VISUAL AIDS FOR TEACHING POWER SYSTEMS

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ABSTRACT

Power systems courses teach the analysis of power apparatus and integration of the apparatus into a power system. Field trips to local installations are commonly used to illustrate apparatus to the students. Coordination of the information obtained from a field trip with classroom material is very difficult plus the students do not see a diversity of system designs. This paper presents a method of using visual aids to enhance the students' conceptual understanding of power systems. Generating the visual aids for multiple use within the educational environment will be discussed.

Introduction

Lecture courses in power systems stress the fundamentals which are based on field theory, circuit theory and control systems. The technology affiliated with power systems is relegated to a minor role by scheduling a few field trips to local installations. Field trips, although beneficial, do not illustrate the variety of equipment a power systems engineer has at his disposal. Also, field trips are usually the first direct contact students have with apparatus, resulting in poor retention of the information.

This paper outlines a visual aid program, initiated within the last year at North Dakota State University, that is designed to solve the problem of students not having a general understanding of power system apparatus. Students will be involved in the program initially to assist the instructor in screening and evaluating the visual aids. The long term objective is to minimally use the visual aids in lectures to illustrate compatibility between theory and practice. Most of the visual aids will be used as homework or laboratory assignments to illustrate power system technology.

Power apparatus is, in general, too large and too expensive to be compatible with a university laboratory. An alternative is to allow students to study visual aids of the apparatus. The benefits of using well designed visual aids in teaching and for learning is well established. The visual aids are to be used by the instructor during lectures and by the students for studying, therefore 34 mm slides will be the primary visual aid.

Objectives

To properly generate slides depicting the features of power apparatus, a clear understanding of their use is the first objective. Illustrating the apparatus during lecture classes assist the student in conceptually understanding what is being discussed. For example, explaining that transposing a line to equalize out voltage drops in each phase may be more meaningful if a student can see the actual line transposition. Practical application of traveling wave theory can be illustrated by showing surge arrestors being physically located close to the protected device.

The above two examples are quite simple and do not involve a great deal of assimulation by the student of visual information. Some topics like the placement of buswork and switches in a substation require prolonged study or there will be an almost complete lack of understanding and retention. Allowing sufficient time during lectures for sketching these technological details may not be justifiable. There is also the chance that the students would not pick out the important features. To solve the above problems, the slides must be generated such that they could be used by the students for studying either as homework or laboratory assignments.

Slide Information

Before taking the slides, one must first decide what visual information is needed for lecture and homework assignments. While it may be profitable in the beginning to take some slides to develop technique and generate ideas, it will be more efficient to concentrate on specific items. Randomly taking slides of transmission lines and substations will yield a surprisingly small percentage of useful slides.

The visual aids must follow and compliment lecture material. The lecture material dictates what slides to use and the order of presentation throughout the term. Actually proceeding through the course, listing what slides are needed before attempting to take them is probably the best way to proceed.

Mechanics of Visual Aid Generation and Use

There are many fine books on how to take 35 mm slides for classroom use.[1,2,3] The slides can be taken by anyone who has an interest in power systems and photography. It is probably best if a power systems instructor does the photography.

Utility companies and their suppliers are generally very cooperative in allowing one to take slides of their apparatus. Usually they will send an engineer out with the photographer to assist him in taking the slides. Supplying the engineer with a well organized list of desired slides simplifies the procedure. In many cases the utility

company already has a number of slides for their own use, which can be copied. Engineers which take and use these slides are a source of useful photographic tips.

Summer and coop employment of students, with an interest in photography, at various utility companies is another good source of slides. Supplying these students with a list of desired slides can provide the instructor with a variety of system designs.

Once the raw slides have been generated they can be used as lecture aids. The instructor can supply the background and supplemental information that necessarily accompanies the slides. Developing a complete group of slides for each given usage simplifies organization.

The slides can also be organized for independent use by the students for homework or laboratory assignments. The approach here is to have a package of slides along with supplemental information on reserve at the library. The students then check out and view the information at the library. Most university libraries have audio visual facilities for this purpose. The slides can include:

1) Titles for the apparatus
2) The apparatus
3) Modifications of the initial slides highlighting certain features
4) Schematics
5) Blueprints
6) Reproductions of manufacturers specifications
7) Graphs and plots

The supplemental information that must be synchronized with the slides can include:

1) Written information explaining the slides
2) Audio cassettes explaining the slides
3) Homework or lab assignments

Most universities have audio visual departments that assist instructors in generating supplemental aids for slides. The degree of sophistication or investment in developing supplemental information depends on available resources.

The use of the slides in the library allows the student to study at his own pace. In certain instances groups of students could study the slides. Students with work experience can be used to lead the groups.

Status of the Program at NDSU

The program outlined of using slides in teaching power system apparatus has been under development for six months. Approximately two hundred slides have been generated and initially sorted. Lists of

desired slides have been made. Outlines of homework assignments using the slides are about 20% complete. The complete visual aid package is scheduled to be used in the power systems sequence starting in the Fall of 1982.

Conclusions

Visual aids can be used to link theoretical concepts developed in lectures to physical apparatus. The technology of power apparatus which is of importance to many engineers can be taught using homework and lab assignments without sacrificing lecture time.

References

1) M. J. Langford, Visual Aids and Photography in Education, Hastings House, 1973, New York.

2) J. W. Brown, R. B. Lewis and F. F. Harcleroad, AU Instruction, McGraw-Hill, 1977, New York.

3) F. M. Pwyer, Strategies for Improving Visual Learning, Learning Services, 1978, State College, PA.