**Development of a Microcontroller Controlled Hydroelectric Power Storage Device**

Equipment Needed:

* Microcontroller (such as Arduino)
* Jumper Wires
* Breadboard
* Resistors, etc
* Tubing
* Bucket (x 2)
* Pump
* Mini hydroelectric generator
* LED light
* Relays
* Power supplies
* Control valve
* LED display

Learning Objectives:

* Programming
* Feedback Control
* Microcontrollers
* Hydraulic Systems
* Energy Conversion
* Electrical Billing
* Project Management
* System Design

Description for Instructor:

This PBL is designed to provide students with the opportunity to explore electromechanical design, microcontrollers, energy conversion, mechanical design, and basic hydraulic, electrical, and mechanical principles. The student will create a system that mimics the use of hydroelectric power principles to store excess electrical generation. In addition to basic principles and application as described, this also provides the instructor the opportunity to delve into discussions on energy economics, alternative energies, and broader system level thinking.

Description for Student:

You have been tasked with developing your company’s new energy storage plan! In an effort to offset its carbon footprint, your company has developed an alternative energy plan to accommodate part of its energy demand. However, part of this plan involves storing both excess energy from the alternative energy methods as well as storing energy from the grid at cheaper times and then using it to offset energy usage when grid power is more expensive. To continue with their green push, your company has decided to avoid the use of batteries and to instead store the energy as elevated water. Therefore it will use cheap grid power and excess alternative power to pump water into towers that can then be released through turbines for power generation later when needed. Your task is to develop this energy storage and retrieval system.

Deliverables:

* Gantt chart
* Budget (Proposed and Actual)
* Flowchart of overall process
* Flowchart for microcontroller program
* Well-documented microcontroller program
* Presentation of design and design process
* Working system

Instructions:

Using the supplied materials, you are to create a system that can both pump water up to the storage tank as well as release the water from the tank (in this case to a water reservoir) for energy generation. This should be an automated process that relies on a signal that either we have an oversupply of power generation from our alternative energy sources (a pushbutton for this project) or that we have entered the timeframe in which power from the grid is cheaper (usually 3rd shift hours…and a programmed timer for this project). If the power is from an oversupply, then you should pump so that you utilize as much power as possible (for the purposes of this project assume 2 minutes). If the power is from low-cost grid power, then you should pump for the amount of time indicated by your energy management director (for the purposes of this project assume 5 minutes). Your microcontroller will also control the release of water to run through the turbine. This should occur by push-button to simulate an operator turning on this excess energy system. The turbine will be used to power a small LED light for this project. Finally, your system should include an LED display that indicates which of the 4 states the system is currently in (excess power storage, low-cost power storage, energy production, or idle).

*Steps:*

1. Develop a Gantt chart
2. Develop your design and budget
3. Build, test, and develop your concept model
4. Provide your presentation and finalized budget

Notes to the Instructor:

This project can be expanded or connected to other PBLs which go into design and manufacture of either the pump and/or the generator.