Illinois Institute of Technology
IPRO303: Failure Prediction Modeling of Power Plant Emission Control Systems.

Project Plan

Instructor: Edmund Feldy, PE
Sponsor: **SmartSignal**
Date: **February 14, 2009**

1. Team Information

A. Team Roster

- Insiyah Arastu, Dave Belanger, John Bouikidis, Zachary Capps, Cari Hesser, Sean Irish, Satyam Kaneria, Brett McQuillan, Lavesh Mohinani, Jay Patel.

B. Team Strengths

- **Software Knowledge:**
  Insiyah Arastu ....Adobe Products, AutoCAD Software, Microsoft Office, 3D MAX
  Dave Belanger ...AutoCAD, Microsoft Office
  John Bouikidis ...Repairing and Maintaining
  Zachary Capps ...MatLab, Microsoft Office, C++, Mechanical Systems, Technical Reports
  Cari Hesser .....Microsoft Office, Conducting Research, Sticking to Schedules
  Sean Irish .....Adobe Products, AutoCAD Software, Microsoft Office, 3D MAX
  Satyam Kaneria ..Programming, Networking
  Brett McQuillan .Mathematica, MathCAD, and SAGE, AutoCAD, Microsoft Office
  Lavesh Mohinani PowerWorld, MatLab, Microsoft Office
  Jay Patel .....Microsoft Office, SharePoint Designer
- **Personal Characteristics:** Fast Learners, Self Motivated, Dedicated
- **Other:** Researching, Programming, Networking, Building, Repairing, Mechanical Systems, Analyzing Technical Reports

C. Skills to Develop

- **Team Expectations:** We hope to learn more about power plant emission control systems, failure prevention systems, as well as gain experience in teamwork. We hope to improve on communication skills. We also hope to learn discipline as it is in the real world and learn to work collaboratively with a group of people who do not share the same area of study.

D. Team Identity

- **Name:** Failure Prediction Modeling of Power Plant Emission Control Systems.
- **Logo:**

2. Team Purpose and Objectives:

The main goal of IPRO 303 is to investigate how SmartSignal's modeling technology can provide value in detecting problems on environmental systems: The main objectives that SmartSignal would like for the team to investigate are:

- What are the regulatory drivers – changes in laws/regulation occurring at various points in time? Are the regulations fleet-wide or regionally specific? Can credits be traded? Etc.
- What types of systems are being deployed to remove what pollutants? Describe different sub-types and configurations within a type of system, and how common they are.
- How much instrumentation is available on these systems, and what signals are measured (temperature, pressure, chemistry analysis, etc.)? How much diversity is there in the levels of available instrumentation?

- What are the failure and performance degradation problems that occur? How common are they? What are the ramifications of these problems – outages, derates, having to burn more expensive fuel or turn up the "peaking" generation units that are more expensive to run, etc.?
- How can the available instrumentation be used to remotely monitor and detect developing problems?

SmartSignal would also like for us to compile a catalogue of information we find and the sources which are helpful for future research. We will submit a report that covers the overall findings of the research and provides any other supplemental information.

To realize this, we set these operating objectives:

- Look at past IPRO studies concerning pollution control and power plants.
- Research different systems that remove pollutants.
- Explore new and research existing ideas on how to monitor and predict failures of a system.
- To examine cost and issues of system failure.

3. Background

A. Sponsor Information: SmartSignal is a corporation that provides applications to increase equipment performance by means of predictive analysis. SmartSignal's solution analyzes information gathered from equipment in power plants, monitors behavior of the plant as a whole, and identifies the risk of failures. SmartSignal's clients include a number of major power plants nationwide and worldwide. The company is located in Lisle, Illinois.

B. Current User Problems: Power Plants need to meet regulations assigned by local governments by reducing the expulsion of pollutants, and to detect failures of equipment that could potentially cost millions of dollars.

C. Sources Used: The team will be doing research through online databases and books on power plants and emission control. We will also be using primary sources by visiting local power plants and interviewing staff.

D. Other Attempts to Solve the Problem: SmartSignal currently offers their services to the generation side of power plants. On the emission and the pollution control side of power generation most plants monitor the final emissions and perform manual inspections of the control equipment.

E. Ethical Issues: SmartSignal operates in a competitive market and any classified or sensitive information or documents obtained from the SmartSignal Company will be kept confidential and will not be disclosed to anyone outside the project team. Also SmartSignal specifically asked that their involvement as a sponsor NOT be disclosed outside the IIT community.

F. Business Cost: Failures on the emission control side of a power plant can have great societal and business costs. If pollutants are released above the prescribed regulations the health of nearby communities may be put in jeopardy. Crops and plant life may also suffer due to an excess of pollutants. Globally, the pollutants may spread further and may have global warming effects. The direct business costs to power plants can total in the millions. Pollution controls are often entire buildings themselves and costs millions of dollars to build. When they malfunction the repairs and fines for breaking regulations can cost the power plant as well. Additionally plants often will reduce production or shut down in order to fix failures. This can lead to excessive costs to supply the needed power to their customers or even lead to brown outs.

G. Implementation of the Solution: Our team plans to research these control systems for SmartSignal. From that point we can make recommendations on how SmartSignal may implement their product and present their services to this sector of the market.

H. Similar Solutions Proposed: SmartSignal offers a unique and cutting-edge approach to predicting failures. Historically power plants monitor control systems in house and utilize manual inspections to predict failures in their control equipment. SmartSignal hopes to improve failure prediction on emission control systems.

4. Team Values Statement

There are five general values that our team emphasizes. They are Decision Making, Success of a Team, Conflict Resolution, Attendance and Proper Decorum, and Quality Work.

- **Decision Making:** Most decisions are to be made by voting and going with the majority, however, important decisions warrant a group consensus and decisions are deemed to be important if there exists a strong dissent. Anybody has the option to dissent and it is strongly encouraged that one speaks up so the group can address the issue.
- **Success of Team:** All work is to be equally divided among all the team members. The success of the team is measured by everybody being successful, so, if someone is struggling with an individual task assignment, they are expected to speak up and the team will address the issues. For all issues that may arise, the team will examine the causes of the problem and will try to remedy them.
- **Conflict Resolution:** In the event that a problem between two people should arise during the course of the project, the team has outlined a problem solving technique.
  1. Try to calmly and rationally talk out the problem between the parties. If that fails then.
  2. Bring the problem to the attention of the group, and have each affected party argue the benefits of his or her position and let the group collectively decide how to proceed.
- **Attendance and proper group decorum:** Attendance is mandatory at all meetings, and if for some reason someone is unable to attend they should notify the group as soon as possible. This IPRO team seeks to foster a productive and happy working environment by being civil, respectful, and providing feedback at appropriate times.
- **Quality Work:** This team strides to produce quality work. We enforce due dates, give guidelines, and offer help whenever someone asks. We also believe in intellectual property and in sourcing any information that we obtain.
- **Team Ethics:** This team strives to hold itself to the utmost ethical standards that are prewired from different societal and personal experiences, furthermore, the team will fully explore different ethical areas and dilemmas later in the semester.

5. Methodology/Brainstorm/Work Breakdown Structure

A. Defining the problem(s): To investigate the opportunity for SmartSignal modeling technologies to provide value in detecting problems on environmental system by researching the following issues:

- Looking at the various instrumentation available on treatment systems
- Different kinds of failure and performance degradation problems associated with air and water treatment systems
- Various types of systems being deployed to remove pollutants
- Various regulatory drivers on environmental pollutant mitigation.

B. Describe how the team will go about solving the problem(s):

I. Understanding the task: David Farrell, Product Manager from SmartSignal, our project sponsor gave a presentation to the team to explain the task at hand. In the presentation, David started by giving the team an insight on the operation of a power plant. The team was introduced to the concept of predictive analytics. The presentation also included a high level summary on the operation of various treatment systems. After the meeting, the following tasks were outlined:

- Get a better understanding of how a power plant works as a system
- Visit a power plant to understand how its emission systems function
- Looking at various regulation proposed by the current government
- Study about various pollutants emitted by fossil fuel combustion
- Determine what kinds of sensors are available on air treatment systems
- Look into the reliability of air treatment systems and the various degradation problems associated with them
- Look into sensors and the reliability of water treatment systems.

II. **Initial Organization**: After defining the above tasks we split the team into 3 groups. The primary task of each group is to study a Treatment system in detail. The 3 main treatment systems widely used are Wet Scrubbers, Electrostatic Precipitators and Fabric collectors. In the weeks to come, we may regroup, and have one group look into water treatment systems.

As of now, the team does not have an overall team leader per say, but if the need arises as the project progresses one will be assigned. As of now most of work is being completed by active volunteering by team members.

C. Analysis: The outcomes of the steps taken in the understanding the task sections as defined above will be regarded as analysis in and of itself.

D. Documentation: Each sub-team will maintain a record of their respective goals and progress made with their assigned task. The sponsor has asked the team to hand over an official twenty page document with all work done during the semester. It is planned that the IPRO Final Report will fill this need. Formal meeting minutes are expected for at least every class session. Thus, the importance of good documentation has been stressed from the very beginning.

E. Analysis of the expected results: Our sponsor will determine quality of our conclusions and suggestions made in the final report and provide a letter grade on the work. The quality of various sub tasks will be discussed with members of the team and IPRO instructor.

F. Production of IPRO deliverables: The team will discuss the guidelines during meetings and each sub-team will take a part of the deliverable to complete. One person on the team will take the responsibility to compile the final document and upload it to iKnow.

G. Additional Documents: There are no documents that need to be attached to the project plan.

6. Expected Results

A. Expected activities involved in the project: Opportunities for SmartSignal modeling technology to provide value in detecting problems on environmental systems will have been investigated through the following:

- Regulatory drivers requiring environmental pollutant mitigation will have been researched and documented.
- The types of systems that are being employed to remove pollutants, their configurations, and their commonness will have been researched and documented.
- The available types of instrumentation for the aforementioned systems will have been researched.
- Failure and performance degradation problems that occur in the pollutant removal systems, the consequences of these failures, and the methods currently employed for detection of impending failures will have been researched.
- All the research will have been combined to discover what indications in the available sensors would suggest developing problems, and how said sensors could possibly be combined to indicate problems.
- Interviews of power plant workers will have been conducted, and members will have toured a power plant. The information obtained will have been documented.

B. Expected data from research or testing involved: A catalog of all research and important information that the group found will have been compiled and presented to SmartSignal.

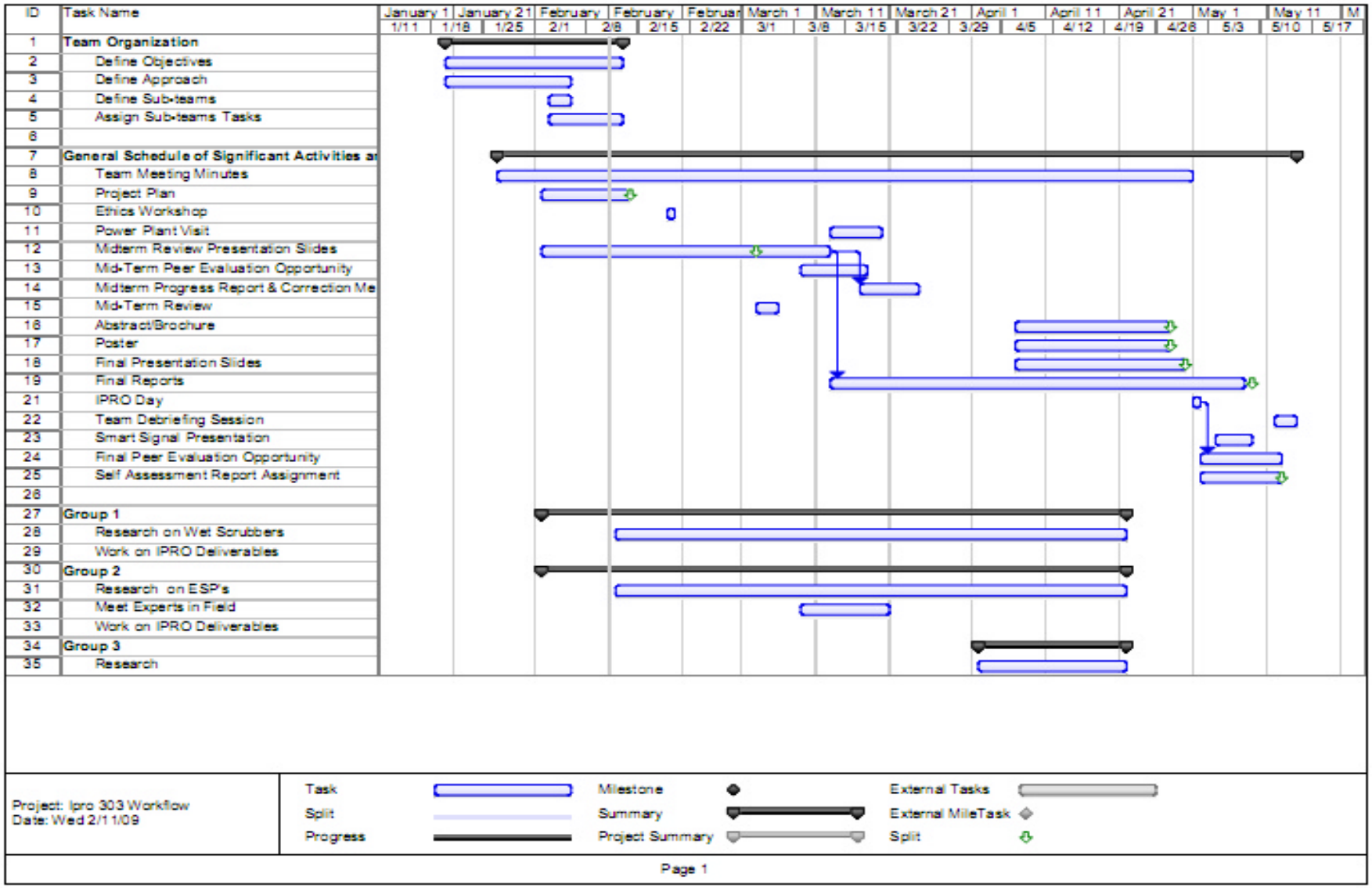
C. Potential Products resulting from research and testing: A summary of the important research as it pertains to the goal of the IPRO will have been presented to SmartSignal.

7. Budget

IPRO Day	$100	Presentation board, supplies, handouts
Transportation	$250	Visiting power plants
Miscellaneous	$200	Photocopying, food

Total	$555	

8. Schedule of Tasks and Milestones



9. Individual Team Member Assignments

After the conference call with the SmartSignal, there were three areas of research and study which were identified as:

- Wet Scrubbers
- Electrostatic Precipitators
- Fabric Collectors (Bag houses)

Our IPRO team did not assign any overall team leaders at this point of time as the team unanimously agreed upon the fact that leaders will be chosen later depending upon who is able to better command the team. Based on the tasks above and the expertise level of each member of the team we formed three sub-teams. Below is the task distribution as up publication time:

A. Wet Scrubbers:

- Insiyah Arastu – *Architecture*
  As part of Wet Scrubbers team, Insiyah will conduct research about the Wet Scrubbers and will be responsible for Team Information and Project background tasks.
- Brett McQuillan – *Architecture*
  In his Major, Brett deals with combining mechanical, electrical, structural and human systems. He has gained knowledge about HVAC systems and pollution control concerning air quality. He will be carrying out research in the Wet Scrubbers team and contacting technical professionals
- John Bouikidis – *Mechanical Engineering*
  John will be responsible for the research on Wet Scrubbers as a team task and will also be documenting IPRO Project Background and Schedule of Tasks and Milestone events.
- Jay Patel – *Computer Science*
  Apart from research for the Wet Scrubbers, Jay will be responsible for file management in iGroups and creating and maintaining Gantt charts that include project progress and tasks from the Project Plan.

B. Electrostatic Precipitators

- Zachary Capps - *Aerospace/Mechanical*
  Zach is primary responsible for presenting Team Values Statement and Methodology Brainstorm Work Breakdown Structure. He will also do research for the Electrostatic Precipitators as a team task.
- Lavesh Mohanini – *Electrical Engineering*
  Lavesh will be involved in the research for Electrostatic Precipitators along with the other group members and would be primarily responsible for the IPRO Deliverables including the Project Progress and Compiled Project Plan.
- Satyam Kaneria – *Electrical Engineering*
  Satyam will also be conducting research and contacting faculty as and when needed for the research. He is also responsible for file management in the iGroups along with Jay and documenting the Individual Team Member Assignments.

C. Fabric Collectors (Bag Houses)

- Sean Irish – *Architecture*
  Sean will be researching on Bag houses as a team task and would work on documenting expected results for the Project. He will also be developing the logo for the team.
- Cari Hesser - *Aerospace/Mechanical*
  Apart from the research on the Bag Houses, Cari will be working on putting up a Budget for the team.
- Dave Belanger – *Civil Engineering*
  Dave will be contacting Faculty and Company professionals in regard to the research on Bag Houses and will be primarily responsible for Designation of Roles for the team.

D. Water System Emission Controls

- To be Determined

10. Designation of Roles

Minute Taker:.....Rotating Assignment
Agenda Maker:.....TBD
Timekeeper:.....TBD
Timesheet Collector/Summarizer: .....N/A
Master Schedule Maker: .....Jay Patel, Insiyah Arastu
iGroups:.....Jay Patel, Satyam Kaneria

A team leader has yet to be assigned, but the need for formal assignment will be discussed in the next few weeks