



Water & Energy Consulting

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Memo

To: Prakash Rao, Jing Luo, Mike Gritzuk, James Doyle, John Sherlock, Jerry Bish, Larry Sawicki

From: Lon W. House, Ph.D. (530.409.9702) www.waterandenergyconsulting.com

Date: June 1, 2015

Re: May Tres Rios Hydro Analysis

Manufacturers

This month I contacted hydroelectric screw manufacturers and discussed the site and data with them. There are a lot of European and Asian manufacturers, but only a couple North American ones.

European hydro screw manufacturers:

England - Renewables First, TASC England, WRE Ltd, ECS Engineering Services Ltd, Freeflow 69 Limited, Archimedes Hydro Screw, totnes Hydro, 3Helix Power, Hallidays Hydropower, Hydroscrew Ltd,

Poland - Archimedesturbine,

The Netherlands - Spaans Babcock,

Czech Republic - KOVOSVIT MAS, a.s. - HYDRO division

Germany - ANDRITZ Atro GmbH

Italy - SPYRAGEN,

China/Asia - Addnew Technologies Limited, Shaoyang Hengyuan Zijiang Hydroelectric Equipment Co., Ltd., Shenyang Getai Hydropower Equipment Co., Ltd., Suzhou Yueniao Machinery & Electronics Import & Export Co., Ltd. , Wuxi HWATAN Electric Machinery Co., Ltd.

North American - New England Hydropower Company (MA), Arcon Energy (CA), Greenbug (Canadian), HydroCoil Power, Inc. (kinda a screw technology) (PA).

The big issue turns out to be the size. As opposed to other hydroelectric generators, a screw will only work when its diameter is less than two times the head, otherwise it will never fill to capacity and will be underpowered. In our case with a head of only 3.2 ft you can only have a 6.4ft diameter screw which limits your maximum flow to less than 40 cfs. At best this means we have a 7 kW machine.

The Good News

This generator will be so small that it will be relatively inexpensive to ship. Heck, I could probably pick it up and bring it here in the bed of my pickup.

The Bad News

- 1) Economically, this limits our electricity production, and the value of the generator. I redid the analysis from last month (theoretical) using a 7KW machine. At 8 cents/kWh retail value, this will save \$4620 per year.
- 2) At this size, not many manufacturers are interested. I'm still talking with GreenBug and New England HydroPower to see if I can get a quote from them. If not, we may need to make this ourselves.

Interconnection

The TEP person for this interconnection will be Ms. Patricia Duran (PDuran@tep.com) in their Renewables Department. They don't quite know what to do with this, it is so small relative to the site load that they are trying to figure out what to do.

Next Steps

The next steps in the process are to:

- See if I can get quotes from manufacturers on the cost of their generation technology, its efficiency curve (used to determine actual kWh generation) and installation requirements;
- Continue to talk with TEP to determine what interconnection requirements they will require, and likely configuration and costs;
- Determine initial generation site configuration and expected costs;
- From the above parameters, determine expected electricity generation and payback period.

I am available for a conference call to go over this if that would be helpful.

Thanks.

Signed:

A handwritten signature in black ink on a light background, reading "Lon W. House". The signature is written in a cursive style.

Lon W. House, Ph.D.

June 1, 2015