Small scale energy harvesting from water sources

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*Physics and Nanotechnology*

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**INTRODUCTION**

One of the reasons I joined Physics and Nanotechnology was due to my interest in energy — and more specific energy storage. Another fascination of mine is gravity — a still not fully understood force of nature. This made me think of ways to combine these interests to harvest energy from gravity. At first I thought of retrieving energy from falling raindrops but that proved ineffective due to the small mass of a raindrop. A realistic method to harvest more energy would require more water. Then I thought of downspouts for gutters or toilets. The water flow is bigger and therefore has more kinetic energy and potentially more energy to harvest. To realize this idea I set up a 3-week special course to manufacture a device to harvest the energy and look at the efficiency.

**THE SETUP**

I planned this course to be an experimental course rather than theoretical. I would like to see if a model could in fact make a lamp glow or charge a battery only by water and gravity. In theory it sounds plausible, but many unforeseen factors can appear to make the idea fail completely.

Originally I had two ideas - a turbine or a watermill structure. Due to the constant pressure around us, I will continue working on the watermill structure. I will start with a small scale version - and if there is time within the 3-week period, a full scale model. If this works then such a machine could be attached to drains/urinals/waste pipes or other vertical fluid systems.

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**Hydropower / Pump Storage**

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**INTRODUCTION**

In modern society we see a growing will and need to replace carbon-emitting energy sources with sustainable solutions. A considerable part of these solutions, such as windmills, depend directly upon forces of nature. Thus, while using such energy sources, we won’t necessarily see a balance between production of and consumption of electricity. Our project is to even out this unbalance by pumping water to a high place at times with excess energy on the grid, and utilize the resulting potential energy at times with low energy on the grid. Using a hydropower system in such a way is referred to as “Pump Storage”. The system we use was made by students at DTU in 2011 and is in the possession of the Department of Electrical Engineering. We wish to demonstrate a control of the system such that it produces an output at 230 V and 50 HZ +/- 10%, which is the general requirement for usual electronics. Further we wish to enhance the existing system with respect to the flow of water through the pipes and turbine from upper to lower container.

**THEORY**

We will use theory from fluid mechanics in order to enhance the flow of water through the system. Furthermore we will use theory from literature about control systems.

**METHODS**

We will work on making a model that describes the system. From this model of the physical system we wish to make a control system that accounts for the resistance connected to the generator and makes sure that a right amount of power is produced.

**RESULTS**

This part will contain results on improvements we have reached concerning the efficiency of the system and a description of the developed control system.

**CONCLUSION**

The overall point of this project is to make an efficient model-scale hydropower system that can work as a pump storage unit. This is an ongoing progress that started with students who wanted to model a hydropower system in 2011, and now in 2012, continued by this project that has made a great deal of enhancements on the existing system. In years to come further projects can be developed to make an even more efficient hydropower system that has even more uses.

The parts on Theory, Results and Conclusion will be deepened in the final abstract.