OPERATION MODEL FOR HYDRO POWER RESERVOIR WITH DYNAMIC HEDGING INTEGRATED RULE CURVE

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ABSTRACT

Water management is really a critical problem that requires focus and effective strategies to address various challenges such as floods, droughts, faced by many regions today. Optimum allocation of water resources becomes increasingly important in regions experiencing population growth and water shortages in accordance with changing climate conditions. Water reservoirs, when properly designed, managed, and integrated into water management strategies, play a pivotal role in ensuring water security, mitigating the impacts of floods and droughts, supporting ecosystems, and meeting the diverse water needs of society.

In reservoir operation analysis, a system approach is often adopted through simulation and optimization techniques in understanding and optimizing the operation of reservoirs to achieve desired objectives. A reservoir simulation model is useful in the planning and real time operation stage to study the behaviour with actual site conditions. In this work, a simulation model for a hydropower reservoir was developed with HEC-ResSim to assess the operational performance.

A simulation model does not directly find the best operating rule. Optimization techniques aim to derive the most efficient policy for the reservoir system based on specified objectives and constraints. In the study, an optimization technique was explored to determine the best operating policy by optimizing the release volume with an aim to maximize the power generation and to incorporate the concept of hedging in operating policy by optimizing the hedging parameters.

The hydrologic regime changes significantly affect reservoir performance; climate change and human interference are two significant factors. Water shortages and lack of reliability will be observed as a result of this. Improving operational practices is a faster and more effective way

to reduce the vulnerability of systems. However, rule curves alone may not always be sufficient to address water scarcity or system vulnerabilities, especially during times of drought or other extreme weather events. Water curtailing or hedging is often used in conjunction with rule curves to improve the effectiveness of water management practices and reduce vulnerability during normal operational periods. In hydropower reservoir operation, hedging or water curtailing helps to increase the reservoir storage, providing better water head for power production with smaller discharge for the same output power. Hence the study focus mainly on effectiveness of hedging concept in enhancing the total power generation of a hydropower reservoir during periods of low inflow. The study explores the utilization of Genetic Algorithm Optimization techniques to improve the goal with an optimized operational model and hedging integrated rule curve.