DATE: October 30, 1998
TO: Gale Greenleaf, Instructor
FROM: Bill Louk, Student
Tom Penick, Student
SUBJECT: Proposal to conduct a research project on photovoltaic power generation.

INTRODUCTION

In this proposal, Bill Louk and Tom Penick are requesting permission to conduct a research project on the use of photovoltaics for power generation. The proposal includes a description of the proposed project, purpose of the project, an outline for the final document, a description of work done, a project schedule, and reasons this project is important.

BACKGROUND OF THE PROPOSAL

On October 19, 1998, Gale Greenleaf, Instructor, issued a request for a proposal. We have prepared this proposal in response to that request.

We began investigating photovoltaic power in late September 1998 when Bill wrote literature reviews on four articles. These articles covered government incentive programs, building-integrated photovoltaic systems, and installations by an electric company and a homeowner. At the same time, Tom did an executive summary on "Going for Broke," an article about a new development in thin-film solar cell technology. In early October, Bill investigated how solar cells convert sunlight into electricity and Tom researched an application of large-scale photovoltaic power generation.

PROPOSAL LIMITATIONS

Our proposal does not specify whether we will include forecasts of the development and use of photovoltaics in power generation. We can include forecasts in the proposed report only if our research reveals clear trends.

PURPOSE OF THE PROJECT

The purpose of this project is to compile an overview of photovoltaic power generation. Our report will include an assessment of the status of photovoltaic technology, a summary of application methods, and a history of photovoltaic development.

The intended audience is students of electrical and computer engineering. The report will give a balanced view of the state of the photovoltaic industry. This will help graduating students assess the merits of entering the photovoltaic industry or of using photovoltaic power in their projects.

PROJECT STRATEGY

Project team members Bill Louk and Tom Penick will share the tasks of research, writing, and editing. Due to the overlapping nature of the materials, it will be difficult to divide research

tasks by topic. We will need a system of communication and organization to assemble our findings into the final report.

COLLABORATION PLAN

Regular Monday and Wednesday meetings and email will provide the communication we need to coordinate our efforts. We will share the job of proofreading and editing by reviewing each other's work. The table below shows how some of the tasks will be divided based on individual strengths and previous research.

Bill Louk	**Tom Penick**
▪ Research on the integration of photovoltaics into building materials ▪ Research on how sunlight is converted into electricity ▪ Writing on the above subjects	▪ Research on photovoltaic development and applications ▪ Writing on the above subjects ▪ Graphics editing ▪ Organization

Using our outline as a guide, we will assemble material from reviewed sources into a working document. When we have collected sufficient information under a particular topic, one team member will begin writing that section of the report. In our regular Monday and Wednesday meetings, we will review progress, discuss areas of the project needing attention, and assign tasks.

USE OF GRAPHIC SUPPORT

Graphics will be employed to describe the function of solar cells on the subatomic level, to illustrate photovoltaic collection systems, and to show the geographic areas most suited to photovoltaic power generation. Charts may be used to illustrate cost and production trends, relative involvement of different countries, usage in various applications, and efficiency improvements.

PROJECT SCOPE

We intend to address the following questions in our report:

1. When was photovoltaics discovered and by whom?
2. What was the first application of photovoltaic power?
3. What are the historical trends in cost and production of photovoltaic cells?
4. What are the historical trends in applications? (scale, location, type, purpose)
5. What are the types of photovoltaic generating systems?
6. Who are the major manufacturers of photovoltaic equipment?
7. How is government involved?
8. How is photovoltaic power generation being used today?

TENTATIVE ORGANIZATION OF THE FINAL DOCUMENT

The following outline shows how we plan to organize our report:

I. Introduction

   A. What the report is about
   B. Brief history of photovoltaic power
   C. Why this subject is important

II. Background

   A. Discovery, development, and early applications of photovoltaic power
   B. How solar cells work
   C. Statistics on production costs and solar conversion efficiencies
   D. Government involvement
      1. Organizations
      2. Legislation
      3. Incentive programs
   E. Obstacles to getting objective information
      1. Optimistic figures
      2. Sensational reporting

III. Technology and Applications

   A. Flat plate collectors
      1. Silicon wafers
      2. Thin film technology
      3. Alternative technologies
   B. Concentrating collectors
   C. Building-integrated systems
   D. Off-grid applications
   E. On-grid applications
      1. Large-scale utility applications
      2. Small-scale residential applications

IV. Conclusions

   A. Significance of photovoltaic power generation
   B. Principal technologies and applications
   C. Importance of photovoltaics to the engineer

APPLICATION OF LEARNED WRITING AND PACKAGING TECHNIQUES

The final report will draw on techniques we have learned in class. We will include a letter of transmittal that is similar to the resume cover letter we did in class. The abstract of the report will be similar to our executive summary assignment. We will employ figures and tables, which have been covered in class. The report will be organized into an introduction, body, and conclusion, as have most of our assignments. Additionally, we will use a heading hierarchy and create a reference page in the IEEE format. We will avoid passive voice and wordiness, and will watch for the common grammatical pitfalls we reviewed in class.

RESEARCH

While working on previous assignments, we have already consulted several sources of information on photovoltaic power generation. We will use this information in our final paper.

OVERVIEW OF SOURCES CONSULTED

"Going for Broke" - The author details the efforts of Solar Cells Inc. (SCI) to develop the technology that will make solar cells practical for large-scale power generation. In a recent breakthrough, SCI discovered a way to produce thin film cadmium telluride solar panels using a coating process that only takes 30 seconds per panel, as opposed to six hours for the competition [1].

"Fabrication, Installation, and Initial Operation of the 2,000 sq. m. Linear Fresnel Lens Photovoltaic Concentrator System at 3M/Austin (Texas)" - This article documents a large-scale photovoltaic power generation project built in 1990. The article describes the construction and use of the solar concentrator type of application, which would be one of the types covered in the project. It also provides some graphics [2].

"Solar Shines Brighter" - The author covers a variety of solar energy systems, including photovoltaic cells, solar ventilation walls, and solar-thermal-energy water heating systems. This article also reports on incentive plans and solar energy usage of several countries. We plan to use statistical data from this report [3].

"What's New in Solar Power" - The article reports on the PV products of United Solar and Atlantis Systems, Inc. The article describes these products as "Building-integrated Photovoltaic (BIPV)" systems. The two companies have designed "solar shingles" to replace conventional roofing materials on newly built homes. The article gives estimates of the cost and electrical output of the solar shingles. BIPV is a recent trend in the use of photovoltaics which Bill will be investigating for our report [4].

"Photovoltaics Support Distribution Feeder" - This report discusses Niagara Mohawk Power Corporation's study of employing photovoltaic power systems to support existing electrical transmission and distribution systems. The study outlines the conditions for cost-effective use of PV systems. We will rely on factual articles such as this to provide material for an objective report [5].

"Power From the Sun: not that Difficult; not that Expensive; Solar Power for the Homestead Farm" - The author has installed a photovoltaic power system in his home. He gives general directions for installing residential photovoltaics and discusses his 12-year experience with his own system [6].

POSSIBLE DIFFICULTIES

Much has been written about photovoltaics. One problem is that authors have sometimes sensationalized their reports and manufacturers have overstated their accomplishments. Some articles give conflicting statistics. These inaccuracies can make it difficult to assess the photovoltaic industry.

ADDITIONAL INFORMATION SOURCES

In addition to the types of material we have consulted, we plan to obtain information from manufacturers of photovoltaic equipment either by contacting them or by viewing their web pages. We will also look for published information from professional and research organizations.

SCHEDULE

The project will take 6-1/2 weeks to complete from the time the request for a proposal was received until the final paper is due on December 4, 1998. Progress will be reviewed each Monday and Wednesday. Refer to Figure 1 on page six for a timeline showing how we intend to budget our time.

CONCLUSION

We are requesting approval to proceed with a research project on photovoltaic power as described in this proposal. We propose to examine past development and use of PV power, assess the current state of the art, and look for trends. There is an adequate amount of material available on the subject of photovoltaics. Given the availability of material, our interest in the subject, and the impact this project has on our grades, the prospect for success seems good.

With interest in *green* power growing, both consumers and providers of electrical power are turning to the use of photovoltaics in spite of its higher cost. This is reflected in a recent upturn in production of solar cells. Inevitably engineers will be called upon to develop photovoltaic technology or be involved in projects using this technology. Many existing reports on photovoltaics cover only one facet of the technology and are sometimes exaggerated on behalf of the company involved. We see a need for an up-to-date, objective report on photovoltaic power generation.

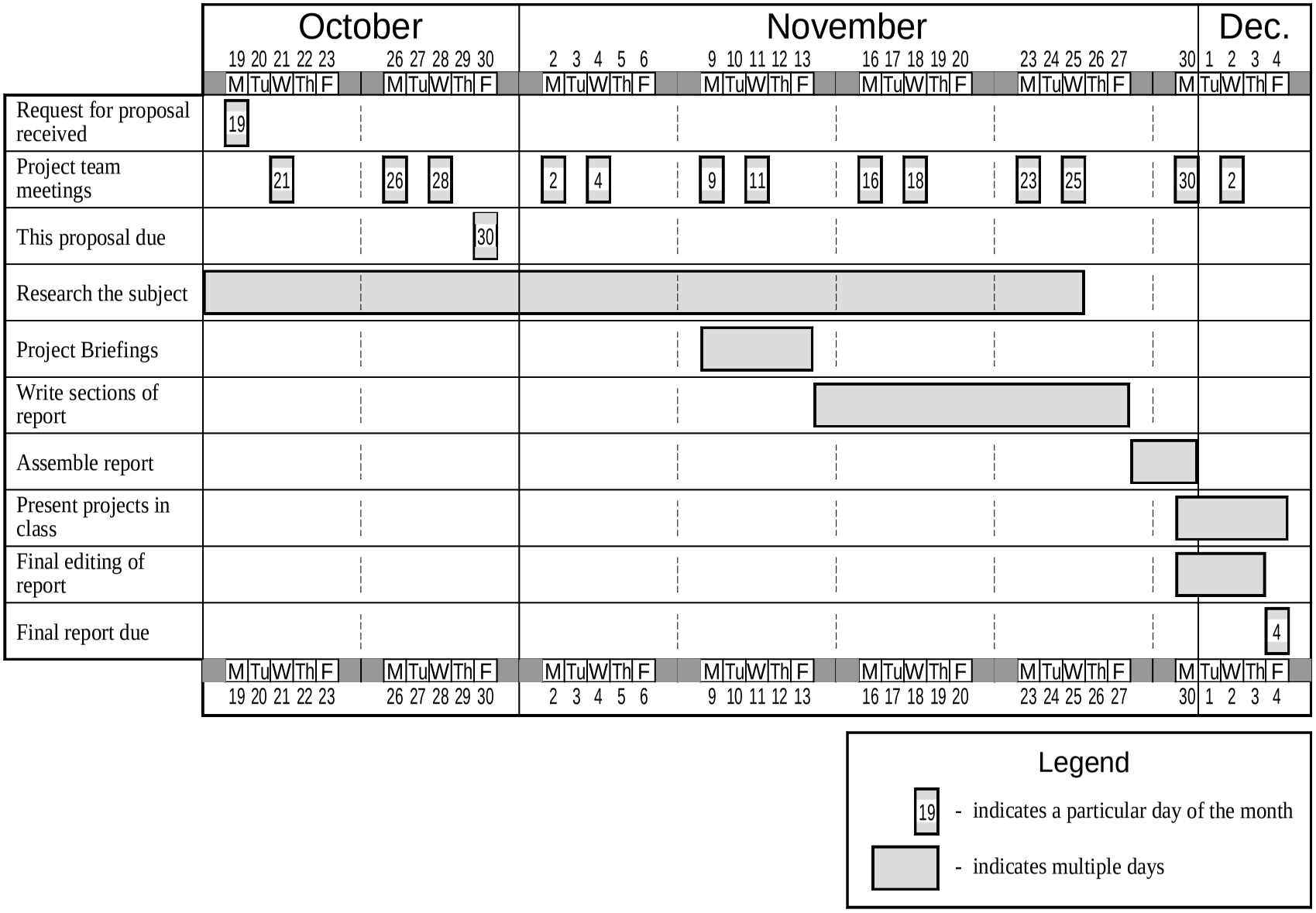

Figure 1. Timeline

REFERENCES

[1] Edward O. Welles, "Going for BROKE," *Inc.*, vol. 20, no. 8, pp. 66-78, June 1998.

[2] M. J. O'Neal, R. R. Walters, J. L. Perry, A. J. McDanal, M. C. Jackson, W. J. Hesse, "Fabrication, Installation, and Initial Operation of the 2,000 sq. m. Linear Fresnel Lens Photovoltaic Concentrator System at 3M/Austin (Texas)," *Twenty First IEEE Photovoltaic Specialists Conference—1990*, vol. 2, pp 1147-1153.

[3] Glenn Hasek, "Solar SHINES BRIGHTER," *Industry Week*, p. 24, April 20, 1998.

[4] Bill Siuru, "What's New in Solar Power," *Electronics Now*, vol. 69, no.8, p.53, August 1998.

[5] Philip P. Barker, Bruce Bailey, A. J. Peterson Jr., "Photovoltaics Support Distribution Feeder," *Electric Light & Power*, p. 20, March 1997.

[6] Larry Behnke, "Power From the Sun: not that Difficult; not that Expensive; Solar Power for the Homestead Farm," *Countryside & Small Stock Journal*, vol. 81, no. 4, p.22, July 1997.