INTRODUCTION:

This document describes and serves as a template for preparation of a Project Readiness Package. The objective of the Project Readiness Package is to document customer needs and expectations, project deliverables (including time frame), budget, and personnel / organizations affiliated with the project. It will serve as the primary source of information for students necessary during the Planning phase to develop a SD I plan and schedule including specific deliverables and due dates. The Project Readiness Package will also support Faculty evaluation of project suitability in terms of depth, scope, and student / faculty resources by discipline.

In this document, italicized text provides explanatory information regarding the desired content of the sections indicated by non-italicized, bold, capitalized headings. If a particular aspect of a section is not applicable for a given project, it is only necessary to indicate that by entering N/A (not applicable).

ADMINISTRATIVE INFORMATION:

Information regarding contacts, budgets, facilities, resources, regulatory or legal considerations, proprietary or specialized components, technologies or intellectual property associated with the project.

- Project Name (tentative): Develop thermoelectric power system for first generation of improved cook stove
- Project Number: P11462
- Project Track:* Sustainable Design and Product Development
- Project Family:* Sustainable Technologies for the Third World
- Start Term: Winter 2010-2011
- End Term: Spring 2011
- Faculty Guide *(project mentor)*: Rob Stevens and Ed Hanzlik
- Faculty Consultants *(disciplinary subject matter experts)*: James Myers – Haiti expert, Brian Thorn – Sustainability, John Wellins – DAQ
- Customer organization and primary contact (name, phone, e-mail):

  H.O.P.E (Haiti Outreach - Pwoje Espwa), Rose-Marie or James Myers
- Principle sponsor or sponsoring organization: (*provider of financial support)* Corning Sustainability Funds

Project Overview (*1-2 paragraphs that provide a general description of the project: background, motivation(s), customer(s), and overall objective(s).*): According to the World Heath Organization more than three billion people depend on biomass fuels (wood, dung, or agricultural residues) primarily for cooking. The practice of cooking with biomass has decimated many ecosystems and requires an enormous amount of human effort to gather. In addition, there is considerable evidence that exposure to biomass smoke increases the risk of common and serious diseases in both children and adults. According to the WHO studies, indoor smoke from solid fuels causes an estimated 1.6 million deaths annually.

To minimize these harmful effects associated with cooking more efficient cook stoves have been proposed. These new stoves are significantly more biomass fuel efficient and thus reduce deforestation rates. These enhanced stoves also reduce indoor air pollution, thereby reducing deaths and illnesses due to biomass cooking.

RIT is working with an NGO partner in Haiti, H.O.P.E., and initially funded by an EPA Energy Research Grant to develop an enhanced stove. The goal of this project is to develop a thermoelectric power system for the first generation of RIT cook stove (project P10461). The thermoelectric power unit should convert heat directly into electricity to power a fan and provide power for auxiliary loads. The team will build on the experience and prototype developed by team P10462. Ideally the prototype developed could be used or slightly modified to couple with the new generation of stoves being developed by team P11461. Team (P11451) will be developing stove measurement and characterization methods and reduce them to practice. A second team (P11461) will design the basic stove and specify the air flow required from the fan. The mission of this project team is to design a thermoelectrically rechargeable battery power source for the combustion assisting fan. Project deliverables would be the complete stove electrical system: fan, battery, TE, charging system, and control system that can be integrated with team P11461's basic stove design.

- Staffing Requirements: (*use WBS and associated resource estimates to summarize anticipated staffing needs)*

Discipline (*number*)		Skills required (*concise*)
EE	2	- Control system for running fan from battery and then charging battery from hot stove. -Maintain the thermoelectric at or near the peak power point. -Develop system level thermal/electrical systems model in partnership with ME's. - Sizing and selecting battery, fan(s), and TE devices to provide needed airflow, battery capability, and charging capacity. -Conduct testing of electrical subsystems.
ME	3	-Use thermal analysis to decide where best to place the TE devices, size heat sinks, ensure the thermoelectric does not exceed max rated operating conditions. -Also using thermal analysis determine the transient behavior of the system. -Conduct experiments to test subsystem and entire system -develop system level thermal/electrical systems model in partnership with EE's. - packaging, mounting, protecting electronics, battery, etc. from excessive heat. - a system engineer/project leader to keep this team and P10461tightly integrated.
CE	0	
ISE	0	
Other	0	

- Continuation, Platform, or Building Block project information (*Include prior project number and title and to what extent previous results are being incorporated*):

DETAILED PROJECT DESCRIPTION:

- Customer needs: Using H.O.P.E. as a surrogate, the needs of Haitians relative to a cook stove must be confirmed. Here are some examples:
    - Accepts standard pot size and doesn't tip over
    - Uses local fuel (wood, charcoal, agricultural waste)
    - time to boil < traditional stove
    - ability to cook local foods (beans, rice, millet)
    - safe and simple to operate (children can use)
    - safe (particulate emissions, CO_2)
    - can be used both indoors or outdoors
    - easy to light
    - affordable by Haitians
    - simple user interface (either no language or in Spanish)
- The engineering needs quantitative measurements that measure stove performance and provide engineering data for design optimization. Here are some examples:
    - Can be locally (in Haiti) assembled or manufactured

    - Fan air flow as specified by team P11461

- Customer deliverables (*Customer requested milestones, progress reports, and expected product*):

An improved RIT power system for the first generation of stove design. The power system should be tested under a range of operating conditions and be robust.

- Customer and Sponsor Involvement (*Describe role of customer and sponsor in the project, planned participation in design and project reviews, etc.*):

  H.O.P.E (Haiti Outreach - Pwoje Espwa), an NGO located in the Borgne area along the Northern coast of Haiti will assist in defining the needs. The team should involve H.O.P.E. in key reviews.

- Regulatory requirements (*i.e. UL, IEEE, FDA, FCC, RIT*):

  All laboratory testing must meet RIT EH&S Laboratory Safety Standards. What Haitian standards exist?

- Project Budget and Special Procurement Processes (*Provide all budget details and processes associated with expenditures*):

  The project will be supported by a donation from Corning for sustainability related projects. Chris Fisher will administer purchasing. Total budget for the three projects within family is $??? for supplies.

- Intellectual property (IP) considerations (*Describe any IP concerns or limitations associated with the project*):
  Review thermoelectric stove patents especially those issued to Philips Corp.

- Other (*Describe potential benefits and liabilities, known project risks, etc.*):

DETAILED COURSE DELIVERABLES:

From the Course Deliverables document, extract general and discipline specific deliverables that are appropriate to the project. This should provide clear guidance to the students on what it expected.

See the MSD I and MSD II. https://mycourses.rit.edu/d2l/lms/content/preview.d2l?tId=1273352&ou=245652

PRELIMINARY WORK BREAKDOWN:

Describe the anticipated distribution of general tasks to be accomplished by project participants based on perceived skill set requirements. This should justify the requested skills and number of students from each discipline.

1. Fully review all previous work done during last year's stove projects paying special attention to the team focused on developing the thermoelectric power unit system. Attend a mini-lecture by Dr. Stevens on thermoelectric operations and issues.
2. Along with the other stove project teams, conduct a test of the current stove design to better understand its operations so you can have a better idea how you might integrate a thermoelectric power unit with the existing stove design. In addition, test project team P10462 prototype design to identify issues with the current power unit design.
3. Along with the other stove project teams, conduct a full needs assessment in collaboration with H.O.P.E (Haiti Outreach - Pwoje Espwa), an NGO located in the Borgne area along the Northern coast of Haiti. Define in Haitian terms what the "job" of the stove is and how it will be used by the Haitians. Example: Stove (fan) must be able to run long enough to cook a pot of food.
4. Map those needs to specific engineering stove specifications and metrics. Example: Stove will run fan on battery power until charcoal or wood is kindled (xx minutes) and the TE devices can take over from

the battery. Prioritize these requirements. Focus especially on specifications related to battery size, how long the fan must run, the power draw of the battery. Review published stove tests to insure RIT stove specifications are captured.

5. Integration: Working with team P10461 define your requirements for an affordable battery that can be recharged during a cooking cycle and that has adequate power to run the stove fan. Team P10461 will tell you their desired sweet spot in pressure volume space they want your fan to operate. Choose a fan that operates there efficiently. Define who on your team will be the interface to the stove design team P10461. Make sure the stove design team will provide a place to mount your TE units and other parts of the electrical system.
6. Perform a literature search on application of thermoelectric power applied to stoves. How have the Philips Stove and BioLite Stove designs employed TE power generation? What is the temperature difference? How will the cold side be kept cold? How many units and what type of TE devices? Using published TE performance curves select the type of device you want to use. Understand the temperature profiles within a stove and during the start up and cool down of the stove. Using a concept selection process choose between potential design approaches for.
7. Create a simple simulation model that simulates energy usage and generation so that the TE devices and battery can be sized properly. There is a discharge period and a charging period. For a given fan size there is an optimum number of TE devices and battery size.
8. Perform a systems level design of a stove that includes features that allow for optimization of the design in MSD II. Evaluate, rank, and select your power management concept. Estimate required power for fan, TE generating capacity, and battery size. How will stove electric system be controlled? Make an initial projection of electrical system cost.
9. Perform a detailed design of the stove. Perform fundamental (meaning simple) thermal analysis to predict TE temperature difference. Confirm feasibility of proposed design using power model above. Select materials appropriate to projected stove temperatures. Confirm team P10451is developing appropriate test methods and instrumentation for your project. Attend their design reviews.

GRADING AND ASSESSMENT SCHEME:

Describe how the grading rubric relates to expectations and deliverables. The impact of project enhancements and improvements from baseline should be clearly articulated.

THREE WEEK SDI SCHEDULE:

List expected activities in the first three weeks. Highlight any project specific activities that may not be part of the generic course syllabus (e.g. customer visits).

REQUIRED FACULTY / ENVIRONMENT / EQUIPMENT:

Describe resources necessary to support successful Development, Implementation and Utilization of the project. This would include specific faculty expertise for consulting, required laboratory space and equipment, outside services, customer facilities, etc. Indicate if required resources are available.

Category	Source	Description	Resource Available (*mark with X*)
Faculty			
Rob Stevens	ME	Expertise in thermoelectrics and heat transfer	X
John Wellin	ME	Expertise in DAQ, fluids, and fan characterization	X
Brian Thorn	ISE	Product Sustainability	X
George Slack	EE	Power electronics	X
Jim Myers	Center for Multidisciplinary Studies	Haiti expert	X
Environment			
Sustainable Energy Lab	ME-Stevens	Lab for testing thermoelectric modules and subsystems. Lab does have ventilation and some DAQ resources	X
Equipment			
DAQ system	ME-Stevens	A USB based DAQ system, laptop, thermocouples, etc. are available through the Sustainable Energy Lab	X
Materials			
Other			

***Project Tracks**: Assistive Devices & Biotechnology, Aerospace Systems & Technologies, Vehicle Systems & Technologies, Systems & Controls, Sustainable Design & Product Development, Printing & Imaging Systems, Entrepreneurship & Business Development, Unknown.*

***Project Family**: a group of closely related (or interdependent) projects.*