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Earl F. Richards
Missouri University of Science and Technology

Max Darwin Anderson
Missouri University of Science and Technology, mda@mst.edu

Jack F. Morris
Missouri University of Science and Technology

J. Derald Morgan
Missouri University of Science and Technology

et. al. For a complete list of authors, see https://scholarsmine.mst.edu/ele_comeng_facwork/4939

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The Development of an Interactive Industry/Academic Power Engineering Education Program at the University of Missouri-Rolla

EARL F. RICHARDS, MAX D. ANDERSON, MEMBER, IEEE, JACK F. MORRIS, MEMBER, IEEE, J. DERALD MORGAN, GEORGE MCPHERSON, JR., SENIOR MEMBER, IEEE, DAVID RAY CUNNINGHAM, MEMBER, IEEE, ROBERT H. NAU, FELLOW, IEEE, AND EDWARD DUKE TWEED

Abstract—This paper describes the development of a unique and innovative program in power engineering education enhanced through an Industry/Academic interrelationship. This program is devoted to both the teaching and the practice of power engineering. The development of the Industry/Academic relationship and its value as a model for power engineering education are related. A summary of present and proposed future activities concludes the report.

INTRODUCTION

THE University of Missouri - Rolla (UMR) was established in 1870 as the Missouri School of Mines and Metallurgy with initial specialization in the engineering fields associated with the mining and construction industries. It enrolls one of the nation's largest undergraduate engineering student bodies, offers the B.S. degree in 18 areas of engineering and science, and in 1975-76 ranked sixth nationally in the number of B.S. degrees granted in engineering.

In the late sixties most schools had all but eliminated power education by relinquishing courses and laboratory facilities in electrical machinery and power systems to other disciplines of electrical engineering. It was a time when the non-competitive salary offers of utilities and related industries could not attract good students from the largely government-supported electronics and control specialties. A few UMR faculty members believed this trend was only temporary and that future demands would revitalize the power engineering program; therefore UMR had not made such drastic changes in its curriculum. Even though emphasizing electronics and systems engineering, the electrical engineering curriculum at this point in time retained more power oriented courses than most schools.

In 1967-68, with the support of the University administration, a small nucleus of UMR faculty developed a strategy for excellence and a plan to achieve excellence in power engineering education. The strategy was:

1. To immediately provide the best power engineering education program that existing staff and facilities would permit.
2. To develop a *Plan for Excellence*, to be implemented as industrial support developed.

The long range *Plan for Excellence* consisted of several parts

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The authors are with the Department of Electrical Engineering, University of Missouri at Rolla, Rolla, MO 64501.

as follows:

1. Attracting top students to power
2. Curriculum modernization and development
3. Laboratory improvement
4. Service to industry
5. Research program development
6. Faculty development
7. A distinguished professorship in power engineering.

The *Price of Excellence* was:

1. Competence
2. Dedication
3. Enthusiasm
4. Money.

PROGRAM DEVELOPMENT

The UMR faculty had an ample supply of the first three components of the price of excellence, but sadly lacked the last ingredient. What was needed was to develop enough outside interest and support for the program that financial support would be available to quality students, and to develop a modest research program and provide for faculty development activities. It was estimated that, in order to accomplish the objectives of the program, in the neighborhood of \$90,000/year would be required in excess of university funds.

The power oriented industry of Missouri and the surrounding states, as the most interested in such a quality power program, was chosen as the target for the initial development effort. A slide program was developed to present to electric utilities indicating our "Five Year Plan" together with a proposed funding level for each company. The funding requested for utilities was calculated on their yearly gross receipts and a factor of 0.018% was decided upon as a reasonable percentage. A list of UMR graduates employed by each company and other statistics were prepared through our Alumni office. This revealed a large number of UMR engineers who were employed by some of the companies we planned to visit. Because of the number of UMR graduates who preferred to remain in the midwest area, the position was taken that aid to our program was a good investment for industry in this area.

It was hoped that these visits to the utilities would stimulate growing industrial associations and backing. It was also suggested that we could help solve their "University-sized" prob-

lems by way of research projects and summer employment for graduate and undergraduate students and possible faculty. They were also asked to provide reviews and suggestions in preparing research proposals. Suggestions in the development of academic programs, including practical engineering programs for teaching and research were solicited.

Needless to say, success in securing support was not immediate. The program was well received, but hesitation existed in providing financial backing to the program. In many cases, faculty and industry people were complete strangers to one another, but with consistent visiting and revisiting we attempted to assure them that we were serious about our program. It wasn't an easy task and resulted in many extra hours spent by faculty in traveling and preparing material in addition to their normal teaching and research loads.

A few initial supporters (Alcoa, Union Electric and Illinois Power) gave us confidence that the program would succeed. Graduate fellowships for specific research projects were provided by Detroit Edison, Bussmann Fuse and Emerson Electric, and Emerson offered \$5000 for Power-Lab development on the condition that the University provide matching funds. The University more than matched this gift, and the laboratory equipment aspect of the plan was moving.

As program support was gained, the idea of forming an Industry Advisory Council (IAC) was conceived, whereby once a year industry representatives are invited to spend a day reviewing the progress and future of the program. The exchange of ideas and broadening of our relationship has been very rewarding for both sides.

To further aid our industry relationship each power faculty member is assigned to serve as a liaison representative to one or more of our supporters. Once a year all of the supporting companies are visited by at least one faculty member to become familiar with their personnel, operation and problems and develop the UMR-industry relationship. This personal contact has added increased awareness of mutual interests and problems, and allows us to make better employment recommendations to industry and to graduating students.

Through our industrial contacts we have been able to arrange student field trips which make the student aware of employment opportunities which helps them plan their academic program.

Undergraduate students whose interest is power are singled out as soon as possible. These students are asked to fill out a questionnaire (Power Preference Form) to assist the faculty in awarding power scholarships/fellowships and formulate a list of prospective power oriented employees. This allows direct contact to be made between industry and students for employment interviews. The questionnaire also serves as a guide in picking undergraduate assistants for employment in research projects, laboratory and equipment development. We have found that if the better students participate in projects with graduate students and faculty, the transition into the graduate program is natural, and the students are able to begin their thesis research much easier. At the present we have 8 scholarships, 6 undergraduate research assistants, and 6 graduate fellowships supported by power development funds from industry.

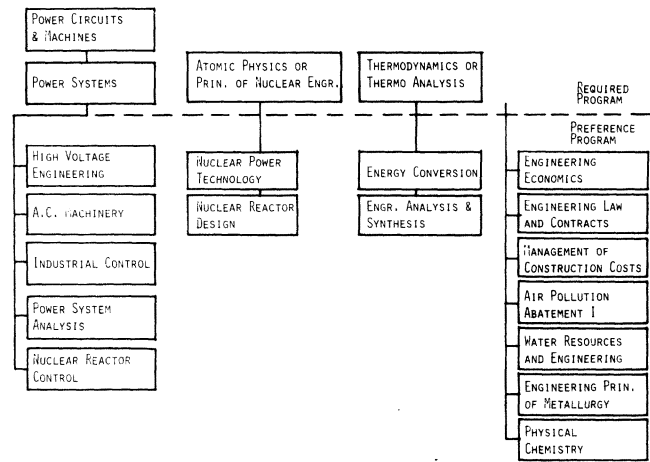


Fig. 1. Electrical Engineering Power Preference Program.

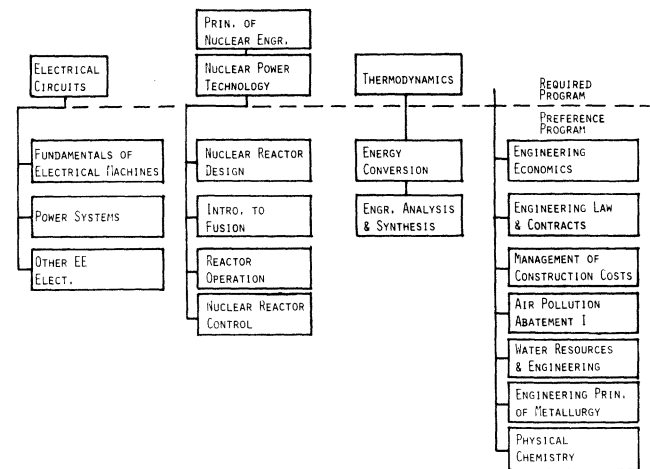


Fig. 2. Nuclear Engineering Power Preference Program.

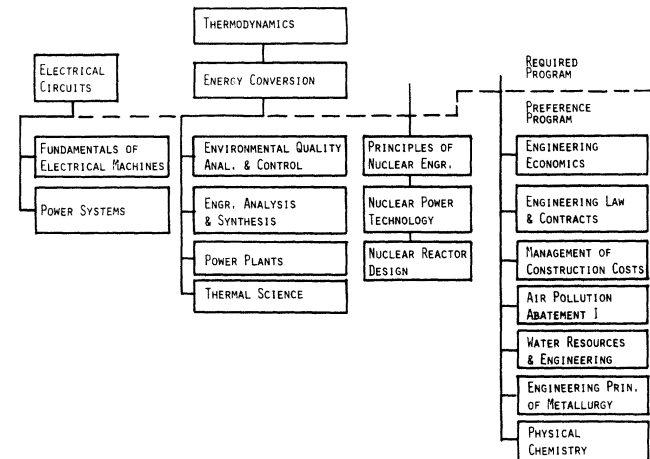


Fig. 3. Mechanical Engineering Power Preference Program.

Since Rolla is a rural area, UMR has established an off-campus graduate engineering program for industrial employees in St. Louis. A graduate level power course is offered every semester with the Rolla faculty serving as instructors and thesis advisors to these students. As an aid in course scheduling, we publicize the course offerings throughout the metropolitan St.

Louis area industry and poll industry for future course requirements.

In the last year we have been circulating to interested parties a newsletter, "Current Transmissions," on power oriented items such as faculty, students and short courses. Students and faculty are encouraged to submit items which would be of interest to industry.

PRESENT POWER PROGRAM CURRICULUM AND ACTIVITIES

In 1975 two additional needs of the Power Engineering program became apparent. The first observation was that the power engineer needed by industry today is not the same as the engineer of just ten years ago. The second was that there was no provision being made for feedback or evaluation of the instructional activity or instructional methods other than the long-term feedback from the power industry through the IAC. As a result, an internal study was initiated to develop an undergraduate preference program in electric power engineering that combines the resources of the departments of Mechanical and Aerospace Engineering, Metallurgical and Nuclear Engineering, and Electrical Engineering. The results of this study are outlines for interdisciplinary courses of study for power oriented students in each of the departments involved. These outlines are shown in Figures 1, 2 and 3.

The members of the Power Engineering Group (PEG) are continually developing courses and laboratories to meet the increased enrollment fostered by the interest and support of the power industry. To assist in this, a project is underway, with the help of the Psychology department faculty, to develop and refine mechanisms for systematic peer course and curriculum evaluation in the departments involved in the power program.

Over the past seven years the faculty have served the power industry with appropriate short courses and conferences. In most cases the short course faculty are a combination of industrial specialists and the power faculty. These activities are offered through our extension division and continuing education units may be obtained by the attendees. The courses are offered on a regular basis and the educational rewards to the power faculty and industry have been significant.

SUMMARY

The Power Engineering program of the department of Electrical Engineering is a special program designed to promote excellence in undergraduate power engineering education through industrial cooperation. The program was conceived

during the years of low student interest in power and low undergraduate engineering enrollment in the late 1960s. Over the last few years the Power Engineering program has enjoyed ever increasing industry acceptance and has become one of the more important undergraduate electrical power engineering programs in the United States.

The PEG consists of eight professionals who have a broad range of capabilities that includes electromechanical energy conversion, high voltage design and testing, power semiconductor circuit design and applications, power system distribution, reliability, modeling, analysis, real-time power system control, and computer applications to power systems.

The PEG receives support and advice from IAC with members from nine electric utilities, six apparatus manufacturers, and two consulting/construction firms. The IAC meets yearly on the UMR campus and is an active catalyst for the continued development and strengthening of the electric Power Engineering program.

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