Journal of Research and Innovation for Sustainable Society (JRISS)
Volume 6, Issue 2, 2024
ISSN: 2668-0416
Thoth Publishing House

DOI: 10.33727/JRISS.2024.2.20:192-195

Considerations on improving the level of reliability and capacity of the energy system

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Abstract: Balancing the energy system, however, has now become an extremely important issue with the closure of the thermal power plants. Because the green methods of energy production, which have been developed recently, wind turbines and photovoltaics do not produce energy constantly. It does not cover the energy needs of SEN in the 24 hours, as well as in the 4 seasons. There has been a constant need for energy capabilities to step in when there is either an excess or deficit of energy in the system. Such a role can be taken over by hydroelectric power plants with accumulation by pumping (CHEAP). Pumped storage plants are neither polluting nor dependent on fossil fuel price fluctuations and can successfully take over the role of energy regulator in the SEN. They are, in fact, some huge "green" batteries that constitute an electrical energy storage solution, at the level of 2020 they represented 95% of global storage.
Keyword: *electrical energy, hydroelectric power plants with accumulation by system , pumped storage, wind turbines, photovoltaics.*

Introduction

The technology of pumped storage hydroelectric power plants is not new, and specialists have drawn attention to the need to start such a project. Both because the countries that had favorable conditions developed these energy systems, and because we need a complementary project to the Cernavoda Nuclear Power Plant [1,2,3, 4,5]. And currently the Cernavoda Power Plant is the best reason, it does not have optimal coverage in relation to consumption, that is, there are intervals when it produces more energy than was needed, and it cannot be stored. Basically, we are the only country that has the conditions for the operation of a CHEAP, but it was not built. The need is increasing, due to the exclusion of the stable energy system from the market and the introduction of multiple systems that do not constantly produce energy. And, in the absence of a CHEAP, we would need a natural gas plant at national level to balance the energy system.

The rate of economic development and the use of existing capacities in the best possible way is a factor that influences the production of electricity. Electricity consumption forecasting is a main function of electricity distribution and supply operators. Electricity in Romania cannot be
storedefficiently, on a large scale (relative to the quantity produced), which means that for distribution and supply operators, demand estimation is an indispensable factor in the transaction management process in a relatively reasonable.According to the specialists, in Romania, for the decision to develop a CHEAP project, technology is not a problem, but the lack of market mechanisms, which recognize from a financial point of view the value of electricity storage and the compensation of system services. Layout with CHEAP in figure 1, according to the Strategy and Forecast Commission.[9]

Figure 1. Hydroelectric power plant with pumping accumulation

Researche direction

The pumped storage plant has an important role in improving the level of reliability and capacity of the energy system. In addition, for the time horizon of 2030, the impact of certain stress factors on the SEN's ability to cover the demand for electricity and system technological services and on the SEN's ability to maintain the level of exports and ensure the imports necessary to operate in safety conditions. From the results of modeling the energy production capacity in the near future, at the level of the 2030s, it shows that Romania could need short-term energy imports (approx. 20-35 GWh in 24 hours), due to climate changes. And in agreement with these fears are also the data on electricity production at the level of the current year, according to ANRE.

Table 1. Production capacities at the level of 2024 – source Transelectrica

Nr. crt	**POWER 2024**		
	Generation type	Installed power [MW]	Avaible power [MW]
1	Hydroelectric power plants	6731	6388
2	Nuclear power plants	1413	1413
3	Termoelectric power plants	12059	10256
4	Wind power plants	3030	2944
5	Solar power plants	1375	1176
6	Biomass power plants	130	99
Total		24.738	22.256

Pumped storage is the only commercially proven technology available for energy system-scale electricity storage. The role of a CHEAP is to cover part of the peak area of the load graph by consuming in the base area of the load graph. In addition, it provides technological system services, at the level of production and transport, services that are the necessary elements to guarantee the quality, security and economy of electricity supply. At the border between the transport system and the distribution system, there must be the concept of service quality, associated with maintaining within acceptable limits the voltage and frequency levels at the delivery points. That means a security in the supply of energy at a minimum cost. The Wholesale Electric Energy Market represents another element in support of the need to develop a CHEAP, the organized framework in which electricity is purchased by suppliers from producers or other suppliers, with a view to resale or own consumption, as well as by network operators to cover their own technological consumption are well represented in the energy bill,by 2024, figure 2.[3]

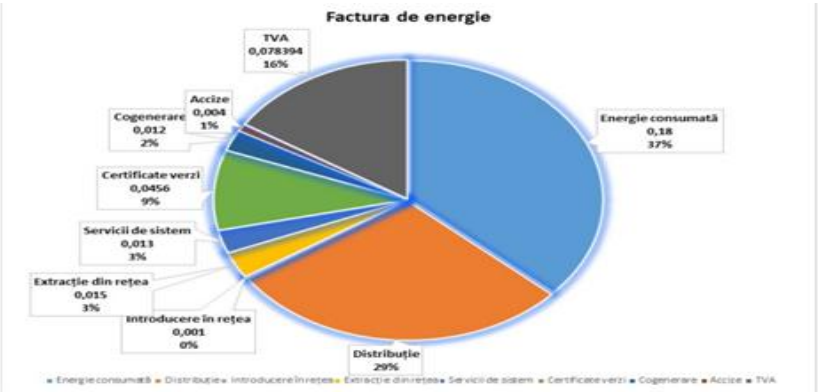

Figure2. The energy bill in 2024[3]

The invoice reflects the transactions on the wholesale electricity market, the purpose of which is the sale - purchase of: electricity; technological system services. In order to avoid network problems, the formation of different price zones is allowed through the market fragmentation mechanism. The price of electricity on the electricity market is influenced by the following factors:

- Evolution of fuel prices.
- Sustainable development measures.
- Limited interconnection capacities.
- Taxes.
- Sector regulatory measures.

The short start-up time and the high speed of loading/unloading of the hydro aggregates give flexibility in operation to the hydroelectric plants which are the main providers of system technological services covering approx. 80% Another aspect related to flexibility in the operation of hydroelectric plants is the role of hydro plants in profiling the daily load curve (consumption).

The variation of the electrical load in a specified time, usually a day (24 hours) is called the Load Curve and represents the energy required to be allocated to the consumers of the energy system. If the amount of energy demanded by consumers is higher or lower than the amount of energy delivered by producers,

disturbances occur in the network voltage and frequency, which endanger the functioning of the consumers, leading to their serious damage. In order to achieve this, the load curve was divided into several consumption areas:

- basic area – it is an area that must be provided permanently; here the energy producers are thermoelectric and nuclear power plants (power plants with low start/stop flexibility, which have a continuous operation, usually with a constant power - CNE, CTE, cogeneration plants, CTE with condensation groups, CHE on the water line;
- the area of variable powers - the power plants have an intermittent operation (with interruptions) and even during operation the power can be variable.

Conclusions

Through the work, we were trying to warn that the imbalance of the energy system is possible in the future, and a solution to prevent it is the construction of a CHEAP, we have in a national energy system, pumping stations fulfill the requirements regarding the quantity and quality indicators of the electricity produced and increase the degree of safety in the operation of the entire system, as would result from the advantages:

- According to the specialists, in Romania, for the decision to develop a CHEAP project, technology is not a problem, but the lack of market mechanisms, which recognize from a financial point of view the value of electricity storage and the compensation of system services.
- Pumped power stations do not create energy from the transformation of resources energy, they only have the ability to store energy during periods of no load and to release it during peak periods of pregnancy.
- The operation of pumped storage plants actually consists of hydro technology (existence of two reservoirs, use of water in pumping and generation, etc.) with thermal and nuclear technology (use of excess capacity at empty load for pumping).
- In order to prevent possible imbalances in the energy system in the future, we insist on the opening and development of pumped storage hydroelectric plants.
- Electricity storage is economical when the marginal cost of electricity generated is higher than the cost of storage and energy consumed during the storage process.

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