Integrating Non-Power Outcomes into Hydro Operations
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Introduction

Water resources planners and operators in British Columbia attempt to balance multiple, and often competing, demands. B.C. Hydro is the third largest utility in Canada, operating 30 hydroelectric facilities with a combined capacity of 10,400 MW and three gas thermal plants, whose total capacity is 1,100 MW. The hydroelectric system derives 50% of its capacity from the Columbia River system, 35% from the Peace River and the remaining 15% from smaller, mostly coastal, plants. Operational flexibility of the Columbia River system is constrained by an international treaty with the United States.

Operations and Challenges

Within B.C. Hydro, the Generation business unit plans and operates the system, as well the individual facilities, in a horizon, which extends from the next hour to three years into the future. Generation is responsible for meeting the peak winter load 3 years from now, and for opening a gate in the next hour to ensure adequate diversion of water for fish.

At the facility level, operators and planners deal with constraints arising from; physical characteristics of the facility, water licenses, environmental legislation, international agreements, commercial agreements, and requirements from the system level. These constraints, often representing competing demands at a facility, include flood control, fishery water releases and water levels, First Nations[1] heritage preservation concerns, recreation lake levels, industrial water use, municipal water supply, capacity, energy and ancillary needs.

By their very nature, complex competing demands cannot easily be resolved by mathematical models. They represent interests, which are not quantifiable with the same units of measurement. They are interests, which assign different order priority to the satisfaction of demands. The demands themselves are subject to change with the passage of time, depending on societal priorities, environmental legislation, economic drivers and commercial arrangements.

Addressing the Challenges

To address these challenges, B.C. Hydro and the Province initiated a program whose aim was to balance environmental, social and economic values in the operation of the

[1] First Nations is a term of ethnicity that refers to the indigenous peoples in Canada

facilities. The water use planning process was designed to provide opportunities for government agencies, community members, First Nations, municipalities, and other interested parties to identify issues and concerns with operations. The desired outcome was a plan for each facility that would clarify B.C. Hydro's exercise of its water rights in the operation of its hydroelectric facilities.

The general Water Use Planning process involves identification of values and objectives, definition of performance measures and development of operating alternatives, which are simulated with computer models. Effectiveness of alternatives are assessed and stakeholders undertake tradeoff exercises.

Complex water management operational studies had to be understandable by experts in non-engineering disciplines and acceptable to a variety of stakeholders within the watershed communities. A modeling framework was delineated to help stakeholders focus on constraints that could feasibly result in operational changes.

A model was developed which simulates hydro systems and enhances the ability of stakeholders to undertake trade-offs. This model utilizes penalty functions to describe constraints that might be violated. Important aspects of the modeling process include standardization of data – input/output and reports, and implementation of a quality assurance process. To further assure participants, modeling results were independently reviewed.

Completed water use plans are sent to the Comptroller of Water Rights. After further consultations by the Comptroller with the stakeholders, the water use plan is operationally implemented by an order containing detailed specification of constraints.

Prior to water use planning, B.C. Hydro's operations took into account approximately 250 constraints for environmental and social requirements. Following water use planning, this number increased to 750 constraints, requiring a corresponding expansion of planning, coordination, and execution of operations.

Management of the water at a facility is the responsibility of an operations planning engineer, who designs operating strategies, which meet multiple requirements in the short term, mid and long term. Operating strategies are devised which prioritize the violation of constraints. In some situations consultation with regulatory agencies and stakeholders are necessary in order to determine the desired operation. Inadvertent violation of constraints also occurs, requiring prompt reporting to the Comptroller of Water Rights, along with corrective measures to reduce such violations in the future.

BC Hydro is completing a few remaining water use plans and is in the process of refining operations including details of implementation of compliance.