IPRO 343 Midterm Report

Title: Technical and Market Integration of Hydroelectric Energy

1 Objective

The objectives are to design a small hydroelectric power plant on an existing low head dam on Fox River and investigate and evaluate the technical and market integration issues of the new hydro-electrical energy into the current power grid.

2.0. Results to Date

A. Details on current activities of the project process.
   - In the design team, we have come up with two sample designs of the Hydro System we will build in the Elgin/Aurora dam. At the moment we are calculating the losses of the two designs to determine which is most efficient.
   - In the marketing team we are currently calculating the years that will take us to gain profit and also finding the agency that will give us funding.
   - In the environment team we have currently found out the two main effects the Hydro System will have on the river life with some more additional information about that

B. Describe Current data results from research or testing involved in the project are shown on following
   i. Electrical and mechanical parameters.
      ① Turbine : Horizontal S type turbine with stainless steel runner blades
         A. Rated head: 15 ft.
         B. Rated flow: 942.9 cfs
         C. Rated speed: 180 rpm
         D. Rated efficiency: 90.0%
         E. Rated output: 1077.3KW
         F. Runner Diameter: 2.25 meters
      ② Generator: Rated capacity: 1000Kw 3 phase 60 Hz 6.3kv 0.85 pf
         A. Rated speed: 900 rpm
         B. Rated efficiency: 90.40%
         C. Excitation: Static solid state control

      ③ Speed increaser
         A. Speed ratio: 1 to 5
      ④ Power suppler: 440VAC, 110VDC

      -Also, see attachment file

   ii. Marketing parameters

      - It will be presented in the final report, but attached as ppt file

iii. Environmental parameters

- see attachment file

Current data results from research are based on in terms of design and marketing. Part i is turbine information that will be used for the hydro-power dam. Part ii is marketing information that determines productivity of hydroelectric dam. Part iii is the environmental part that has the facts based on the impact on the environment.

C. Define current or potential products resulting from research and testing.

i. Current Product

- The model and main parameter of electrical and mechanical Equipment
- Some Portion of Economic and investment cost analysis report
- Facts on the Hydro-Power System's impact on the environment

ii. Potential Products

- Three dimensional blueprints of the dam, hydropower house, and other related facilities.
- Control and operation scheme of the hydropower station. The annual profit analysis of hydropower station under the power market environment
- Full version of Economic and investment cost analysis report
- More sensitive analysis about the Hydro System's on the environment.

D. Define current or potential outputs produced through the execution of the assigned tasks.

i. Current outputs

- An efficient hydro unit to be used, and a contracture to make use of water at its most efficiency
- Some portion of the impact of hydro power to power market, and how to dispatch hydro energy to get the most economics
- Fundamental facts of the impact that the Hydro System has on the environment.

ii. Potential Products

- Output of hydro power at each time based on the information of available water flow and users demands
- A suitable position to build small hydro generator from a set of candidates

- Full version of the impact of hydro power to power market, and how to dispatch hydro energy to get the most economics
- How our Hydro System will have an impact on the Fox river

E. Discuss the current results in terms of deliverables that will be produced by the project team (i.e. a working prototype).

Initially, deliverable expected results are project plan, midterm report, final report, exhibit poster, website, presentation power point file, and CD that contains potential sites pictures, video clips, and hydro-electric dam design files. Currently, Project plan and midterm have deliberated. Website and CD are partially prepared. By the end of the semester, our project team will provide project plan, midterm report, final report, exhibit poster, website, presentation power point file, and the CD.

F. Discuss whether or not the current results address the problem of the sponsor/customer.

The key goal of the sponsor/customer is to develop renewable sources of energy to meet the energy, economics, and security issues. Currently, time frame of gaining profits for the first dam which was highly recommended by previous IPRO team has longer years which cannot be accepted. Our marketing team is still looking for proper place to make that the sponsors can expect income to cover their investments.

G. Discuss how the current results will be incorporated into the proposed solution or solution framework.

In this project, we are expecting to build a hydro plant over the Fox River. To achieve this goal, we went there for a field trip and collect all the data needed. Then we chose a suitable hydro turbine which can fit the practical conditions of the intended location and design all the relevant details. At last, an evaluation on the connection of this hydro plant with real power grid will be done based on the output of the hydro plant. The expected results such as benefiting the community can be tested by evaluating the social welfare resulted from this project such as environmental protection, low-cost power supply, water flow control and so on.

3.0. Revised Task / Event Schedule

A. Finding the proper site task is still on project task even though it should to be done by Oct 13th.

B. Include any changes to summary tasks or sub tasks pertaining to IPRO deliverables, list all associated due dates.

Most tasks that were introduced at the project plan are well progressing. On the other hand, marketing sub team also has responsibility to find the proper site, and the due date for the task should be finished by Nov 3. In addition, there is extra task finding funding which will contribute to update the marketing report of final, and the due date is Nov. 29th.

C. A further breakdown of what each summary task into sub tasks, skill sets necessary, or educational background needed to complete each sub task should be given here.

a) Choosing Site

- Having enough information of potential sites such as water flow, landscape, and head of the dam.
- This part will be interrelated with market integration.

b) Market Integration of Hydroelectric power

- Use the program, Marsi, which was developed by the ECE department at IIT to study the marketing impact of an additional plant on the existing system.
- Utilize the expertise of Ph D. students in our group.
- Understanding and utilizing the Small Hydro Project Analysis Software (RETScreen International)

c) Hydroelectric power system Design

- Fundamental power system knowledge
- Fluid mechanical engineering knowledge
- Capable of using graphical programs such as auto CAD or Pro-e

D. Include a revised estimate of hours needed and number of team members needed to complete each sub task.
Please refer to the MS project file.

Name	Work time hours per week	Work time hours for semester	Planning the project and agenda	Marketing	Hydroelectric Power System Design	Environment	presentation/ final report	Slack Time
Choe, Hyung	6	42	17				20	5
Burgos-Lopez, Mauricio	6	42	-		17		20	5

Ha, Sooyoung	6	42	-		17		20	5
Lee, Chi Hwan	6	42	-		17		20	5
Liu, Cong	6	42	-				20	5
Song, Chang	6	42	-	17		17	20	5
Wang, Jianhui	6	42	-	17			20	5
Wu, Lei	6	42	-	17			20	5
Total		336	17	51	51		160	40

Blue : Hours Available Red: Working hours

For MS Project file, see attached file

E. If necessary explain why the timeline has changed.

Due to unexpected inaccurate and unreliable date from previous IPRO team, our team has to research about the choosing proper site. Therefore, our team timeline has changed.

F. Provide information on completed sub tasks and how the completed sub tasks have contributed to the progress of the team.

A couple of completed sub tasks, understanding basic hydroelectric knowledge and choosing a proper turbine have been completed. The completed sub tasks contributed to process marketing and design team sub tasks such as finding the LMP values among potential sites and design a small hydroelectric power plant respectively.

4.0. Updated Task Assignments and Designation of Roles

A. Discuss current and planned team organization.
Marketing, Design, and Environment are three sub teams for project team.

B. Define revised sub team or individual sub task assignments and responsibilities.

- Describe the functions each sub team performs or is expected to perform.

Currently our team has same sub teams as we planned. Additional, finding the funding tasks are given to Chang and Liu

C. Describe current team member roles within the team and sub teams.

Choe, Hyung: Team Leader/ Time Keeper/ Master schedule Maker/Agenda Maker

Burgos-Lopez, Mauricio: Design Team Leader/ Team Sub-Leader/ Drawer/ Designer

Ha, Sooyoung: Design Team member/ In charge of AutoCad/ Designer
Lee, Chi Hwan: Design Team member/ In charge of AutoCad/ Designer
Liu, Cong: Marketing Team Leader/ Funding Searcher/ profit calculator
Song, Chang: Environment Team Leader/ Minute Taker/ Team Sub-Leader/ In charge of Environment team
Wang, Jianhui: Marketing Team member/ profit calculator/ documentation
Wu, Lei: Marketing Team member/ profit calculator/ documentation

D. If appropriate, explain how and why the team organization has changed since the project plan was first formulated.

E. If applicable, attach the revised graphic chart of remaining project tasks, remaining hours and team member assignments.

5.0. Barriers and Obstacles

Marketing Team:

A. Describe any obstacles encountered while completing the planned summary tasks for the project.

1. There is a lack of data that could be used to assess the financial feasibility of our hydro project, for example, the cost of equipment, the daily flow rate on Elgin dam, the residual flow on the Fox River…
2. It is difficult to evaluate the reliability and correction of the data which are found on the internet or the report by the last semester.

B. Explain how the team or subteam resolved these obstacles.

As to the short of data, our marketing subteam could search the related information on the internet (For example, Google is pretty convenient tool to find some useful data) or calculate it by some means or experiential equation (For instance, in order to obtain the flow duration curve, we need to know the daily mean flow rate on this candidate site. However, there is not a gauge station on Elgin Dam, so daily mean flow data used to develop flow duration curves can be obtained from interpolating the flows for the other sites on the Fox River by assuming that flow at any point in the river is proportional to the watershed area above that point.）

Also we contacted with our sponsor Dr' Tseng who have abundant experience to build small hydroelectric facilities on several country. His experience would give our subteam some good suggestion.

C. Identify any remaining barriers that need to be addressed before the team can successfully complete the planned work.

1. That how evaluate the reliability of the data and our final results is the remaining barriers that need to be addressed before the team can successfully complete the planned work.
2. To reduce more cost and get more benefit for our sponsor, our subteam still needs to do investigations and studies to find out whether the Renewable Energy Production

Credit and the Green House Gas Emission Reduction Credit are valid for small hydro or not in Illinois State. If the project does can get some bonus from government, we must fix the exact number and their influence on the final financial feasibility.

D. Describe any foreseeable obstacles or barriers.

1. The proposed of schemes by technical subteam maybe not economically by the assessment of our marketing subteam, we must improve the communication and give some good suggestion about the scheme revision.
2. Stakeholders' perspective may change.

Design Team:

A. Describe any obstacles encountered while completing the planned summary tasks for the project.

- The members of our team are not completely familiar with the small hydro concept and the technical aspect of the real design.
- There are many unknown data and geometry about the Elgin dam and the turbine suggested by the sponsor on the Fox River.
- No one is very skillful using 2-D or 3-D design software.
- It is quiet complicated to determine the optimal design of the siphon piping duo to many variables which are at the moment unknown.

B. Explain how the team or sub-team resolved these obstacles.

- Design sub-team studied the related information about the small hydro dam and had been to the Elgin dam on the Fox River.
- The turbine data and geometry about the Elgin dam were obtained from our sponsor Dr'Tseng who has abundant experience to make small hydro and the previus IPRO 319.
- Each member study Auto-Cad and Sketch-Up program for 2-D and 3-D design of the Elgin dam and practice these programs.
- Using the Mat-lab, C++, or Excel the optimal design of the siphon geometry will be obtained.

C. Identify any remaining barriers that need to be addressed before the team can successfully complete the planned work.

The main barrier that we are still facing is to come up with an optimal design for the siphon unit on the Elgin Dam. There are no enough literature about this topic at this moment. In addition the program for calculating an optimal design is complicated in the sense of the multiple variables that we do not know entirely. Another barrier is that the information about the turbine that will be use in the project has not been totally specified to us as well some questions regarding with the expectation of the sponsor have not been addressed either.

D. Describe any foreseeable obstacles or barriers.

We need to find out detail dimension for each design to calculate the losses and evaluate the efficiency. However, it is very difficult to get most efficient dimension for the design. We will

have to numerous trials for finding any meaningful data. That is our foreseeable obstacles and we will try to figure out the way to reduce that time for simulation by using any grouping data.

What is desirable result for this project?
: We want to accomplish an optimized design which can generate power and that will be suitable to build using standard equipment. In addition the design must be optimal from the technical perspective as well from an economical point of view.

Environment Team:

A. Describe any obstacles encountered while completing the planned summary tasks for the project.

1. One of the first problems when starting with this project was we were unable to figure out where to start looking for the impact that the Hydro System has on the environment.
2. Finding files and documents about the environmental impact that the Hydro System has was not easy, for there were not many companies or departments that were doing significant research on that part.
3. Working on the environmental aspect alone wasn't an easy job

B. Explain how the team or subteam resolved these obstacles.

Having problems with finding the place to look for the documents I needed, I spent considerable amount of time reading materials about the Hydro System borrowed from the library and also on the internet. Searching for the right agency that had the resources on this area wasn't easy. As time went by after spending time on reading and searching for documents I was able to understand which aspect I had to focus on when doing research on the environmental area. After being aware of what I should focus on, getting the resources what I needed wasn't hard to do. However overcoming the problem of having to work myself on all this is still an issue.

C. Identify any remaining barriers that need to be addressed before the team can successfully complete the planned work.

Since the work that the environment team is devoting on is based only on searching about the facts that the Hydro System's impact on the environment, the only obstacle that exists in this team is about being aware of the facts we have to look for and searching endlessly through the internet. However, now we know the issues we need to focus on, and that we have considerable amount of resources in our hands, there will be only a few obstacles we'll have to worry about such as doing a more sensitive research about finding the impact our Hydro System will have on the Fox river.

D. Describe any foreseeable obstacles or barriers.

The obstacle I can currently foresee is finding information I'll need to make a more sensitive analysis on the Fox River's environment that will have impact by our Hydro system. To overcome this obstacle, the environment team will use the

photographs taken at the Fox River and also some data about the river life of Fox River.

Blue: questions to TA