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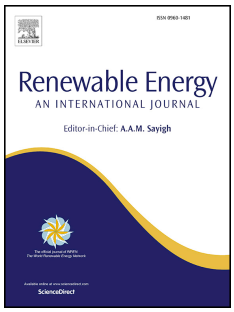

Assessment of the power potential extraction in the Chilean Chacao channel

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PII: S0960-1481(18)30303-3

DOI: 10.1016/j.renene.2018.03.008

Reference: RENE 9877

To appear in: *Renewable Energy*

Please cite this article as: Villalón V, Watts D, Cienfuegos R, Assessment of the power potential extraction in the Chilean Chacao channel, *Renewable Energy* (2018), doi: 10.1016/j.renene.2018.03.008.

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Assessment of the power potential extraction in the Chilean Chacao channel

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The feasibility of a tidal plant is assessed by studying the stream velocities, the hydrodynamic impacts and disturbances in the marine environment. However, as these technologies approaches a commercial stage, it is important to assess the feasibility of injecting energy into the grid in a cost-effective way. Finding available transmission infrastructure and capacity is now one of the main barriers for renewable energy development.

In this paper we assess the power potential of the Chilean Chacao channel and model the power evacuation impacts on the electric grid of the surrounding area in order to assess whether tidal plants in such isolated area are technical and economically feasible. Data obtained from direct measurement and hydrodynamic simulations is used to evaluate the electric power available through one year. The injection of power is simulated using a nested Newton-Raphson power flow solver that gives voltage and power flow changes as the tides evolve considering the characteristics of the grid. We found that a pilot project of 2.4 MW can produce 11.2 GWh per year, injecting in a 23 kV line. The region can integrate 7.4 MW without significant impact. Beyond this capacity, expensive reinforcement along the transmission system is needed.

Keywords: Tidal current; tidal resource assessment; Chile; Nested Newton-Raphson

Nomenclature

FVCOM Model:

σ_i: Layer i used on the vertical axis of the stream flow.

$\Delta\sigma$: Distance between vertical axis.

u: east horizontal velocity of the stream flow.

v: north horizontal velocity of the stream flow.

classical tidal harmonic analysis:

N:Number of constituents used in the analysis.

$a_0, a_k, \& \ b_k$: Amplitude component of the constituent k.

σ_k: Frequency of the constituent k.

Nested Newton Raphson:

i: Discretized time index.

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