

Title: Evaluation of Pumped Storage Operations for Coordination with Wind Resources and for Supplying Ancillary Services.

Authors:

Diana Hurdowar-Castro, Ph.D., P.Eng, Director, Power and Water Optimization at Hatch, Ontario, Canada

Francois Welt, Ph.D., P. Eng., Senior Optimization Specialist and Mechanical Engineer at Hatch, Ontario, Canada

Dieter Matzner, Principal Power Consultant, Hatch Woodmead, South Africa

Pumped storage has the capability to support renewable power projects by providing the necessary generation required to firm such supplies. Pumped storage capacity can also be used to trade between off and on peak energy and to provide ancillary services. This paper discusses the sizing of storage and pump/generation facilities and their interaction in the market by describing specific experiences gained with pumped storage plants.

Of particular interest is the growing role of wind power in the overall energy mix and the larger amount of variability that results from its large scale implementation. To demonstrate the economic and operational viability of pumped storage in re-regulating wind energy, an optimization model has been implemented for a potential pumped storage plant and wind farm in Lesotho, Africa. Results were generated over a full year of operation for various wind scenarios and different plant and storage characteristics. This includes the calculation of shortfall probabilities for various firm supply levels and the expected economic return under various assumptions for preferential tariff application. It also provided a good insight on how a pumped storage plant would be operated on an hourly basis under the given wind conditions.

Pumped storage plants can also be very useful in providing ancillary services, especially for systems where conventional hydro is small or nonexistent. Spinning and non spinning reserves can be produced in both the generating and pumping modes of operation, depending on the selected design of the pumping/generating units and control system. To further assess the contribution of pumped storage to the ancillary market, in addition to the energy market, several non spinning and spinning reserve requirements were considered.

With a growing demand for energy storage and rapid expansion of renewable energy, the analysis discussed herein is applicable to the evaluation of any future large scale renewable projects.