IPRO It takes a team INTERPROFESSIONAL PROJECTS PROGRAM

IPRO 346

BP Whiting Refinery Expansion: Developing Lake Michigan Wastewater Cleanup Options

Spring 2008

Project Plan

22 February 2008

Advisors:

Jeffrey Zalc, *BP* ● Javad Abbasian, *IIT* ● Satish Parulekar, *IIT*

Team:

Sahar Ashrafi ● Ray Ballard ● Chris Chock ● Yak Yong Chung ● Hana Fakhouri ● Anthony Ferrese ● Fernando Gomez ● Laura Haak ● Katherine Hammes ● Jichul Kim ● Alex Leasenby ● Richard Lewis ● Zhi Li ● David Malon ● Henry Michael ● Miri Park ● Kirsten Reimann ● Ben Roberts ● Jong Mu Song ● Willy Taracena ● Josie Truong ● Russel Ucci ● Anna Vassi ● Michael Walter ● Andrew Witek ● Jaewon Yoo ● Yin Zhao

1. Objectives

IPRO346 will focus on familiarizing itself with British Petroleum's (BP) wastewater treatment plant (WTP) for its oil refinery in Whiting, IN. Specifically, this IPRO will analyze the current permits and their stipulations regarding the amount of ammonia and total suspended solids (TSS) in the wastewater being dumped in Lake Michigan. Ultimately, possible methods and designs will be devised to reduce the levels of ammonia and TSS remaining in treated wastewater. These designs will take the form of a process flow sheet with a computer simulation to model the designs. At the culmination of this IPRO we will have several different models for possible upgrades to the Whiting refinery wastewater treatment plant to reduce the levels of ammonia and TSS in the wastewater entering Lake Michigan as well as a cost to implement each solution.

2. Background

For the past three years BP has been planning a $3.7billion upgrade to its Whiting refinery to process Canadian heavy crudes. This upgrade will provide several hundred new jobs in the Whiting area and allow the refinery to process 90% Canadian heavy crude instead of mixing it with a minimum of 70% light crude, primarily from the Middle East. Not only will this result in less crude oil coming from politically unstable regions, but it will also allow the plant to increase its gasoline and diesel production by 15%. Unfortunately, the Canadian heavy crude contains a significant amount more nitrogen and sulfur which, with the ever increasing standards for gasoline and diesel, need to be removed. In order to move forward with this project, BP filed for a new permit with the State of Indiana to allow the Whiting refinery to increase the allowed levels of ammonia and TSS in its wastewater to be increased by 50%. This new permit was approved both by the State of Indiana and by the Environmental Protection Agency (EPA) and falls well under the federal maximum for ammonia and TSS waste. However, when the media and public hear of the new permit, there was a public outcry against any increase in the disposal of waste into Lake Michigan. Because of the massive outcry, BP decided that, although it knew of no current technology that could remove ammonia and TSS down to the standards set by the original permit, BP would not implement its design for the Whiting expansion until they could come up with an acceptable design for the wastewater treatment plant which would not increase the amount of ammonia and TSS being dumped into Lake Michigan. If no solution presented itself BP stated that it would scrap the entire project thereby losing nearly all of the $3.7billion budgeted for the expansion.

3. Methodology/Brainstorm/Work Breakdown Structure

3.1 Definition of Problem

The overall purpose of this IPRO is to find an alternative design for the wastewater treatment plant that will allow BP to continue with their projected refinery upgrade. This design will (1) decrease the emissions of the plant, (2) remain fiscally reasonable, and (3) consider and employ a high standard of ethics.

3.2 Work Breakdown Structure

In order to solve this problem, the goals of the team are (1) to gain a better understanding of the problem, (2) to use this understanding to create several different models, and (3) to determine the feasibility and economic viability of the models. To achieve this, the work for the semester has been broken into two Phases.

Phase 1: Research

During this phase, the team will focus on gaining a deeper understanding of the problem and possible solutions. This will be achieved through separating the team into sub teams which will take an in-depth look at various aspects of the problem and then report back to the team through weekly group presentations.

Phase 2: Development

Once several solutions have been established, the sub teams will shift their focus from research to development. This will include developing a process flow sheet for each solution, creating a model to simulate the process, and to determine the feasibility and economic viability of each solution.

4. Expected Results

Through combined effort, the team will present a recommendation at the end of the semester. This recommendation will either include a plan which will allow BP to continue in its current endeavor or it will include a detailed recommendation of why BP should not continue. This recommendation will be based on both concrete data and informed opinion.

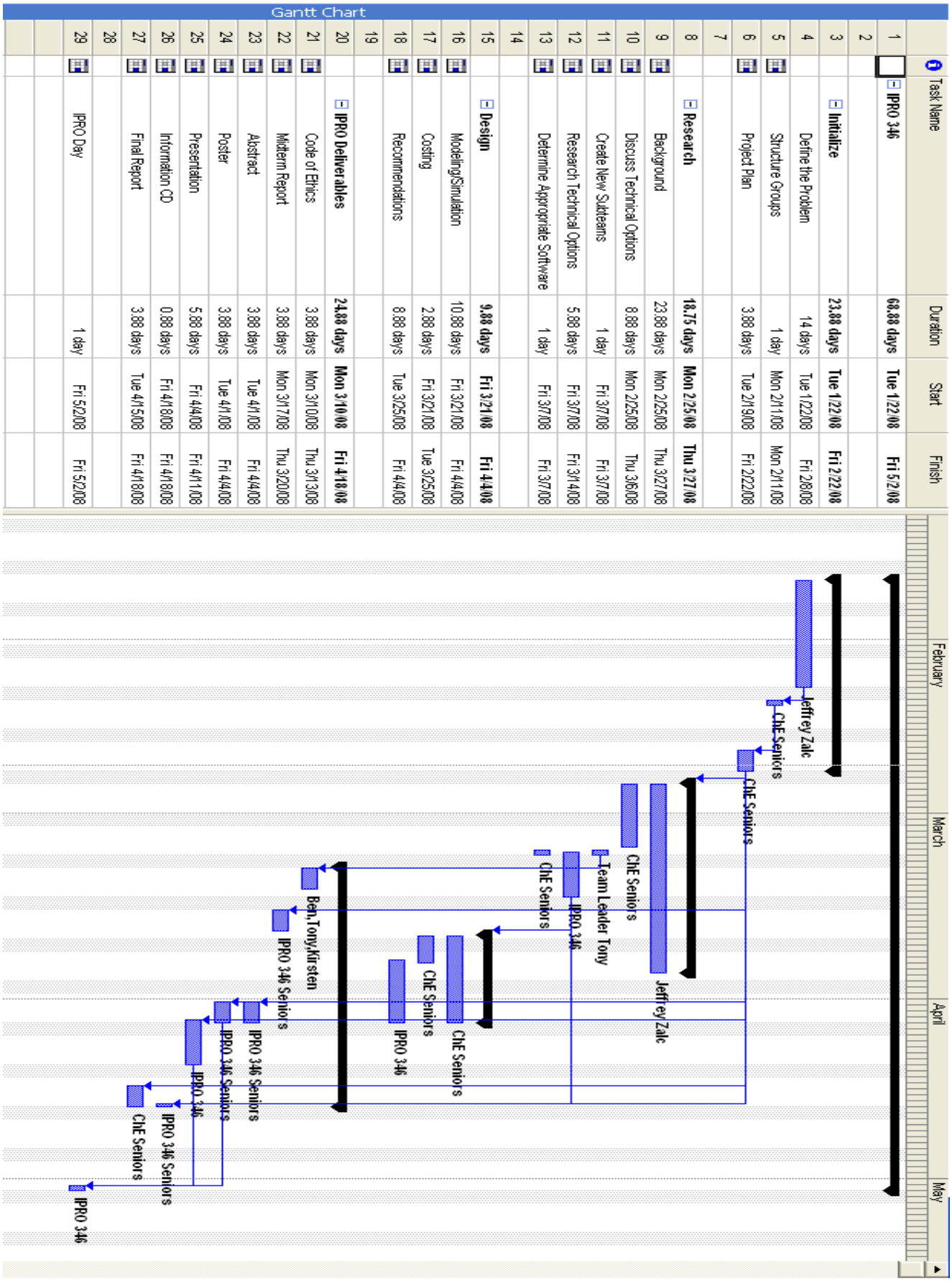
5. Project Budget

Under the current circumstances in the project no for seen costs have been found and therefore none requested.

6. Schedule of Tasks and Milestone Events

Gantt Chart

	Task Name	Duration	Start	Finish
1	IPRO 346	68.88 days	Tue 1/22/08	Fri 5/2/08
2				
3	Initialize	23.88 days	Tue 1/22/08	Fri 2/22/08
4	Define the Problem	14 days	Tue 1/22/08	Fri 2/8/08
5	Structure Groups	1 day	Mon 2/11/08	Mon 2/11/08
6	Project Plan	3.88 days	Tue 2/19/08	Fri 2/22/08
7				
8	Research	18.75 days	Mon 2/25/08	Thu 3/27/08
9	Background	23.88 days	Mon 2/25/08	Thu 3/27/08
10	Discuss Technical Options	8.88 days	Mon 2/25/08	Thu 3/6/08
11	Create New Subteams	1 day	Fri 3/7/08	Fri 3/7/08
12	Research Technical Options	5.88 days	Fri 3/7/08	Fri 3/14/08
13	Determine Appropriate Software	1 day	Fri 3/7/08	Fri 3/7/08
14				
15	Design	9.88 days	Fri 3/21/08	Fri 4/4/08
16	Modeling/Simulation	10.88 days	Fri 3/21/08	Fri 4/4/08
17	Costing	2.88 days	Fri 3/21/08	Tue 3/25/08
18	Recommendations	8.88 days	Tue 3/25/08	Fri 4/4/08
19				
20	IPRO Deliverables	24.88 days	Mon 3/10/08	Fri 4/18/08
21	Code of Ethics	3.88 days	Mon 3/10/08	Thu 3/13/08
22	Midterm Report	3.88 days	Mon 3/17/08	Thu 3/20/08
23	Abstract	3.88 days	Tue 4/1/08	Fri 4/4/08
24	Poster	3.88 days	Tue 4/1/08	Fri 4/4/08
25	Presentation	5.88 days	Fri 4/4/08	Fri 4/11/08
26	Information CD	0.88 days	Fri 4/18/08	Fri 4/18/08
27	Final Report	3.88 days	Tue 4/15/08	Fri 4/18/08
28				
29	IPRO Day	1 day	Fri 5/2/08	Fri 5/2/08



7. Individual Team Member Assignments

7.1 Team Members

Name	Major, Year	Skills and Strengths	Experience and Academic Interest	Team
Ashrafi, Sahar	ChE, Sophomore	Extensive knowledge of Microsoft Office as well as experience in MATLAB, Maple and HYSYS	Specializing in Energy, Environment and Economics (E3)	Regulatory Group Team Member
Ballard, Ray	Chemical Engineering, 2nd Year	Have planned and executed significant projects with groups in other classes and organizations. Proficient in MS Office. Learning Hysys and Matlab	President or Vice President of several project-driven organizations. Currently taking Chemical Engineering Courses. Pursuing a degree in Chemical Engineering and Law, and plan to work in industry	Refining Team
Chock, Chris	ChE, Sophomore	Photography, design, MATLAB, Web design.	Photo editor for TechNews (07-08), TA for ChE 100/101 (07-08), Student Assistant for Marketing & Comm. Person for ChBE (07-present). Want to go into Process design, statistical modeling	Waste Water Team
Chung, Yak Yong	ARC, Senior	Website Design	Website Design	Website Team
Fakhouri, Hana	Chemical Engineering, 2nd Year	Learning Hysys. MS Office.	Planning to go to graduate school.	Regulatory
Ferrese, Anthony	chE, Senior	Led several teams, Proficient in Matlab, Hysys, and MS Office	Significant amount of research in renewable energy. Planning on pursuing a PhD in Chemical Engineering	Team Leader, Wastewater sub team leader
Gomez, Fernando	Chemical Engineering, 3rd Year	Proficient in MS Office. Learning Hysys and Matlab	Worked last summer as a research assistant at Harper College. Plan to work in industry after graduation and then go back to graduate school	Refinery

Haak, Laura	Mechanical Engineering, 3rd Year	Have worked on group projects and coordinated different subgroups together	Experience in quality control and designing with CAD and ProE.	Refining Team
Hammes, Katherine	Chemical Engineering, 3rd Year	Have worked as a leader in multiple student organizations. Know how to use HYSYS, Labview, MS Word and MS Excel.	Currently enrolled in multiple Chemical Engineering courses. Planning to pursue a PhD in the future.	Refinery
Kim, Jichul	Mechanical Engineering, 4th Year	Fluent in Matlab, Solidworks, C/C++, Linux, words, PowerPoint, excel	Undergrad Research .(Navigation and Guidance lab), The forth annual autonomous lawnmower competition (Institute of navigation)	Tar sands
Leasenby, Alex	ChE, Sophomore	Public speaking, Mass Balances, 33rd Production Treasurer	Aspirations of wastewater engineer	Wastewater Group
Lewis, Richard	ChE, Sophomore	Energy/Mass Balances, MATLAB, HYSYS	BP Lab Technician	Tar Sands Group
Li, Zhi	Chemical Engineering, 2nd Year	MS Office, HYSYS (in training)	Enrolled in Chemical Engineering courses, interested in research.	Tar Sands Group
Malon, David	ChE, Sophomore	Problem Solver, C++ Programming, National Event Planning, Technical Writing	Computer Programming	Wastewater Group
Michael, Henry	Chemical Engineering 4th Year Senior	Team Captain for a Cricket Team, Team Leader for Several Projects, Fluent in Matlab, Hysys, MathCad, MathLab, ChemCAD, MS Office, Polymath.	Team Leading Skills, Sales Experience, Process Design/Environmental Engineering/Economic, Environment, Energy Specializations.	Regulatory Team Leader
Park, Miri	chE, Senior	Significant amount of research in biomedical fields, HYSYS, MATLAB, Process Design	New advances in the biological and biomedical fields, hydrogel technology	Tar Sands Co-Team Leader
Reimann, Kirsten	ChE, Jr	Fluent in AutoCAD, Microstation, Hysys. Have lead multiple committees	IPRO Sub team Leader, Code of Ethics. Interested in petroleum refining and process design	Code of Ethics Team, Refining Team

Roberts, Ben	chE, Senior	Project Management, extensive knowledge of process simulation software	Former IPRO Team Leader, Project Manager, Process Engineer. Interests include petroleum refining, process design	Assistant Team Leader, Refining Sub-team Leader
Song, Jong Mu	chE, Senior	General computing skills	Process Design	Tar Sands Co-Team Leader
Taracena, Willy	ChE, Sophomore	Excellent interpersonal skills	Process Design	Regulatory Team
Truong, Josie	Mechanical Engineering, 4th Year	Know how to use Matlab, SolidWorks, Pro/E, and MS word	Interested in working with Renewable and Alternative Energy. Interned with Illinois EPA, assisting engineers on regulations of air.	IPRO member. Regulatory Sub team
Ucci, Russell	Chemical Engineering, 3rd Year	Know how to use HYSYS, Labview, MS excel, and MS word	Worked on executive board of AIChE and attended leadership camps	Wastewater
Vassi, Anna	Chemical Engineering, 2nd Year	MS Office, mastering HYSYS	Worked as a research assistant, planning to pursue graduate school	Regulatory
Witek, Andrew	Civil Engineering/Junior	Fluent in AutoCAD, SAP2000, Mathcad, and Microsoft office.	Worked for Edward J. Molloy and Associates, a construction and land surveying company, over the past summer. Interested in Structural Engineering, Structural Design, and Environmental Engineering.	Wastewater group
Yoo, Jaewon	EE, Senior	Know how to use Ms-word		Website
Zhao, Yin	CHE, Jr	Computer programming and modeling, material synthesis and characterization, lab bench techniques and spectroscopy	Co-op with Bayer Material Science, interested in computational modeling and material science	Website, team member

7.2 Sub Teams

Team Leaders

- Anthony Ferrese
- Ben Roberts

Sub Teams

1. Refining Process

   The objective for this team is to gain an understanding of the regulations regarding the release of pollutants into Lake Michigan. This included finding state, Indiana Department of Environmental Management and EPA regulatory limits for ammonia and total suspended solids (TSS).

   - Ben Roberts*
   - Ray Ballard
   - Fernando Gomez
   - Laura Haak
   - Katherine Hammes
   - Kirsten Reimann

2. Regulatory Group

   The objective for this team is to gain an understanding of the regulations regarding the release of pollutants into Lake Michigan. This included finding state, Indiana Department of Environmental Management and EPA regulatory limits for ammonia and total suspended solids (TSS).

   - Henry Michael*
   - Sahar Ashrafi
   - Hana Fakhouri
   - Willy Taracena
   - Anna Vassi

3. Waste Water treatment

   Wastewater is in charge of providing the background knowledge for a wastewater treatment facility, specifically the Whiting Refinery plant. This includes a basic understanding of the design and operations of a wastewater treatment facility, the units involved in treating wastewater, and provide a process flow diagram for the BP Whiting Wastewater Treatment facility.

   - Anthony Ferrese*
   - Chris Chock
   - Alex Leasenby
   - David Malon
   - Russell Ucci
   - Andrew WItek

4. Tar sands

   This group's objective is to provide a basic understanding of the difference between Canadian heavy crude oil and traditional light 'sweet' crude. Specifically, this team will look into the difference in nitrogen and sulfur content and how that affects the refining process. A second objective of the Tar Sands team is to understand the process involved in the pre-refining process which includes how the oil is extracted from the ground and the unit operations undergone in order to pipe the oil to Whiting.

- Miri Park*
- Jong Mu Song*
- Jichul Kim
- Richard Lewis
- Zhi Li

5. Website

   The website sub team is in charge of designing the group's website and update the site weekly with news on the group's progress.

   - Yin Zhao*
   - Yak Yon Chung
   - Jaewon Yoo

*Denotes the sub team leader

8. Designation of Roles

Minute Taker: Fernando Gomez, Miri Park. This member is in charge of recording decisions made during meetings including task assignments or changes under consideration.

Agenda Maker: Anthony Ferrese. This member is responsible for creating an agenda for each team meeting. This provides structure to the meetings and offers a productive environment.

Time Keeper: Henry Michael. This member needs to be responsible for making sure meetings go according to the agenda.

Attendance Keeper: Josie Truong. This member is responsible for taking attendance during all meetings and reporting to team leaders any substantial amount of meetings missed by an individual.

Team Leader: Anthony Ferrese, Ben Roberts. These individuals are in charge of weekly meetings are to give guidance to the logistics included in the project. They are direct channels of information to and from the professor as well as mediators to any dispute the group experiences.