



## PJSC Ukrhydroenergo Kaniv PSP Construction Project



# General information about PJSC Ukrhydroenergo

PJSC Ukrhydroenergo being the main hydro power company in Ukraine provides peaking capacity, frequency and power regulation, and flexible emergency reserve in the UPS of Ukraine.

The part of its capacities in the Ukrainian power system is approximately 8%.



9 plants

103 hydropower units

3000 employees

5744 MW capacities

202 bln kWh/year electricity generation per 21 year

10 bln kWh/year total installed capacities of plants

21 km<sup>3</sup> total active storage capacity of the reservoirs

100 km total length of earth dams

# Strategic Purposes of PJSC Ukrhydroenergo

The purpose of PJSC Ukrhydroenergo activity is to provide the Ukrainian power system with electricity and with the power reserve from the renewable sources, namely from the Dnieper and Dniester rivers.

This task is applied not for the current period only, but for the next 30-40 years as well.

The strategic purposes of PJSC Ukrhydroenergo include:

- securing the reliable condition and quality operation of the installed equipment;
- generating capacities development on the Dnieper and Dniester rivers.

To achieve the strategic purposes we plan to put 978.2 MW of new capacities into operation before the year 2020, 3540 MW of new capacities will be put into operation before the year 2026, total installed capacity of PJSC Ukrhydroenergo will be 8868.4 MW and PJSC Ukrhydroenergo's part will be equal to 15.5% in the total electric capacity in the UPS of Ukraine.

PJSC Ukrhydroenergo's strategy is based on the following factors:

- efficient power equipment, digital systems of engineering process control, up-to-date materials and use of know-how in the sphere of construction etc;
- minimization of negative impact on the environment, mandatory compensatory environmental measures;
- social security for PJSC Ukrhydroenergo's employees and local communities, namely development of the social infrastructure in the regions where the new capacities are to be constructed.

# Investment projects of PJSC Ukrhydroenergo

## Dniester PSPP. Completion of the First Stage Construction

- is currently under active implementation (3 units 324 MW each have been put into operation for daily regulation and emergency reserve system)
- construction works are being carried out to increase the volume of the lower reservoir, which will increase the efficiency and stability of the hydrological regime of the Dniester River

## Dniester PSPP. Completion of the Second Stage Construction

- construction works and manufacture of main hydropower equipment in progress
- expected result:  
324 MW – in generator mode,  
421 MW – in turbine mode for daily regulation and emergency reserve system

## Completion of the Second Stage of PJSC Ukrhydroenergo's HPPs Rehabilitation

- is currently under active implementation
- expected capacity increase – **425.6 MW**;
- extension of the operation life of HPPs by 30-40 years

## *Kaniv PSP Construction*

- preliminary works for the construction to be launched
- expected result:  
**1000 MW** (4x250) – in generator mode,  
1040 MW (4x260) – in turbine mode for daily regulation and emergency reserve system

## Kakhovka-2 HPP Construction

- The feasibility study for construction in Ukrainian format (TEO) received a positive conclusion from the State Enterprise "Ukrderzhbudekspertiza" dated Aug. 23, 2008, No. 00-1769-15/ПБ. CMU approved TEO for construction worth UAH 13.4 billion by the Decree №156-p, dated Mar. 10, 2017
- expected result – **additional 250 MW (4x62.5)** and transmission of HPP existing capacities of 351 MW from the base area into peak and semi-peak area

## Upper Dniester HPP cascade construction

- preliminary design works
- expected result – 390 MW generated from renewable sources, flood protection i minimization of human activity consequences in the Dniester basin, promotion of water supply

# HISTORY OF KANIV PSP CONSTRUCTION



Since 1972, the Kaniv Hydro Power Plant (HPP) with an output 489.5 MW has been in operation on the Dnipro river. Having a capacity of 2480 mln m<sup>3</sup>, its upper reservoir is an attractive site for the lower reservoir of the future Kaniv Pumped Storage Plant (PSP).

In 1983 a design was developed for construction of the Kaniv PSP with a total installed capacity of 3600 MW (16 power units). In the USSR, with an increasing number of fossil-fuel and nuclear power plants, exhibiting low flexibility, there was a growing understanding of the need to develop flexible capacity by means of constructing new pumped storage plants. 1984 – Construction of the pumped storage plant began.

In 1991 a moratorium was placed on the construction (by the CMU Resolution No. 258 dated Oct. 14, 1991).

In 1999 the moratorium was lifted and PJSC Ukrhydroenergo was put in charge of developing a construction design project of PSP on the basis of refined data on Ukraine's UPS conditions (1000 MW, 4 power units).

In 2007 feasibility study in Ukrainian format (TEO) was updated and approved, with the installed capacity reduced to 1000 MW. Resolution of CMU No. 965-p dated Nov. 8, 2007, endorsed TEO (the cost is UAH 4.9 bln); the issue of project financing however remained pending.

In 2009 – 2013 development of the design documentation under the Design stage was performed. Design documentation get expert review conclusion No. 00-1837-12/ ПБ with positive conclusion for the “Kaniv PSP Construction” project and the proposal to approve the project (Cost Estimate of “Kaniv PSP Construction” project is UAH 11.98 bln).

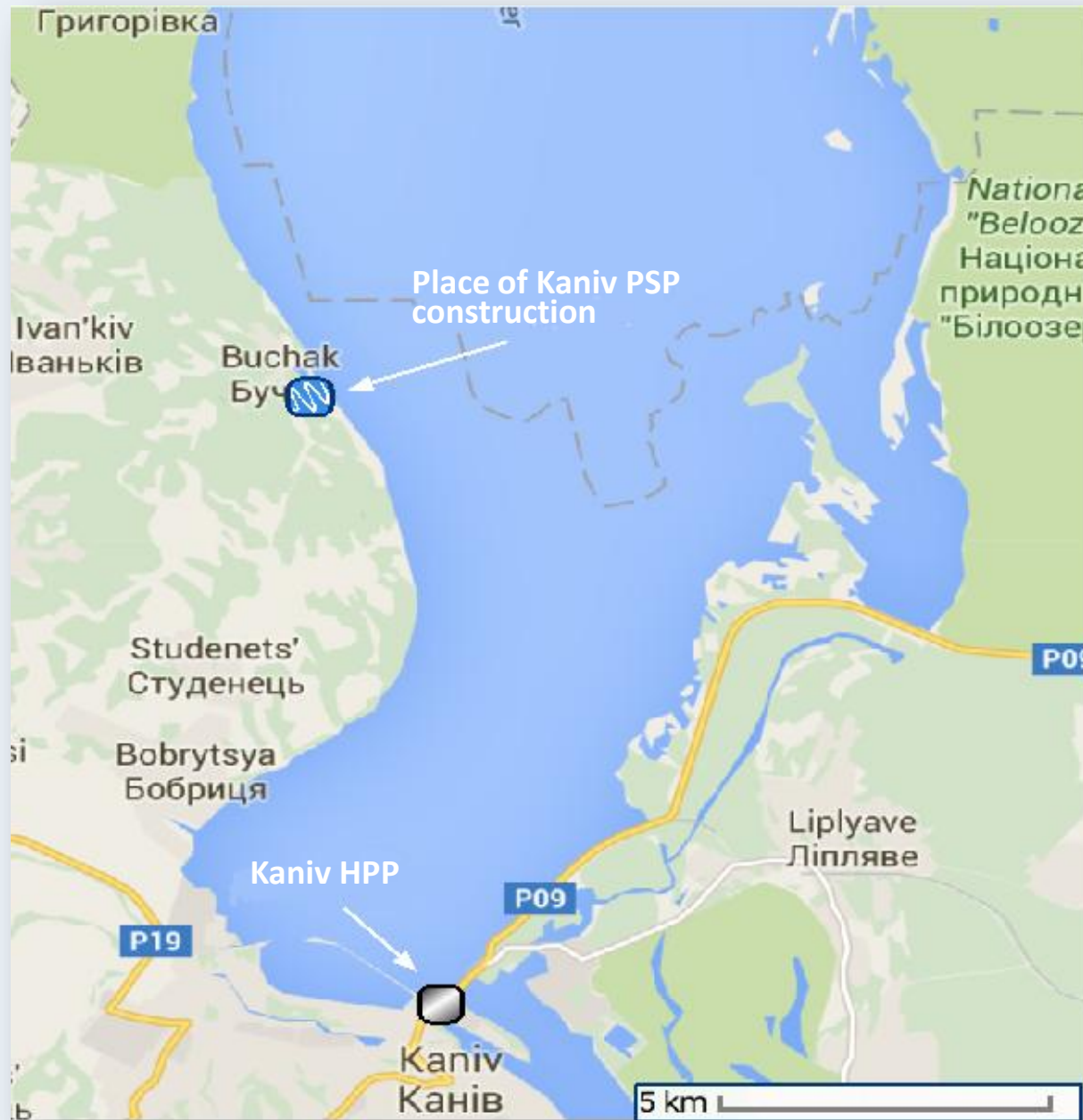
On Oct. 18, 2013 a positive decision No. 17/024 of a State ecological panel of the Ministry of Environment and Natural Resources of Ukraine was received.





Planned Kaniv PSP

# Schematic map of the district where Kaniv PSP will be located



# Significance of the Kaniv PSP Construction project for the power system and Ukraine

- Increasing the energy independence of the state
- Enhancement of safety and flexibility of the UPS of Ukraine by means of:
  - Ensuring flexible emergency reserve in the UPS of Ukraine to compensate tripping of the largest generating unit (1000 MW unit of NPP)
  - Regulation during peak load and night valley hours for the base load plants
  - Controlling the frequency and voltage in high-voltage networks
- Up to 10% of additional hydropower generated in Ukraine (1,3 bln kWh per year)
- Development of infrastructure in the Cherkasy region ≈ USD 11 mln
- New work places for local population, more than 2000 employees involved in the construction and about 230 persons of operating staff
- Environmental neutrality, minimal impact on the environment
- The system-wide effect for the UPS of Ukraine is achieved by reducing the number of the TPP generation units start-ups (saving of gas ≈ 125 mln m<sup>3</sup> per year) and stabilizing their load and efficiency (saving of coal ≈ 560 ths tones per year).

# Project support at the state level



- The Project was approved by CMU Decree No. 1050p, dated Dec. 11, 2013 “On the Project and the Construction Title of “Kaniv PSP Construction” approval” (appendix No. 1);
- The project is included in the Strategy for Sustainable Development “Ukraine – 2020” approved by decree of the President of Ukraine No. 5/2015, dated Jan. 12, 2015 (appendix No. 2);
- Energy Strategy of Ukraine for the Period until 2026 part of which is “Kaniv PSP Construction” project was approved by the CMU Decree No. 552-p dated July 13, 2016 “On Energy Strategy of Ukraine for the Period until 2026” (appendix No. 3) ;
- CMU addressed letter to IFIs on the support of “Kaniv PSP Construction” project by the state of Ukraine (appendix No. 4).

▪ More details on the documents can be found during project evaluation

# Interconnection between Kaniv PSP Construction project and strategic purposes and priorities of Ukraine's development

No	Project title	Energy Strategy of Ukraine for the Period until 2030, approved by the CMU Decree No. 1071, dated July 24, 2013	Energy Strategy of Ukraine for the Period until 2026, approved by the CMU Decree No. 552-p dated July 13, 2016	Consolidation with the Sustainable Development Strategy "Ukraine - 2020" approved by decree of the President of Ukraine No. 5/2015, dated Jan. 12, 2015	The medium-term plan of the Government's priority actions by 2020, approved by the CMU Decree No. 275-p, dated Apr. 3, 2017	Consolidation with Plan of the United Energy System of Ukraine for the next ten years (project NPC "Ukrenergo")
1	2	3	4	5	6	7
1.	Kaniv PSP Construction	<p>Project implementation is provided in Section 3, paragraph 2.7</p> <p>Proposed to be included in Power Strategy of Ukraine till 2030 when it will be updated</p>	Implementation of the project is provided in the section "Basic directions of hydropower development. Perspective projects of new construction and reconstruction of hydropower facilities"	Project implementation within "Program of Energy Independence" and "Program of Environmental Protection" of Safety movement vector; measures implementation within "Program of Energy Efficiency" and "Program of Investment Promotion" of Development movement vector	<p>Ensuring energy security of the state through efficient development of hydropower with the maximum use of cost-effective hydropower potential.</p> <p>Increasing the regulatory maneuver capacity of HPPs and PSPPs.</p> <p>Involvement of credit resources for the implementation of the project "Kaniv PSPP Construction".</p>	Implementation of projects under the Plan of UES of Ukraine, in particular, "Development plan for hydroelectric generating capacity (HPP) and pumped storage power plants (PSPP) for the period until 2026".

# Key design solutions technical specifications

## Hydro-unit

The Kaniv PSP Construction Project provides for installation of 4 reversible units with PO HT-B-675 Francis pump turbines having runners  $D_1=6750$  mm, design head  $H_d=95.0$  m, and synchronous 3-phase generator motors of 250 MW capacity each and 260 MW in pumping mode, at the rated speed  $136,4 \text{ min}^{-1}$ . Automatic control of pump turbine and auxiliaries.

### Power Generation Indicators

PSP installed capacity as per the design:

- generating mode – 1000 MW
- pumping mode – 1040 MW

PSP operating time at full capacity:

- generating mode – 4.25 h.
- pumping mode – 5.3 h.

Number of units – 4

Head – 95 m

Unit capacity:

- generating mode – 250 MW
- pumping mode – 260 MW

Electricity output – 1038 million kWh

Electricity consumption for pumping – 1320 million kWh

Duration of construction period – 6.5 years

## Upper Reservoir

Facilities of the upper reservoir having an active storage of  $17 \text{ mln m}^3$ , normal water surface elevation of  $+202.0$  m and dead storage elevation of  $+180.0$  m include:

- reservoir basin with the bottom elevation of  $+176.0$  m;
- 308.0 m-long headrace tunnel with the bottom elevation varying between  $+164.0$  m near the intake and  $+176.0$  m at the junction with the reservoir basin;
- retaining earth fill dam with a dam crest elevation of  $+204.0$  m, crest width of 10.0 m, waterfront length (along the dam axis) of 3.972 km.

## Powerhouse

The powerhouse structure is designed to be continuous, with cross-sectional dimensions of  $90.83 \times 102.0$  m and an overall height of 40.7 m. An erection bay with cross-sectional dimensions of  $55.10 \times 78.25$  m adjoins the powerhouse on the right side. The storage for gates is located on the downstream crane maintenance area. Four hydro-units with Francis pump turbine having runner diameter of 6.75 m will be installed in the powerhouse. The semi-spiral chamber will be made of metal, with a spanning angle of  $351^\circ$ .

## Water Passage

The key factor in deciding upon the design of water passage laid on the non-rocky slopes is its reliability, i.e., prevention of catastrophic failures. The water passage consists of four composite reinforced-concrete buried pipes with a length of 900.78 m and an internal diameter of 8.00 m.

## Water Outlet

The tailrace channel together with a protective section to prevent scouring has a length of 240.00 m a varying width: 91.00 m near the powerhouse and about 125.00 m near the point where the water flows into the Kaniv Reservoir and fills the whole width of the channel.

## Headrace Tunnel

The headrace tunnel width varies from 54.7 m, at the junction with the water intake, to 235.5 m, at the junction with the reservoir basin.

## Lower Reservoir

The existing Kaniv Reservoir acts as the lower reservoir. Its full capacity is  $2.6 \text{ km}^3$ , and the active storage is  $0.3 \text{ km}^3$ , including  $0.017 \text{ km}^3$  for PSP, normal water surface elevation is of  $+91.50$  m.

# Key design solutions cost indicators

No.	Title of estimated costs	*Cost, million USD
<b>1.</b>	<b>Construction works</b>	<b>588,0</b>
<b>2.</b>	<b>Equipment</b>	<b>577,9</b>
	including	
2.1.	Hydropower equipment	276,0
	Pump-turbine - 4 pcs.	137,6
	Generator-motor - 4 pcs.	120,8
	Control and governing system - 4 pcs	6,9
	Ring gate - 4 pcs	10,6
2.2.	Mechanical equipment	13,8
	Travelling crane of 320/32+16 tons capacity -2pcs	3,0
	Gates, ґрати сміттезатримуючі	4,0
	Gantry crane of 2x63+5 tons capacity -2pcs	6,8
2.3.	Power equipment	138,3
	Equipment for control system and electrical protection	7,5
	Electrical equipment of the powerhouse and erection bay	79,2
	Electrical equipment for water intake	0,2
	GIS 330 kV equipment	30,1
	Outdoor transformer yard equipment	21,2
2.4.	Compressor equipment	1,8
2.5.	Other equipment ( APM, water supply, sewage and ventilation networks, security and fire alarm, lift equipment, instrumentation, communication, other process equipment)	148,0
<b>3.</b>	<b>Other and design work</b>	<b>333,5</b>
	including VAT	<b>249,7</b>
	<b>Total project cost, including VAT</b>	<b>1499,3</b>
	*USD exchange rate as of Jan. 01, 2013	7,993

# Cooperation with IFIs

## Technical assessment

The technical assessment was carried out by independent experts involved by IBRD and EIB.

Conclusion on the project and relevant recommendations from ICOLD were received\*

According to the conclusion in order to achieve the safety of the PSP in compliance with the best practice it will be necessary to add (to the approved project at the next stages) construction measures that will not significantly affect the project and its cost

## Economic assessment

IBRD and EIB have carried out economical assessment of the project\* and reached the conclusion on the positive economic effect of Kaniv PSP project: the profitability in the baseline scenario is 8.87% with an opportunity to increase to 10.64% (conditioned upon higher demand and higher fuel prices) and a decrease to 6.67% (conditioned upon lower demand).

## Ecological assessment

The following documents were prepared in accordance with the requirements of the IFIs by DE APPOLONIA - Italy:

- ESIA report\*
- Resettlement Policy Framework and Resettlement Action Plan\*
- Stakeholders Engagement Plan for the discussion of Kaniv PSP Construction project\*
- Non-Technical Summary\*

Report on radiology \* prepared by Danish Energy Management A/S - Denmark)

- Всі проведені оцінки підтверджуються листами підтримки проекту з боку МФО:
- Letter from IBRD No. 2014/12/9-24, dated Dec. 9, 2014 (appendix No. 5)
- Letter from EIB No. ops/ENSA-1/2013-1184/LR/jf, dated Dec. 15, 2014 (appendix No. 6)
- Letter from IBRD No. 2016/07/06-1, dated July 4, 2016 (appendix No. 7 )

\* *More details on the reports result and recommendations can be found during project evaluation*

# Condition of readiness before construction works

- Total area of 967,1912 hectares was allocated for construction with the land use right registration
- A part of the infrastructure is available for the construction of the Kaniv PSP: roads, temporary buildings at the construction bases No. 2,3 are in the initial stage of the construction (the construction was suspended in 1991)
- All necessary measures are taken to begin the implementation of priority works on infrastructure restoration, including:
  - procurement procedures are carried out;
  - a contract for the implementation of priority works has been concluded;
  - funds are allocated in the tariff of PJSC Ukrhydroenergo;
  - permission for construction works was obtained (appendix No. 8).



# Additional steps needed to start the project implementation:

- Develop a model for participation of the state and an international investor in the implementation of the project.
- Attract international investors to the project.
- Register two land plots under the main buildings with an area of 22.8 hectares.
- Carry out basic surveys to update the environmental impact assessment (recommendations of IFIs).
- Carry out additional geological surveys to confirm stability of hydraulic structures (recommendations of IFIs).