



42nd Annual Report

Taufik
EPI Director

2012-2013

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LETTER FROM DIRECTOR

Dear Friends,

It is my pleasure to present once again this annual report on behalf of the Electric Power Institute at Cal Poly State University.

EPI has the mission to develop the best possible educational research and service in the area of power and energy systems, power quality, renewable and sustainable energy and power electronics. The EPI faculty initiates and carries out an expanded program of senior and graduate student research projects of a basic and widely applicable nature with the support of the program funds provided by the sponsors.

The resources of the Electric Power Institute (EPI) enhance the strong reputation of excellence that the Electrical Engineering Program at Cal Poly has maintained. The faculty, students, and the power program have also benefited from the continued work of EPI and the financial support it receives from the power industry.

This past year we've continued our focus on pursuing research activities in several key areas including renewable energy, power system protection, and smart grid which encompasses cyber security. Renewable energy has become critical especially in California where the state has mandated that 33% of electric power generated has to come from renewable energy sources by the year 2020. Our focus on this area has resulted for examples in the development of Sustainable Energy lab funded by San Diego Gas and Electric, and research activity to develop DC House technologies sponsored by Electronic Control Systems and Chevron. EPI will also continue the effort on smart grid and cyber security. These areas in particular have also drawn a lot of attention within Cal Poly as well as nationally. Last year, EPI received sponsorship from San Diego Gas and Electric to conduct research projects on several smart grid issues. In conjunction with the Collaborative-Agent Design Research Center (CADRC), EPI submitted a grant proposal to Department of Energy on cyber security. In the area of power system protection, led by EPI member Dr. Ali Shaban, we received power system protection and digital relay equipment donation from Schweitzer Engineering Laboratories Inc. (SEL). This generous donation enables us to expand our research ability in power systems in general.

We look forward to the coming year. With your ongoing support EPI will continue its active involvement with students, faculty, and the power industry. Please do not hesitate to get in touch with me if you have any questions or comments regarding this annual report. Thank you for your kind attention.

Sincerely yours,

A handwritten signature in black ink, appearing to be 'Taufik', written over a faint, stylized star or geometric shape.

Dr. Taufik, Professor, Electrical Engineering Department

INTRODUCTION

In 1971, the university approved the release of a preliminary proposal, which outlined plans for the establishment of an Electric Power Institute. The proposal represented the culmination of many hours of effort by a small group of faculty in the Electrical Engineering Department. As stated in the proposal, the Electric Power Institute was established to serve as an interface between the university and the electric power industry, also serving as a center for electric-power-oriented activity within the university. The Institute also supports the administration of other projects in Electrical and Computer Engineering.

Throughout the Electric Power Institute's forty-two years of existence, many companies have supported its activities. This support comes in the form of financial contributions, conference sponsorships, workshop participation, seminar speakers, equipment donations, consulting opportunities for our faculty, and summer job opportunities for students and faculty.

We encourage our supporting companies to visit our campus and meet the faculty and administration, familiarizing themselves with our facilities. We find that these one-to-one visits strengthen our industrial ties, leading to a better understanding of the mutual needs of university and industry.

Each year of operation, the Institute has produced an annual report, this being our 42nd. This report is primarily a summary of the Institute's activities for the 2012-2013 academic year. A projection of activities and budget for the 2013-2014 academic year is also included in this report.

ORGANIZATION

The Electric Power Institute was the first institute to be formed at Cal Poly, making it necessary for the university to establish a set of operational guidelines to insure that the Institute's activities conformed to established university procedures. For example, funds contributed to the university must be accepted and disbursed in accordance with the rigid state laws and under the supervision of the Cal Poly Corporation.

As approved by the university, the leadership of the Institute is the responsibility of the director, who reports to the Dean of the College of Engineering. On a regular basis the director consults with the Advisory Committee, whose members are selected by the director of the Institute with the Dean's approval.

Director

Dr. Taufik, Electrical Engineering Department

Advisory Committee

Electrical Engineering Department

Dr. Ali Shaban, Electrical Engineering Department

Dr. Ahmad Nafisi, Electrical Engineering Department

Dr. Helen Yu, Electrical Engineering Department

Non-University

Mr. Laurence Abcede, Engineering Manager, San Diego Gas and Electric.

Members of the Electric Power Institute

Electrical Engineering Department

Dr. Bill Ahlgren

Dr. Dale Dolan

Dr. Helen Yu

Dr. Taufik

Dr. Ahmad Nafisi

Dr. Ali Shaban

San Diego Gas & Electric

Mr. Laurence Abcede

Administrative Assistant

Yuri Carrillo-Martines

INSTITUTE ACTIVITIES

1) Seminar Program

As part of the Electric Power Institute's continuing program to bring industry to campus, our seminar program brings individuals that are considered to be experts in their industry field to Cal Poly. Following are the seminars sponsored by EPI for 2012-2013:

“Efficiently, Safely, and Reliably Transforming Voltage Levels from Generation to the Transmission and Distribution Power System”, John Villalpando, Pacific Gas and Electric, October 16, 2012.

“LTSpice for Circuit Analysis and Simulation”, Glen Fabian, Linear Technology, March 5, 2013.

Central Coast Annual Power Conference, co-sponsor with the Electrical Engineering department, May 2013.

2) Publications

- [1]. D. Dolan, Taufik, "Characterizing Energy Usage of Chevrolet Volt Versus Speed", Proc. of SusTech, 2013.
- [2]. Taufik, K. Liang, and M. Taufik, "Design and Simulation of DC Light Bulb for DC House", Proc. of 2013 PIPS, May 2013.
- [3]. Taufik, D. Dolan, "WIP: Enhancing Students' Learning in Introductory Power Electronic Course Using an LED Driver Project", Proc. of 2013 ASEE-PSW Conference, April 2013.
- [4]. M. Taufik, A. Soriano, E. Loza, Taufik, and Soeprapto, "Steady-State Analysis of Step-Down Charge Pump", Proc. of 2012 MICEEI, December 2012.
- [5]. M. Taufik, C. Arntzen, G. Chavoor, Taufik, and S. Sidopekso, "Analysis of Flyback Current-Fed Push-Pull DC-DC Converter", Proc. of 2012 MICEEI, December 2012.
- [6]. M. Taufik, D. Gonzalez, R. Baake, and Taufik, "Steady-State Analysis of Step-Down Charge Pump", Proc. of 2012 MICEEI, December 2012.
- [7]. Taufik, Soeprapto, S. Sidopekso, M. Taufik, "A Comparison of Multiple Boost Configurations for Small Renewable Energy Battery Storage Systems", Proc. of 2012 International Conference on Sustainable Energy Engineering and Applications, November 2012.
- [8]. Soeprapto, Taufik, S. Sidopekso, M. Taufik, "The DC House Project for Sustainable Rural Electrification", Proc. of 2012 International Conference on Sustainable Energy Engineering and Applications, November 2012.
- [9]. M. Taufik, Taufik, J. Thornton, "Piezoelectric Wind Energy Harvesting for Small Scale Systems", Proc. of 2012 International Conference on Sustainable Energy Engineering and Applications, November 2012.

- [10]. A. Amin , S. Sidopekso, and Taufik, "Studi Rancang Bangun Portable Nano-Hydro Sebagai Alternatif Sumber Pembangkit Energi Listrik", (In Indonesian) Seminar Nasional Teknik Mesin, Jakarta, October 2012.
- [11]. M. Taufik, Taufik, T. Wong, "Multiple-Input Single-Output Converter for Renewable Energy Sources", Proc. of IEEE Symposium on Industrial Electronics & Applications, September 2012.
- [12]. Taufik, S. McClusky, J. Paolucci, and D. Dolan, "A Robust PWM Inverter for DC Power Supply", Proc.of 2012 North American Power Symposium, September 2012.
- [13]. C. Grasberger, D. Dolan, and Taufik, "Development of an Open-Source High-Performance Battery Management System", Proc.of 2012 North American Power Symposium, September 2012.
- [14]. S. Leonard, D. Dolan, K. Zombro, and Taufik, "A Low Cost Portable Parabolic Solar Concentrator for Combined Heat and Power", Proc.of 2012 North American Power Symposium, September 2012.
- [15]. D. Dolan, L. Friedman, J. Huff, and Taufik, "Solar Trainer for Photovoltaic Systems Education", Proc.of 2012 North American Power Symposium, September 2012.
- [16]. P. Suharmanto, S. Sidopekso, and Taufik, "Pengaruh Jumlah Sudu Terhadap Daya Output Turbin Angin Bersumbu Horizontal Diameter 1.6 Meter Sebagai Sumber Penyedia Listrik DC Pada DC House", (In Indonesian) Proc. of National Seminar in Physics, Surabaya, September 2012.
- [17]. Taufik, "DC House Project for Sustainable Rural Electrification", Proc. of ETBKE Conference and Exhibition, July 2012.
- [18]. Erna I., Puji S., Satwiko S., Setiadi N., Taufik, "DC House as A Solution of Electrical System Distribution for Rural Areas in Indonesia", Proc. of ETBKE Conference and Exhibition, July 2012.
- [19]. Taufik, M. Taufik, "The DC House Project: Promoting the Use of Renewable Energy for Rural Electrification", The International Conference on Power Engineering and Renewable Energy, July 2012.
- [20]. Taufik, J. Thornton, M. Taufik, "Small-Scale Wind Energy Harvesting Using Piezoelectric Converter", The International Conference on Power Engineering and Renewable Energy, July 2012.

3) Short Courses, Conference & Special Institute Attended

- [1]. "Getting Scholarships for Graduate Studies in the U.S.", Guest Lecturer, Universitas Bakrie, May 2013.
- [2]. "Recent Status and Challenges of the DC House Project for Rural Electrification", Guest Lecturer, Surya University, May 2013.
- [3]. "Recent Status and Challenges of the DC House Project for Rural Electrification", Guest Lecturer, Universitas Muhammadiyah Malang, May 2013.
- [4]. "Smart House for a Smarter Grid: An Electrical Engineering Perspective", Guest Lecturer, Politeknik Negeri Malang, May 2013.
- [5]. "Recent Status and Challenges of the DC House Project for Rural Electrification", Invited Speaker, Padjadjaran International Physics Symposium, May 2013.

- [6]. "DC House Project for Sustainable Rural Electrification", Panelist at the EBTKE Conference and Exhibition, Jakarta Convention Center, July 2012.
- [7]. "DC House Untuk Akses Listrik di Pedalaman dan Beasiswa Kuliah Di Amerika Serikat", Guest Lecturer, Universitas Trunojoyo Madura, July 2012.
- [8]. "DC House Untuk Akses Listrik di Pedalaman dan Pengalaman Studi di Amerika Serikat", Guest Lecturer, Universitas Brawijaya Malang, July 2012.
- [9]. "DC House Untuk Akses Listrik di Pedalaman", Panggung Inovasi, Ikatan Ilmuwan Indonesia Internasional, Aula RRI, July 2012.

4) Cash and Equipment Grants

- Equipment Donation, Schweitzer Electric Lab, \$160K
 - SEL donated four different types of equipmt.
 - 8 SEL311L for Transmission line protection
 - 8 SEL587 for Transformer protection
 - 1 SEL387 for Transformer protection
 - 8 SEL710 for motor protection
 - 8 SEL4000 for relay testing
- Total Alumni gifts \$ 2,835.50

5) Summer and Permanent Job Program

EPI seeks and assists students in acquiring summer and full-time positions whenever possible. Professors Shaban and Taufik obtained summer employment with San Diego Gas and Electric from June 2013 to September 2013.

6) Theses and Senior Projects

The following is a list of Master's theses funded by the Institute:

Kevin Wong	Multiple Input Single Output (MISO) Tablet/Phone Charger
Robert Baake	A Flyback Inverter Topology Without Electrolytic Input Capacitors As Energy Storage Element
Ben Johnson	Modeling and Analysis of a PV Grid-Tied Smart Inverter's Support Functions
Timothy Haskell	Modeling and Analysis of a Dynamic Voltage Regulator
Harpreet Bassi	Design and Modeling of Centralized Distribution Network for the DC House Project

Austin Luan	Bidirectional Flyback DC-DC Converter for the DC House Project
Abesh Mubarak	Impact of Photovoltaic System Penetration on the Operation of Voltage Regulator Equipment
Marvin Macairan	Design of Portable DC Light Bulb for the DC House Project

The following is a list of Senior Projects funded partially by the Institute:

Juan Avelar, Juan Galindo, and Juan Ramos	Swing Human Powered Generator for the DC House Project
Randy Lormand and Christopher Goloskie	Wind and Hydroelectric Power Simulation for the DC House Project
Daniel Barnicle and Dario Romero	Merry-Go-Round Human Powered Generator
Nolan Joksche	Design of Improved Distribution Panel for the DC House

7) Club Activities

Professor Dolan is the advisor for the Cal Poly Chapter of the Power and Energy Society (PES). Scott Leonard was the president of the Power and Energy Society during 2012-2013. The club holds bimonthly meetings, arranges industry field trips, and brings in industry speakers for seminars. They made field trips to Pacific Gas & Electric and San Diego Gas and Electric Company. They arranged info sessions for companies offering summer internships and employment. EPI has contributed to the Power Engineering Society Club activities.

INSTITUTE PLANS

Much of the work of the Institute is ongoing and will continue in its present form. Specific plans for the upcoming year are indicated below:

1. **Power Engineering Conference and Seminars**

EPI continues to sponsor the annual power conference at Cal Poly and professional seminars for students and faculty on various topics of power engineering. Seminars will be held once each quarter during the normal academic year. Guest seminar speakers will be invited from sponsoring companies and the power industry in general. Whenever possible, we seek to include Cal Poly alumni who have been working in the field for several years. These speakers provide special insight for current Cal Poly students.

2. **Sustainable Energy Laboratory.**

The Institute will continue to support the development of Sustainable Energy Laboratory located in 20-150.

3. **Professional Development**

As part of our continuing effort in the area of professional development, the Institute supports faculty attendance at short courses, special institutes, and conferences.

4. **Sustainable Engineering**

EPI continues to support senior projects, master theses, and research efforts related to sustainable energy.

5. **Financial Support**

We will continue to solicit support for the Institute from the power industry. Support will be requested for both the ongoing program of the Institute and for assistantships for graduate students and senior projects.

FINANCIAL STATEMENT

The following financial statement for June 30, 2013 is a reflection of the 2012-2013 operating statement prepared for EPI by the Cal Poly Foundation:

BEGINNING BALANCE		90,913.80
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INCOME	Income (Gifts)	2,835.50
	TOTAL INCOME	2,835.50
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EXPENSES	Operational Expense	940.63
	Sustainable Energy Lab	4,867.09
	Power Electronic Lab	600.00
	Power Electronic Project	913.92
	Meetings	382.37
	SDGE Smart Grid	1,483.16
	Travel Expense	1,419.14
	TOTAL EXPENSES	10,631.61
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REMAINING BALANCE		83,117.69
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PROJECTED BUDGET FOR AY 2013-2014

INCOME	Industry and Individual Gifts	15,000.00
	TOTAL INCOME	15,000.00
EXPENSES	Administrative Support Services	2,000.00
	Benefits	500.00
	Operational Expenses	1000.00
	Project Equipment	10,000.00
	Travel Expenses	3,000.00
	Seminar/Short Courses	3,000.00
	SUBTOTAL	19,500.00
	Corporation Fiscal Charges	500.00
	TOTAL EXPENSES	20,000.00