MUSKRAT FALLS HYDROELECTRIC DEVELOPMENT

Summary of Studies on Firm and Average Energy Production

Date: June 9, 2011
Rec. No. 202-120142-00007

nalcor energy
LOWER CHURCHILL PROJECT

Muskrat Falls Hydroelectric Development

Summary of Studies on Firm and Average Energy Production

This summary speaks to three studies which numerate the estimates for average energy and firm energy production at the Muskrat Falls development. It identifies the studies from which the values were obtained, provides background on those studies and comments on the influence which water management has on the values.

Initial Studies: A study by Acres International Limited in 1998 resulted in a report titled "Churchill River Complex, Power and Energy Modeling Study", dated July 1998, which provided the basis for the average and firm energy production values that have been most often used for the Muskrat Falls development. That study assumed three developments on the Churchill River, those being the existing Upper Churchill, Gull Island and Muskrat Falls. Table 5.2 in that report provides an estimate of the average annual energy production attributable to the Muskrat Falls development of 4.91 TWh/year. The firm energy potential of Muskrat Falls, while not specifically stated, can be derived from the estimate for the river system's firm energy potential. System firm for the entire river is estimated to be 46.24 TWh/year. That firm total, when proportionally allocated to each facility in a similar manner as that same table allocates average energy between plants, places Muskrat Falls firm generation potential at 4.48 TWh/year. This 1998 study based its results on a hydraulic record for the period between 1943 and 1997 and employed Acres' ARSP software package to perform the simulations.

Recent Studies: A study by Hatch (formerly Acres International Limited) in 2010-2011 resulted in a report titled "MF1330 - Hydraulic Modeling and Studies update, Report 6: Muskrat Falls Regulation Study", dated May 2011, which provides a more recent estimate of the average energy potential for the Muskrat Falls development. Table 4-2 in this report shows that the average energy production attributable to Muskrat Falls,

with and without the presence of a reservoir at Gull Island, is 4.878 TWh/year and 4.870 TWh/year, respectively. This 2011 study, based its results on a hydraulic record for the period from 1957 to 2006, and employed Hatch's Auto Vista software package. This estimate of average energy is essentially the same as that derived from the 1998 report.

An additional report prepared by Hatch in 2011 titled “MF1320 - Estimate of Firm Generation Potential of the Muskrat Falls Development”, dated June 2011, estimates the quantity of firm energy available from the Muskrat Falls development. Table 7-1 of this report estimates that 4.47 TWh/year of firm energy is available from Muskrat Falls. This study based its results on the same hydraulic period and used the same software package employed in the MF1330 study. This estimate of firm energy is essentially the same as that derived from the 1998 report.

Water Management: A water management agreement has been formalized between CF(L)Co and the Lower Churchill facilities to ensure that all plants produce in concert to maximize energy production from the river. All the studies conducted contain some or all of the provisions of the agreement. Studies MF1320 and MF1330 explicitly contain the requirement to coordinate operations and share the regulating benefits of the Upper Churchill storage system between plants along the river, thus permitting the benefits of regulation to apply to each facility during the calculation of firm energy. The Acres 1998 study implicitly coordinated production between plants, in that all plants were operated to serve all loads; however, the benefits of the regulation provided by the Upper Churchill reservoirs were not explicitly numerated for the individual facilities. Hence, the requirement to breakdown the total value provided in that study.

Future Studies: All of the studies referenced above assume a 4 x 206 MW plant at Muskrat Falls employing either all, or a majority of, propeller type units operating with a half meter of live storage, with energy values referenced to the plant's high voltage bus. During final design and optimization it is expected that 4 x 206 MW Kaplan type runners

will be installed in the facility. This modification is expected to increase the average and firm energy values that have been quoted. Other plant characteristics are subject to improvement as well.