DATE: November 20, 1998
TO: Gale Greenleaf, Instructor
FROM: Tom Penick, Student
Bill Louk, Student
SUBJECT: Progress report on the photovoltaic power generation research project.

INTRODUCTION

This report is to advise you of our progress on the photovoltaic power generation research project. The purpose of the project is to compile an overview of the use of photovoltaics for power generation. Our final report will help engineering students become more familiar with photovoltaic power generation technology and its applications. Students can use this information when deciding whether to enter a related field or when considering the use of photovoltaic technology in their projects.

In this progress report we describe the work we have done, work we are doing, and what remains to be done. We discuss the use of graphics and the graphics editing that we must do. We also mention difficulty we have had locating some material, changes we are making to the organization of our report, and problems we have experienced with the ECE computer labs. We have included our updated timeline is on page five.

WORK COMPLETED

Since our October 30, 1998 proposal was approved, we have set up a skeleton draft using the report outline from our proposal to create the heading heirarchy. The next step was to add the material from Bill Louk's literature review, Tom Penick's executive summary, and our previous classroom presentations. We also added the references from these projects to the rough draft's reference section. We keep this document, as well as our research data and graphics, on the internet to allow us to access the most recent version from school or home.

Previous Research

Our previous research includes Bill Louk's September 1998 literature review on four articles. These articles cover 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.

Continued Research

We have continued by reviewing additional material from a list of about 20 journal articles and encyclopedia entries that we had assembled during our previous work. This material exists in electronic format on a web page accessible to the team members. Most of our material has come from journal articles found on the LEXIS-NEXIS system, accessed through the UT library; additional material comes from books and encyclopedia entries. We have added additional material and now have about 50 articles. We have reviewed about half of these and added their

information to our report. These materials include trade journals, web pages, business magazines, and entries from Encyclopaedia Britannica.

Graphics

We will be using graphics in both our presentation and our final report. We have collected more than 30 graphics from library books, web pages, and a textbook. Fifteen of these graphics illustrate how solar cells work; we will probably need only four or five. We have two graphics showing solar radiation patterns across the United States. Six images illustrate progress in cost, efficiency, and manufacturing capacities, and shipments of photovoltaics. We have collected numerous images showing photovoltaic applications. We will be selecting graphics from this collection and editing them to suit our needs.

We have had difficulty in locating charts or tables with data on the progress of photovoltaic technology in terms of solar cell cost, production, and efficiencies. We have finally located a source for this information in the magazine, *Japan 21st*, which we plan to use for graphics. One graph shows annual shipments of photovoltaic modules by Japan, Europe, and the USA from 1985 to 1995. Another graph gives solar cell manufacturing costs from 1974 to 2000 (projected). There is also a chart showing solar cell conversion efficiencies from 1984 to 1993 for Japan's Sunshine Project.

Project Meetings

The team members have been meeting regularly on Mondays and Wednesdays since early October. During these meetings we have reviewed the most recent draft of the report, discussed current research, and determined short-term goals. We will continue to hold Monday and Wednesday meetings for the duration of the project.

Problems

The most significant problems we have encountered involve the ECE computer labs. Since all of our research is collected, stored, and exchanged in electronic format, we rely heavily on the ECE computer system. When logging on to the system, one is presented with an assortment of error messages to be acknowledged. Zip drives and scanners were out of service for weeks due to configuration problems. Printers often run out of paper and remain that way for some time. When paper finally arrives, the result is a deluge of printouts from print jobs waiting in the queue. These accumulate at the printer since many students have had to leave for class before their printouts were ready. The department has responded to this problem by threatening to revoke lab privileges from students who don't pick up their printouts.

One never knows what the problem of the day will be in the ECE computer labs. Typically, several machines will not function, sometimes whole rows of machines are out of service for weeks. For example, Tom rushed into the lab with a volume of magazines to scan on a two-hour checkout from the Perry Casteñeda Library. After one scan, the machine locked up. The proctor didn't know how to fix it, nor could she retrieve the zip disk which the machine refused to give up. The machine couldn't be turned off and reset because the power switch is also broken. When Tom finally retrieved the zip disk and moved to the other scanner machine, he found its zip drive had been removed.

CURRENT WORK

We are currently involved in writing the rough draft for our final report, preparing for our presentation, and gathering additional information for both. In the process of assembling this information, we have realized improvements in the organization of the report.

Report Organization

As our skeleton draft comes to life, we are rethinking our original heading hierarchy. The original headings for the skeleton draft came directly from our proposed outline of the report. Due to the interrelated topics, we are faced with numerous organizational options. For example, the topic "How Solar Cells Work," originally under the major heading "Background," is also related to items found under the major heading "Technology and Applications." The way that solar cells work includes a discussion of the materials involved. The properties of the materials, such as cost and efficiency, have suggested the paths researchers have taken to improve and apply the technology. This has resulted in the selection of photovoltaic technologies we have today.

Although materials technology is also related to the applications of photovoltaic power generation, the topics of photovoltaic technology and photovoltaic applications can be separated and presented sequentially. We have decided to replace the original major headings, "Background" and "Technology and Applications" with the new headings "Photovoltaic Technology" and "Photovoltaic Applications." Background development will be discussed under "Photovoltaic Technology" and mentioned briefly in the introduction. Several subtopics have been moved and new ones added.

Locating Statistics

We have recently located statistical data on yearly solar cell cost and efficiency improvements. We will use this information for graphics and possibly to determine development trends.

Building-Integrated Systems

An emerging area of photovoltaic power generation is in the use of building materials that incorporate photovoltaic technology. We have found a great deal of information on the World Wide Web about building-integrated PV systems. Companies, governments, and other organizations provide this information about recent photovoltaic projects. For example, the Swiss Federal Department of Energy and the Swiss Federal Institute of technology maintain a web site that provides information on demonstration PV systems built by companies from Europe, Japan, and the United States. Due to the large number of sites, we may not be able to visit enough sites to gather the best information.

WORK TO BE COMPLETED

We will continue to review material we have collected, incorporate this material into our report, and locate new information. We will be evaluating our rough draft and concentrating on topics that require more information. For our November 30th presentation, we need to finalize the organization, edit presentation graphics, and rehearse.

Graphics Preparation

We will also be selecting and editing graphics in the final stages of the project. Figure 1 shows a map of the U.S. giving average daily solar radiation levels. We will probably use this graphic in both the presentation and the final report. As you can see, the text is small and will need to be replaced with larger type to be readable. This is typical of the graphics editing we must do.

Anticipated Problems

While we have gathered a large volume of information and have made a good start on the rough draft, we anticipate that progress will be more difficult as our focus narrows to fewer and more elusive topics. We expect the workload to increase as we search for the final details, edit graphics, and integrate this information into a cohesive report.

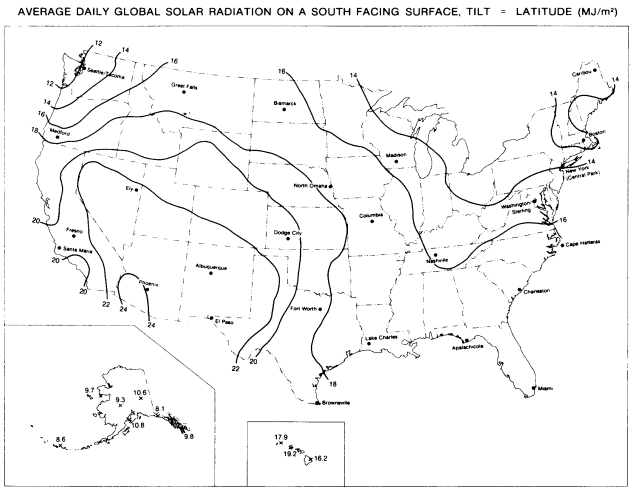

Figure 1. Map of the United States showing average daily solar radiation levels [1].

CONCLUSION

With two weeks remaining to complete the project, we have accumulated a substantial amount of information and incorporated much of this into a 20-page document. Although problems in the ECE computer labs are a constant annoyance, we have been able to work around them so far. We have 30 graphics from which we will select illustrations for our presentation and the final report. Progress to this point has been steady. We will continue by preparing for our presentation, editing graphics, reviewing collected materials, and writing and editing the final report. We plan to complete the project by the December 4th deadline.

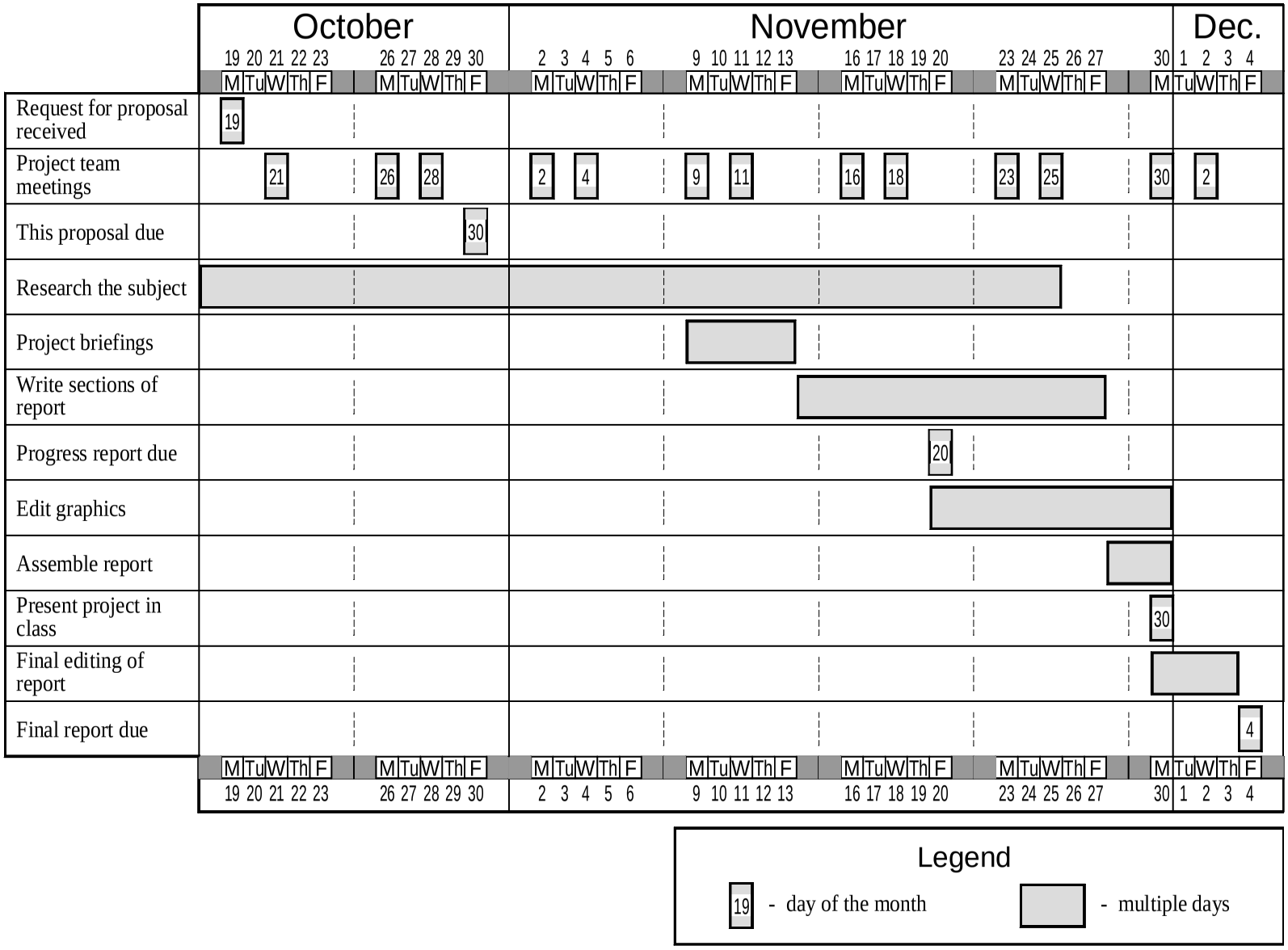

Figure 1. Revised timeline

REFERENCE

[1] Kenneth Zweibel and Paul Hersch, *Basic Photovoltaic Principles and Methods*, New York: Van Nostrand Reinhold Company Inc., 1984.