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Research and Application of Key Technique on Optimal Operation of Cascade Reservoirs

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Currently, the inflow forecast and optimization of cascade reservoirs has become a key issue for basin water resources development and utilization, and a series of scientific achievements in the long-term runoff forecasting and reservoir optimal operation have been gradually applied to production practice. However, due to the lack of effective articulation techniques between them, the most new approach of muilti-reservoir forecast and operation still exist on the application, and there are a lot of basic work on models and methods improvement need for further improvement and resolved. This paper focuses on how to carry out cascade reservoirs optimal operation by considering the runoff forecasting uncertainty quantified from the results of long-term probabilistic forecasts, combined with improved intelligence algorithm and its common parallelization framework for the development of cascade reservoirs operation rules multi-objective optimization techniques and risk analysis techniques of power generation. The main research cascade reservoirs as follows:
(1) Hydrological analysis and random runoff simulation of the Yalong River. Based on the historical and real-time data of cascade reservoirs in the downstream Yalong River, mathematical statistical methods was used to analyze the runoff characteristics of these reservoirs and find the runoff variation inherent laws. In order to meet needs of the operation rules optimization and power generation risk analysis, PARMA model was used to generate artificial runoff sequences, using expectation and standard deviation parameters compared with these of historical runoff to verify its legitimacy.
(2) This paper analyzed cascade reservoirs risk analysis factors including risk factors, risk assessment indicators and so on, especially focused on the description of the hydrology risk factors and definition of power generation dispatching risk. On this basis, combined with Monte Carlo risk assessment techniques and cascade reservoirs risk dispatching techniques based on risk punishment or risk constraint of scene earnings, cascade reservoirs power generation risk operation technical framework was constructed. Finally, this paper assessed power generation operation of cascade reservoirs in lower Yalong River, carried out risk assessment study based on historical runoff series, meanwhile, took Jinping I and Ertan Reservoir as important research objects to analyze benefits and risks of year-end storage combination among cascade reservoirs, and then analyzed power generation risk considering year-end storage risk.