

# Ball valve for pumped energy storage power station

Should ball valves be closed during the runaway process of high-head turbine-generator units?

Abstract. During the runaway process of high-head turbine-generator units due to wicket gate failure, the ball valve should be closed promptly to prevent accidents, and the dynamic hydraulic characteristics during the closing process should be studied.

Does pumped storage power maintain grid stability?

Many countries configured a certain proportion of pumped storage power in the network to keep their grid stability. This paper introduces the current development status of the pumped storage power (PSP) station in some different countries based on their own economic demands and network characteristics.

Why is pumped Energy Storage important?

Besides, it is an effective power storing tool and now it has become the largest and most widely used energy storage form. Many countries configured a certain proportion of pumped storage power in the network to keep their grid stability.

Why are ball valves important?

Ball valves are widely used as the main valves located before turbines in high-head hydropower and pumped-storage power stations. These ball valves are important because they are the main means to control runaway accidents after wicket gate failure. The main ball valves traditionally do not play the role of adjusting flow rate.

What is a ball valve involving in the transient process adjustment?

The ball valve involving in the transient process adjustment means the design levels of the PSP unit and water delivery passage need further improving, which is the key design parameter for the manufacturer. This value is usually obtained through one -

What is a hydraulic power station?

Conventional hydraulic power station is mainly used to produce electricity. There are many roles for frequency and phase, quickly start-up and providing standing reserve for electric power system. "strong and intelligent" grid. Besides, the world is in a critical transition period from traditional fossil

Huang et al. [19] presented a control strategy that uses the linkage closing law combining ball valve and the guide vane in a pumped storage power station, the results proved that the proposed closing law can prevent the units from entering the S-shaped unstable area and ensure the safety of the units.

Energy Storage Comparison (4-hour storage) Capabilities, Costs & Innovation \*Source: US DOE, 2020 Grid Energy Storage Technology Cost and Performance Assessment \*\*considering the value of initial investment at end of lifetime including the replacement cost at every end-of-life period Type of energy storage

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## Comparison metrics Pumped Storage Hydro

The installed power capacity of China arrived 2735 GW (GW) by the end of June in 2023 (Fig. 1 (a)), which relied upon the rapid development of renewable energy resources and the extensive construction of power grid systems during the past decade [1]. The primary power sources in China consist of thermal power (50 %), hydropower (15 %), wind power (14 %), and ...

This paper presents a control strategy using coordinated regulation of the intake ball valve and the guide vane for such cases.

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One- and three-dimensional coupling flow simulations of pumped-storage power stations with complex long-distance water conveyance pipeline system. Author ... (Menendez et al., 2020). For overcoming the challenge of low-quality clean energy generation in the power grid, the development of energy-storage technologies must be prioritized (Li et al ...

"S" characteristics of a pump turbine may result in certain problems, such as excessive water hammer pressure, unstable no-load operation, and difficulty in synchronization. Accordingly, a new start-up strategy based on the partial opening of a ball valve is proposed, and the calculation model of the hydraulic transition process with misaligned guide vane devices ...

For overcoming the challenge of low-quality clean energy generation in the power grid, the development of energy-storage technologies must be prioritized (Li et al., 2019). ... Particularly, for the pumped-storage power station containing complex long-distance water conveyance pipeline system and surge tanks, the required computational mesh ...

Pumped-Hydro Energy Storage Potential energy storage in elevated mass is the basis for . pumped-hydro energy storage (PHES) Energy used to pump water from a lower reservoir to an upper reservoir Electrical energy. input to . motors. converted to . rotational mechanical energy Pumps. transfer energy to the water as . kinetic, then . potential energy

Abstract For some pumped storage power stations, the maximum pressures at the spiral case inlet and the draft tube inlet cannot be limited to their allowable ranges by simply optimizing the guide vane closing law for extreme conditions. This paper presents a ...

The transient characteristics caused by the operating-condition switches in pumped storage power stations (PSPSs) are crucial for safe and reliable operations of hydropower systems, ...

Driven by China's long-term energy transition strategies, the construction of large-scale clean energy power

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stations, such as wind, solar, and hydropower, is advancing rapidly. Consequently, as a green, low-carbon, and ...

The prototype ball valve of a pumped-storage power station was adopted in this study. As shown in figure 1, the whole computational domain contains 4 parts: the upstream pipe (P1), the valve, the ... valve, which can be quantified as the ratio between the mechanical energy loss passing through the valve and the kinetic energy of the main flow ...

The 1D MOC and 3D hydraulic transient are proposed respectively to investigate transient flow characteristics inside a ball valve, as well as the UFSI models for its relevant dynamic structural responses during ball-valve closing and load rejection in a pumped storage power station.

The closing law based on ball-valve and guide vane was applied for the load rejection in a pumped storage power station (Zhang & Yang 2011). A numerical simulation of the closing law based on ball-valve and guide vane was adopted by Hou & Cheng (2005), where the results proved that the closing law can ensure the safety of the unit during load ...

Huang et al. [19] presented a control strategy that uses the linkage closing law combining ball valve and the guide vane in a pumped storage power station, the results proved that the proposed closing law can prevent the units from entering the S-shaped unstable area and ensure the safety of the units. Based on the above research, three ...

In order to reduce the increase of volute water pressure and pressure pulsations in load rejection of pumped storage power stations, an effective technique for controlling flow ...

**PRINCIPLES OF PUMPED STORAGE** Pumped storage schemes store electric energy by pumping water from a lower reservoir into an upper reservoir when there is a surplus of electrical energy in a power grid. During periods of high energy demand the water is released back through the turbines and electricity is generated and fed into the grid. Pumped ...

Inlet ball valves bear the brunt of the impact and disturbance from upstream pressure pipeline under extreme conditions on PSPSs. Artificially change the wicket gate and ball valve ...

The Ref. [14] proposes a practical method for optimally combined peaking of energy storage and conventional means. By establishing a computational model with technical and economic indicators, the combined peaking optimization scheme for power systems with different renewable energy penetration levels is finally obtained through calculation.

Fluid-structure coupling analysis of inlet ball valve on pumped-storage power station under extreme conditions. Chang Liu 1, Jianzhong Zhou 1, Ran Duan 1, ... While pumped storage power stations (PSPSs)

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provide clean energy, they are also facing many problems of safe operation. Inlet ball valves bear the brunt of the impact and disturbance from ...

Their power and storage capacities are at a more intermediate level which allow for ... for short durations. ii. Pumped Hydro Energy Storage, which pumps large amount of water to a higher- level reservoir, storing as potential energy, is more suitable for applications where ... Charging Stations Power Plant Solar Panels Substation ESS Office ...

Download scientific diagram | Ball valve structure material settings. from publication: Fluid-structure coupling analysis of inlet ball valve on pumped-storage power station under extreme ...

Hou et al. [10] introduced a ball valve into the optimization of CLGV problems, which can reduce the water hammer pressure in spiral cases by rapidly closing at the ...

Guaranteed calculation for regulation (GCR) is indispensable in the operation of a pumped storage power station (PSPS), which aims to determine the rotational speed of turbines and pressure in the water diversion system under extreme conditions, such as load rejection. The closure law of guide vanes (CLGVs) requires optimization to minimize the maximum value of ...

Pumped storage is now the most commonly used power storage method in the world, with plants across the globe achieving an installed capacity of around 140,000 MW by 2010. EDF has built six pumped hydro-electric energy storage (PHES) plants in France, which it is now renovating and extending. PHES PLANTS ARE A PARTICULAR TYPE OF HYDRO ...

Pumped storage power stations can cooperate with or replace some thermal power units to reduce fuel consumption and pollutant emissions of the power grid, so as to achieve energy saving and emission reduction of the power system. ... a coordinated scheduling strategy is implemented between pumped-storage power stations and renewable energy ...

In order to study the self-excited vibration of ball valve in pumped storage power station and maintain the normal operation of equipment, a modeling and analysis framework for...

Ball valves are widely used as the main valves located before turbines in high-head hydropower and pumped-storage power stations. These ball valves are important because they are the ...

In this paper, the double units" load rejection transient with the joint closing law of ball-valve and guide vane was calculated for a pumped storage power station. The numerical ...

While pumped storage power stations (PSPSs) provide clean energy, they are also facing many problems of safe operation. Inlet ball valves bear the brunt of the impact and disturbance from upstream ...

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When integrating the generation of large-scale renewable energy, such as wind and solar energy, the supply and demand sides of the new power system will exhibit high uncertainty. Pumped storage power stations can improve flexible resource supply regulation in the power system, which is the key support and important guarantee for building low-carbon, safe, ...

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