Maximizing Waters of the Niagara River for Power Generation: Challenges Constructing the Niagara Tunnel Intake Approach

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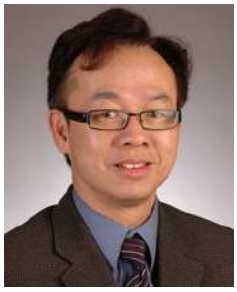

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Summary

The Niagara River, forming part of the boundary between Canada and the United States, carries water averaging 6,000 m^3 per second and drops about 100 m along its route from Lake Erie to Lake Ontario. Over half of the drop occurs at the world famous Niagara Falls. Since the late 19th century, power plants have been developed on both sides of the river to tap into this valuable natural resource. Due to progressive retirement of the century old inefficient hydro stations adjacent to the Falls, and Ontario Government initiatives to close remaining coal-fired generating stations, Ontario Power Generation Inc. decided in 2004 to proceed with the construction of the CAD$1.6 billion Niagara Tunnel Project to boost average annual generation at the existing Sir Adam Beck hydroelectric stations by 1.6 billion kilowatt-hours. One major challenge is the design and construction of the intake approach located in the 2 km wide upper Niagara River to direct water into the 12.7 m diameter tunnel, as outlined in this paper.

Keywords: Hydroelectricity, diversion tunnel, intake walls, modular precasting, ice management.

1. Introduction

Ontario Power Generation (OPG), the largest electricity generator in the Province of Ontario, Canada, operates nuclear, fossil and hydroelectric facilities to supply approximately 70 percent of Ontario's 150 terawatt-hour annual demand.

OPG shares the significant hydroelectric resource available on the Niagara River with the New York Power Authority (NYPA) under the terms of the 1950 Treaty between Canada and the United States. The Niagara River is 56 km in length and flows from Lake Erie to Lake Ontario with a total drop of approximately 100 m. About 55 percent of the drop occurs at the Horseshoe Falls with another 40 percent of the drop occurring through rapids upstream and downstream over a distance of about 8 km. Lake Erie outflow varies from about 4,000 m^3/s to about 10,000 m^3/s, averaging about 6,000 m^3/s. The 1950 Treaty stipulates that no less than 2,832 m^3/s (100,000 ft^3/s) of water must flow over the falls during the daytime in the annual tourist season, from April 1 to October 31. At all other times, no less than 1,416m^3/s (50,000 ft^3/s) must flow over the falls. The remaining flow is split between Canada and the United States for hydroelectric power generation. Canada's share for power generation varies from about 1,000 m^3/s to about 3,000 m^3/s, exceeding OPG's current

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