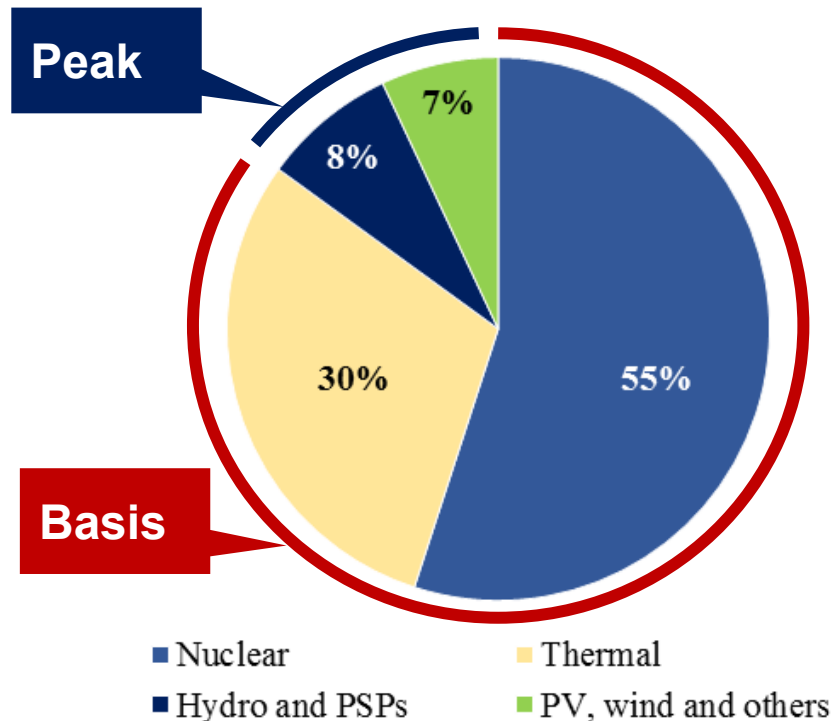


Peculiarities of the operation of PSPs on the run-of-the-river reservoirs

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Electricity generation in Ukraine



Schemes of PSPs

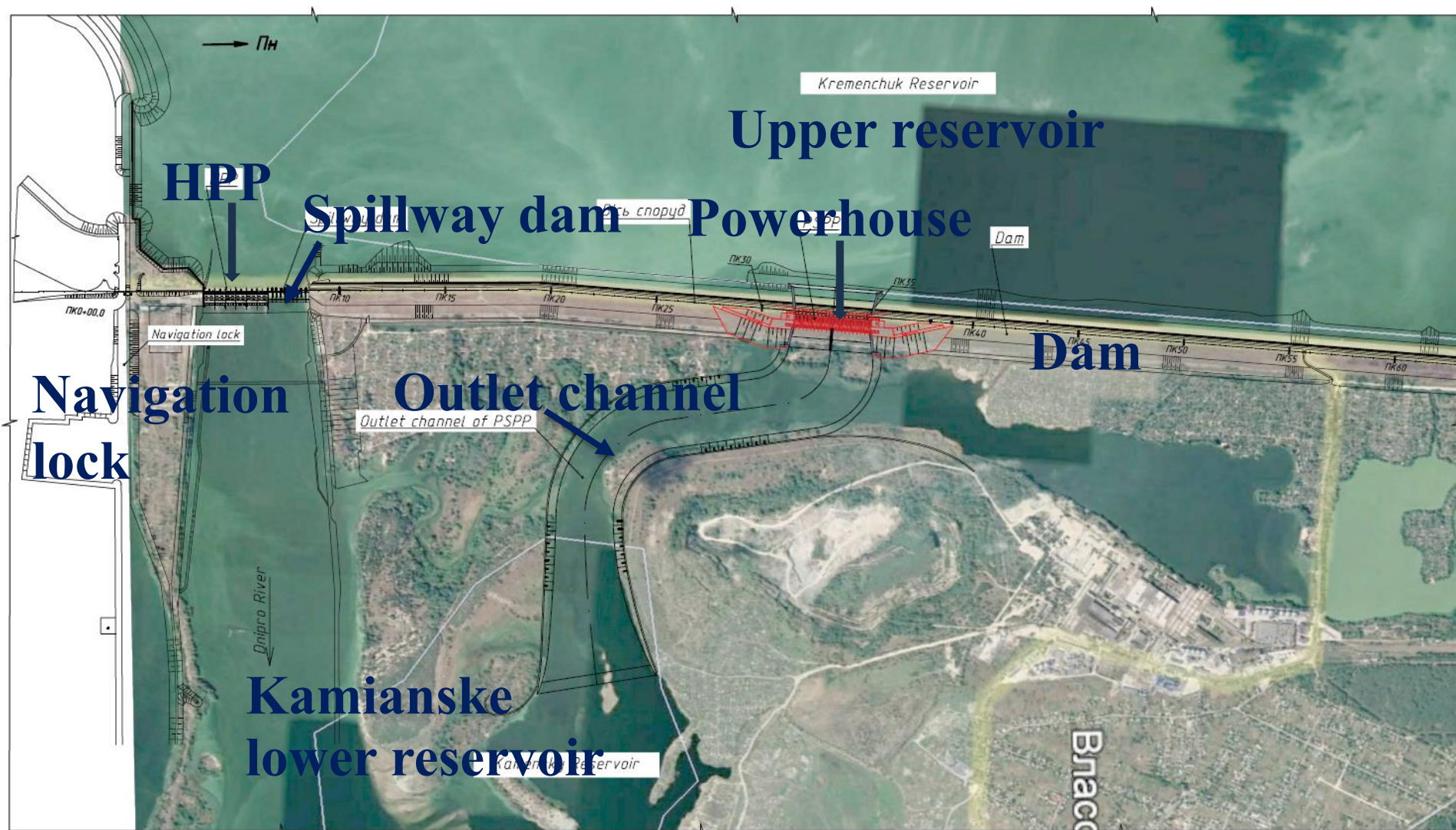
Based on the conditions for the location of the PSP, three schemes can be distinguished:

1. **The most common scheme of PSPs**, with the placement of the upper reservoir on a high plateau and on the river by a hydro development with HPP with the creation of a lower reservoir. The heads at such pumped-storage power plants can be more than 100.0 m, but the operation is limited by the volume of the reservoir. These pumped-storage power plants can provide operation in generator mode continuously for approximately 6 hours, in pumping mode - 7 hours using the balancing of the daily load schedule with the number of transient modes per day up to 20, in conditions of unstable operation of wind power plants and solar power plants.
2. **PSPs on the run-of-the-river reservoirs**, which can be created on existing hydro developments (the Dniester and Dnipro HPP cascades) with small heads up to 50.0 m with unlimited volumes of both the lower and upper reservoirs of the PSP and can operate for 12.0 hours in both pumping and turbine modes, and in general, greater flexibility and favorable operating conditions of the power system are achieved;
3. **PSPs using spent stone quarries for reservoirs**, etc. reservoirs, which reduces the construction time of such PSPs. They can be located in the South-Eastern and Central regions of Ukraine with heads of 50.0 m and more.

Location of Kremenchuk PSP and Dnipro PSP



Layout of Kremenchuk PSP facilities

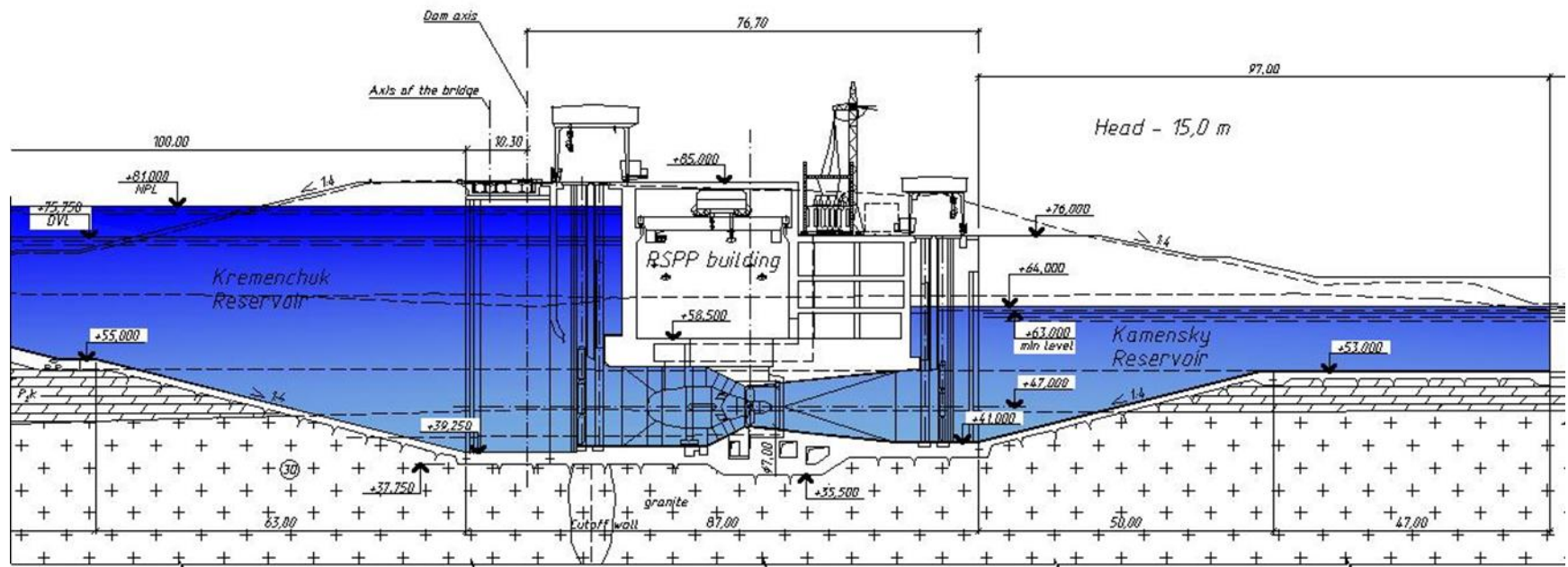


PSP building with 20 reversible horizontal hydro units

Cross-section of the PSP building

The Kremenchuk PSP structures include:

- upper reservoir, which is used as the Kremenchuk reservoir;
- inlet channel;
- PSP building with 20 reversible horizontal hydro units;
- outlet channel;
- lower reservoir, which is used as the Kamianske reservoir.



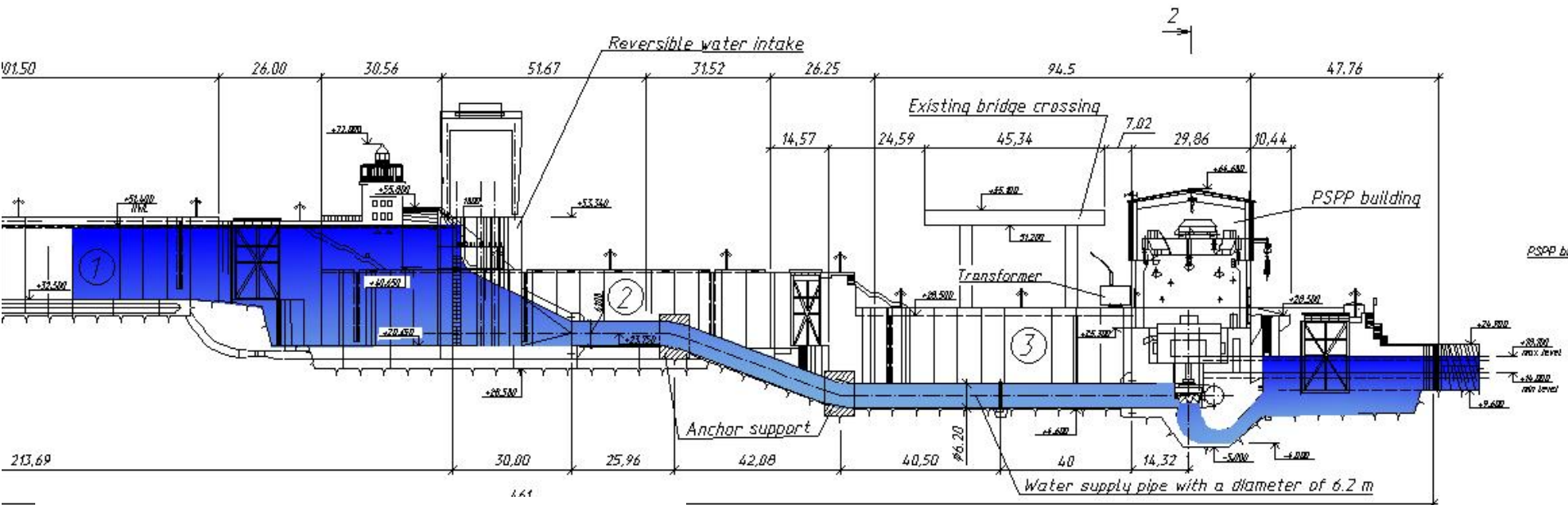
Previous technical indicators of Kremenchuk PSP

Parameters	
Capacity, MW:	
- Turbine mode	500
- Pump mode	590
Number of units, pcs	20
Annual power generation, mil kW a year	1320
Annual power consumption, mil kW a year	1760
Net head in turbine mode, m:	
- Maximum	18,40
- Minimum	11,75
- Design	15,0
Flow at H_d and N_r m ³ /s:	
- Turbine mode	4125
- Pump mode	3250

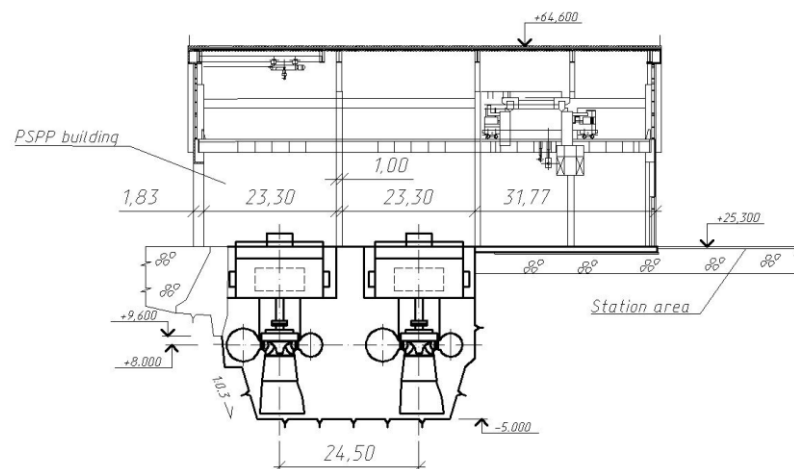
Construction of a PSP in the old three-chamber decommissioned lock of the Dnipro HPP



Location of PSP structures in a three-chamber lock



Section 2-2



The Dnipro PSP structures include:

- upper reservoir, which is used as the Dnipro reservoir;
- inlet channel;
- PSP building with 2 reversible hydro units with an installed capacity of 90 MW;
- outlet channel;
- lower reservoir

Previous technical indicators of Dnipro PSP

Parameters	
Capacity, MW:	
- Turbine mode	90
- Pump mode	104
Number of units, pcs	2
Annual power generation, mil kW a year	178
Annual power consumption, mil kW a year	237
Net head in turbine mode, m:	
- Maximum	37,40
- Minimum	32,50
- Design	33,80
Flow at H_d and N_r m ³ /s:	
- Turbine mode	304
- Pump mode	261



The main focus in creating a renewed Ukrainian power industry

Based on the new realities, the creation of a renewed electric power industry of Ukraine is expected to:

- ✓ - a radical change in the structure of generating capacities in the electric power industry, where nuclear power remains the basis of the power system, covering the basic part of the load schedule, and distributed generation from renewable energy sources, primarily from SPPs and WPPs, accounts for most of the electricity production.
- ✓ - regulation of the power system primarily at the expense of hydropower with a rapid increase in the capacity of PSPs.
- ✓ - evolution of centralized power systems with a transition to decentralized distributed generation - more flexible and safer.

The priority development of distributed generation, including the use of complex hybrid power plants consisting of various combinations of technologically connected wind power plants, solar power plants, hydropower plants, PSPs, industrial batteries, etc., operating on local networks and integrated with the United Energy System of Ukraine (UES), will also provide significant advantages in the operation of the United Energy System of Ukraine, and most importantly, increasing its stability and survivability in critical situations (military actions), and generally increasing energy security.



Conclusions

The considered PSPs on the run-of-the-river reservoirs in a complex with HPPs, SPPs and WPPs, producing "green" electricity, provide reliable electricity supply, also in emergency situations in the United Energy System of Ukraine and under martial law, and generally increase energy security. At the same time, an increase in the level of efficiency of electricity use is achieved at all stages: generation, transportation and consumption.

Minimal impact on the environment and improvement of environmental conditions in general is achieved due to:

- ✓ - use of existing reservoirs, which does not require the allocation of land for reservoirs and structures, and implementation of a set of environmental protection measures.
- ✓ - provision of balancing of PSPs, wind power plants and SPPs with the production of "green" electricity, instead of production at TPPs with a reduction in coal combustion, CO₂ emissions and other pollutants, and in general a reduction in the man-made load on the environment.



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