukovo Pole". These waters cause overflows above the built catchments of the system Gorna Radika, and with chronological interval of duration of one month. That is particularly expressed at the catchment Crn Kamen, which at the same time is utilized for regulation of the discharge in the intake channel to the Mavrovo Lake, and the overflows at this catchment are largest and

the longest lasting. The basic technical solution for catchment and diversion of water, of the Gorna Radika basin, namely from the Adriatic to the Aegean basin is consisted of construction of the Dam "Lukovo Pole" and accumulation in which with an headrace canal the overflowing waters are brought to the existing channel Gorna Radika. With the regulation of these overflowing waters at the same time floods are avoided and also additional generation is yield.

Besides the aforementioned reasons, the justification for considering the construction of this new system Dam "Lukovo Pole" with Headrace channel of Korab waters, it is necessary to be noted also series of other benefits as for JSC "ESM" as well for Republic of North Macedonia as country.

The technical documentation for this project is on the level of Main design. The design was prepared by EMO - Ohrid in 1989, and this design serves as a basis for updates of the design in undergoing in 2012.

## BRIEF PROJECT DESCRIPTION

The storage "Lukovo Pole" is located in the northwest part of North Macedonia at the border with the Shar Planina and Korab massif. The main quantities of water, about  $47,48 \times 10^6 \text{ m}^3$  or average yearly discharge of  $Q = 1,506 \text{ m}^3/\text{sec}$ , in the future storage will collect from the r.Crn Kamen where the construction of rock filled dam is planned.

The Dam "Lukovo Pole" is located at the r. Crn Kamen in its upper part, namely near by the inflow of the both rivers that are forming the r. Crn Kamen. It is 71,00 m high and allows forming accumulation with total volume of  $36,18 \times 10^6 \text{ m}^3$  of water and useful volume of  $34,83 \times 10^6 \text{ m}^3$  of water that will generate  **$106,80 \times 10^6$**  KWh electricity annually.

Within the catchment of the Korab waters, construction of the headrace channels and tunnels in length of about 12,44 km, that will catch the Korab waters to the inflow in the accumulation "Lukovo Pole" with total annual flow of about  $47,48 \times 10^6 \text{ m}^3$  or with average annual flow of  $Q = 1,506 \text{ m}^3/\text{sec}$ .

The intake of the Korab waters is located in the northwest regions of North Macedonia and it is spread along the entire length of the Korab massif, at altitude above the sea level of about 1620,00 m.

In May 2011, ESM has signed a Project preparation advance with the World Bank (IBRD) in amount of 3 million dollars in order to prepare update of technical studies and perform additional geological investigations.

## Technical Studies

Additional site investigations have been carried out in 2012 by the Geological Institute of North Macedonia (GIM). To update the Main Design prepared in 1986, the Design and Supervision consultants JV of Acciona Ingeneria from Spain and ABC Consulting from North Macedonia were hired in August 2012.

### Dam Safety Review Panel (DSRP)

For the purpose of internal review of the technical design documents and in accordance with the practices of the World Bank, JSC ESM constituted Dam Safety Review Panel (DSRP). The dam safety panel is constituted of International and National experts in the field of Dams and Hydropower.

## Environmental Studies

The project is principally expected to have positive environmental impacts in that it would contribute to North Macedonia's use of renewable energy sources, help to lower greenhouse gas emissions, increase the resilience of the existing hydropower system Vrutok-Raven-Vrben against climate change impacts, more stable biological minimum of the Vardar River. Environmental impact that can occur during the construction of the facilities will be mitigated with cautious selection of location of roads, borrow areas, stockpile areas, and appurtenant structures and work methodology.

ESM in accordance with its efforts for reduction of CO<sub>2</sub> emissions and the other greenhouse gases, helped by the Clean Development Mechanism, will develop the Lukovo Pole project which has considerable potential for saving of greenhouse gases emissions.

### **Environmental and Social Impact Assessment (ESIA)**

JSC ESM has hired renowned international consultants BRLi from France in consortium with Macedonian consultant GPM Consulting to conduct an ESIA. The environmental / safeguards aspects of the hired consultants focused on the following issues:

- risk of substantial degradation of critical habitats;
- status of new zoning and management plan for Mavrovo National Park;
- field survey and identification of key potential environmental issues of water conveyor system, dam and reservoir area and quarry areas and auxiliary facilities;
- continuation of NGO/CSO dialogue, and
- drafting of project's preliminary due diligence procedures and environmental framework.

### Environmental Panel (EP)

For the purpose of internal review of the ESIA and related documents and in accordance with the practices of the World Bank, in the process of project planning ESM has included Environmental Panel of experts (EP) specially constituted for this purpose. The Environmental Panel of experts is constituted of International and National experts in the field of Environment.

## Project Benefits

The basic objective of the project is reduction of the dependence by electricity imports in Republic of North Macedonia, through generation of electricity from renewable energy source. Also, this project shall strengthen the investment cycle in Republic of North Macedonia.

**Energy benefit** - With the construction of this system JSC "ESM" will annually generate and place to the consume additional 106.80 GWh of electricity through the already constructed three hydro power plants and the new one HPP Crn Kamen, distributed as follows:

- HPP „ Vrben “	19,48 GWh
- HPP „ Vrutok “	61,82 GWh
- HPP „ Raven “	7,91 GWh
- HPP „ Crn Kamen “	17,58 GWh
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Total	106.80 GWh

**Regulation of the waters** - HPP Vrben is converted from run-of-river to accumulation plant with the construction of this system, which means that during the entire year will be loaded with nominal capacity, and on the other side the accumulation "Lukovo Pole" will present compensator of the accumulation "Mavrovo", namely it will allow for smaller oscillations of the accumulation "Mavrovo" and average yearly level of the same higher through inflow of  $47,48 \times 10^6 \text{ m}^3$  newly collected waters. It should be mentioned that HPP Vrben will be optimized and most probably smaller third unit of the small waters will be added, also the power of the two existing turbines will be increased to match the power of the generators that were refurbished.

**Water potential** - The regulation of the new  $47,48 \times 10^6 \text{ m}^3$  of water per year provides series of benefits for the entire country beginning from more stabile biological minimum of the Vardar river as well as series of other benefits by energy utilization of the new planned power plants on the Vardar river from its spring all the way to Gevgelija, as well as utilization of the waters for industrial needs.

**Benefits for the tourism** - The infrastructure will be improved with the construction of this system that geographically belongs to the National Park "Mavrovo", there will be better road connections to the natural beauties of North Macedonia (the mountains Korab and Shar Planina), and it will create conditions for exploring of the mountain, recreational and country tourism as well as enhancement of the hiking, fishing, farming and forestry.

## PROJECT INVESTMENT COSTS

According to the part of the Project Report submitted by the Acciona Consultant in 2014, the projected project costs are 84 million euros. This amount is not final and there may be changes in the preparation of technical documentation in the next phase.

## Attachments:

**Table 1: Main technical parameters of LPREP**

<b>1. HYDROLOGICAL FEATURES</b>	
AVERAGE WATER FLOW	2,54 m <sup>3</sup> /s
AVERAGE WATER INFLOW	44.46 mil m <sup>3</sup>
<b>2. HYDROTECHNICAL FEATURES</b>	
<b>2.1 WATER STORAGE (Dam Lake)</b>	
TOTAL VOLUME	36,18 x 10 <sup>6</sup> m <sup>3</sup>
USEFUL VOLUME	34,83 x 10 <sup>6</sup> m <sup>3</sup>
NORMAL LEVEL	1587,00 maSL
MIN. LEVEL	1540,00 maSL
<b>2.2 DAM</b>	
DAM TYPE	rock fill
DESIGNED HEIGHT	86,76 m
SURVEY HEIGHT	70,32 m
DAM VOLUME	1.660.468 m <sup>3</sup>
LENGTH OF THE DAM CROWN	335,00 m
WIDTH OF THE DAM CROWN	13,50 M
<b>2.3 EVACUATION FACILITIES</b>	
<b>2.3.1 OVERFLOW</b>	
TYPE	Shaft
CAPACITY	117,38 m <sup>3</sup> /s
<b>2.4 SUPPLY FACILITY from Korab</b>	
TOTAL LENGHT	12,44 km
CANELS	9,39 km
TUNNEL PROJZABA	2.260,00 m
TUNNEL STREZIMIR	793,00 m



Map 1: Position of LPREP in R. North Macedonia and the connections to the transmission system

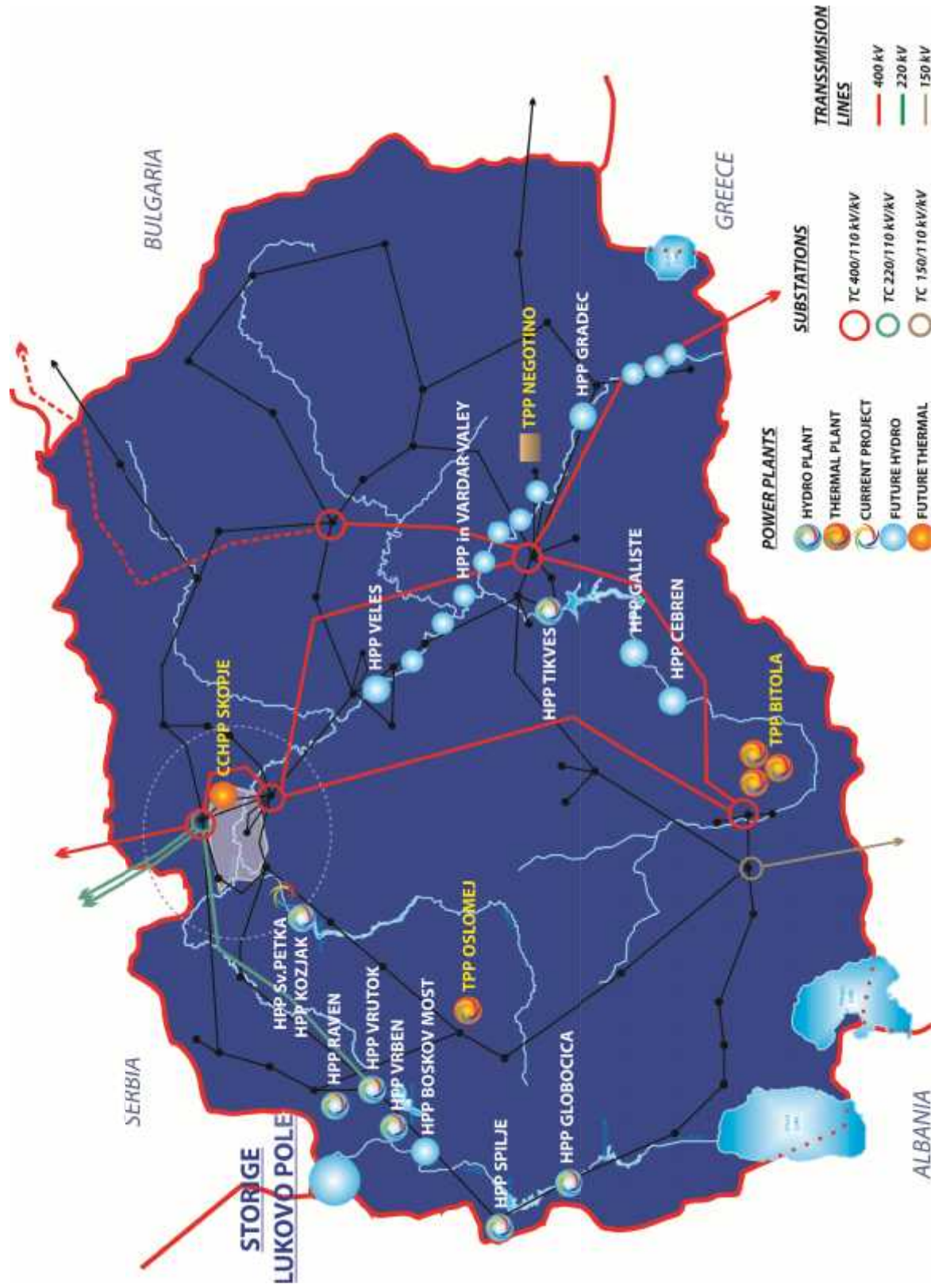
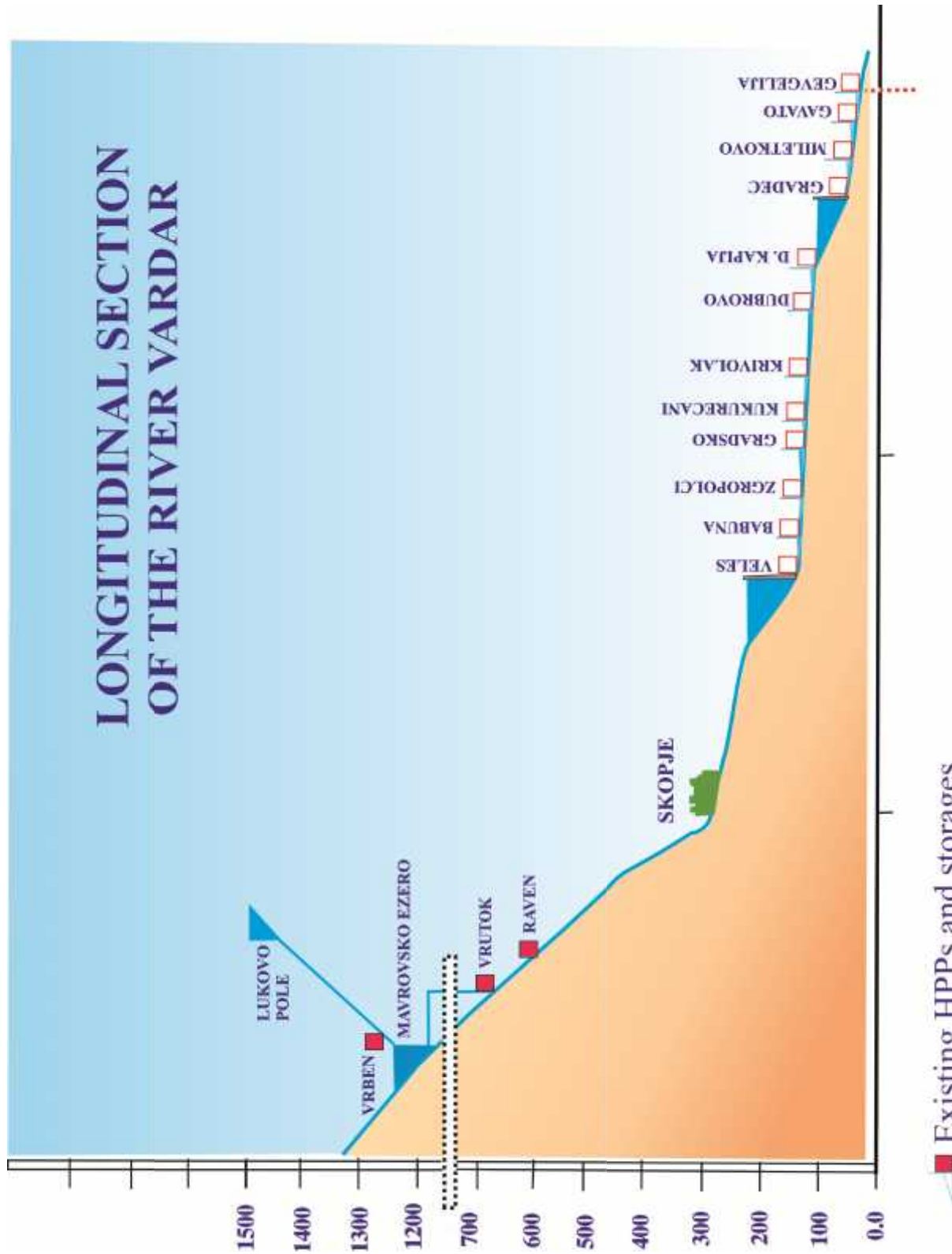


Figure 1: Longitudinal section of the Vardar river from Lukovo Pole to Gevgelija (Greek border)



Map 2: Layout of the LPREP

