Low-Impact Hydropower Development

Overview
Taylor Energy Alternatives has conceived of an idea for a low-impact cost-effective hydroelectric power system. Mine water drainage sites in Pennsylvania have significant water discharge, which can be harnessed by the conceived system to create power for immediately surrounding households and businesses and, thus, decrease reliability on fossil fuels. Such a site has been identified outside Hazleton, Pennsylvania.

Objectives
A team of senior engineering students at the Pennsylvania State University was assigned the task of developing the inlet and penstock (piping) routing with cost estimates for this hydropower system. The team was also asked to design a laboratory and on-site test procedure for the first 30-kilowatt turbine that has been developed by Taylor Energy Alternatives in coordination with the Penn State Civil Engineering Department.

Approach
- Customer needs were determined with conference calls to the sponsor
- A patent search was done to compare previous work with the project’s objectives
- The needs were further defined using black box models
- Compared ideas with work previously done on the project
- The mine tunnel drainage site was visited to further understanding and scope of the project
- Based on the needs and previous designs, several inlet and route concepts were generated
- Using Google Earth, the optimal penstock routing was determined
- Final concepts were chosen using a scoring matrix
- Calculations were performed to determine pipe sizing, flow rates, inlet size, and system efficiency
- A CAD model prototype of the inlet was created to visualize the idea
- Suppliers were researched or contacted to determine costs associated with the construction
- Test procedure for the 30-kW turbine was outlined

Outcomes
- The test procedure will be implemented, and the designs will be refined as needed throughout the next year.
- The entire system cost, including materials and construction, is expected to be just under $500,000.
- With electricity being sold at $0.10 per kilowatt-hour, the company expects complete return on investment within five years.
- If this system proves to be successful, similar systems will be implemented at appropriate sites across Pennsylvania.