



47th ANNUAL REPORT

TAUFIK
Director of Electric Power Institute
Professor of Electrical Engineering

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LETTER FROM DIRECTOR

Greetings,

This document contains Electric Power Institute's annual report at Cal Poly State University covering the academic year 2017 – 2018.

EPI has the mission to develop the best possible educational research and service in the area of power and energy systems, renewable 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.

EPI continued and will continue to support the “Advanced Power System Initiatives” to modernize the power engineering program curriculum in the electrical engineering department. This past year, EPI received equipment donations from several companies that will directly support the initiatives. Partnering with the Power and Energy Students club, EPI hosted several technical seminars and presentations in power engineering related fields.

EPI will continue the commitment to support the power program at Cal Poly through active involvement with students, faculty, and the power industry. Thank you very much for your time and attention.

Sincerely yours,

A handwritten signature in black ink, appearing to be 'Taufik', with a stylized, overlapping loop and a long horizontal stroke extending to the right.

Taufik
Director of Electric Power Institute
Professor of Electrical Engineering
taufik@calpoly.edu

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 a liaison 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 Engineering.

Throughout the Electric Power Institute's long years of existence, many companies and alumnus have supported its activities. This support comes in the form of financial contributions, workshop 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.

This 47th EPI Annual Report primarily summarizes the Institute's activities for the 2017-2018 academic year. A projection of activities and budget for the 2018-2019 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 and the Interim Vice President for Research and Economic Development. 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

Taufik, Professor, Electrical Engineering Department

Advisory Boards

In prior years, EPI has the following advisory board members. However, their memberships have not yet been renewed. Therefore, for this past academic year EPI has not appointed an advisory board. Since the organization document for EPI is old and outdated, I further intend to revise the document this academic year with the consultation and approval from the College of Engineering Dean's office, which include the policy on the formation of the advisory board memberships.

Electrical Engineering Department

Ali Shaban, Professor, Electrical Engineering Department

Ahmad Nafisi, Professor, Electrical Engineering Department

Non-University

Laurence Abcede, Engineering Manager, San Diego Gas and Electric

Daniel Spaizman, Engineer II, San Diego Gas and Electric

Members of the Electric Power Institute

Electrical Engineering Department

Bill Ahlgren

Dale Dolan

Ali Banadaki

Helen Yu

Majid Poshtan

Ahmad Nafisi

Ali Shaban

Administrative Assistant

2017 – 2018: Samuel Lopez

INSTITUTE ACTIVITIES

1) Seminars

As part of the Institute's continuing education program, the Institute brings industry to campus to provide professional seminars for students and faculty held at Cal Poly. Below are the seminars sponsored by the EPI in AY 2017-2018:

SEL Digital Relay, 2/8/18 – 2/9/18 **Building 20-101, 8:00 am – 4:00 pm**

Instructors:

1. Tom McQuilken, P.E.
Application Engineer I – Protection, Schweitzer Engineering Laboratories
2. Robin Jenkins
Senior Application Engineer – Automation, Schweitzer Engineering Laboratories

This course was fully funded by Pacific Gas and Electric for the amount of \$5400 to allow 6 faculty and 6 students to enroll and participate in the class.



Wind Energy + Storage for Commercial and Agricultural Applications

Building 20A, 4/21/2018, 9:00 am to 4:30 pm

Instructors:

1. Paul Gipe, Wind-Works
2. Ron Ishii, AESC

This seminar was co-hosted by the PG&E Pacific Energy Center. A total of 50 people attended the seminar.



2) Outreach Event

Boys & Girls Club of South San Luis Obispo County
Oceano Teen Center, 1830 19th Street, Oceano
 10/27/2018, 4 pm – 5 pm



3) Summer and Permanent Job Program

EPI seeks and assists students in acquiring summer and full-time positions whenever possible. Professor Taufik obtained summer employment with San Diego Gas and Electric from June 2018 to September 2018.

4) Publications

- Taufik and Rosmaliati, "Characterization of DC Arc Fault Currents in Low Voltage Residential Electricity", Proc. of International Conference on Applied Electromagnetic Technology, April 2018.

- M. Poshtan, "Two Experiments in Adopting Computer-Aided Learning in Engineering"; Accepted for ASEE-PSW Conference, the University of Colorado at Boulder, Boulder, Colorado March 25-27, 2018
- E. Osborn, A. Shaban, and Taufik, "Development of Laboratory Experiments for Protection and Automation in Microgrid Power Systems", Proc. of American Society for Engineering Education Zone IV Conference, March 2018.
- Safia B. Bahir, Abdul R Beig, M. Poshtan "New Multi-Modular Converter to Connect PV Systems to AC Power Systems", International Journal of Renewable Energy Research, Jan. 2018
- N. Ghanbari¹, H. Golzari, H. Mokhtari, M. Poshtan, "Reducing Active Power losses in Transmission lines by Allocation of Small Distributed Generators", International Journal of Renewable Energy Research, Jan. 2018
- A. Abubakar, A. Ponniran, and Taufik, "Simulation and Analysis of Multiphase Boost Converter with Soft-Switching for Renewable Energy Application", International Journal of Power Electronics and Drive Systems, Vol. 8, No. 4, December 2017.
- Taufik, "Research Experience on the DC House Project for Rural Electrification", Proc. of International Conference on Computational Science and Computational Intelligence - Symposium on Education, December 2017.
- N. Ghanbari¹, H. Golzari, H. Mokhtari, M. Poshtan; "Optimum Location for Operation of Small Size Distributed Generators" ICRERA 2017, San Diego, USA, Nov. 5, 2017
- Safia B. Bahir, Abdul R Beig, Majid Poshtan "An Improved Space Vector PWM for Grid-Connected MMC", ICRERA 2017, San Diego, USA, Nov. 5, 2017
- M. Taufik, Taufik, and B. Stafford, "Comparison of AC and DC LED Light Bulb Efficiency for Residential Electricity", Proc. of International Symposium on Materials and Electrical Engineering (ISMEE), November 2017.
- Taufik, A. Tjahjono, "A Flyback Inverter Without Input Electrolytic Capacitor", Proc. of International Electronics Symposium (IES), September 2017.
- Taufik, Rosmaliati, and M. Taufik, "Performance Analysis of Multiple Input Boost Converter with Inherent OR Diode Configuration", Proc. of 18th International Seminar on Intelligent Technology and Its Application, August 2017.
- Taufik, C. Aarstad, A. Kean, "Arc Fault Characterization System for the Low Voltage DC Arc Fault Circuit Interrupter", Proc. of International Conference on Systems Engineering, August 2017.
- A. Afarulrazi, M. Wahyu, A. Ponniran, and Taufik, "Simulation and Analysis of Multiphase Boost Converter with Soft-Switching for Renewable Energy Application", Proc. of International Conference on Systems Engineering, August 2017.
- Taufik. A. Mubarak, M. Wahyu, and A. Afarulrazi, "Impact of Photovoltaic System Penetration on the Operation of Voltage Regulator Equipment", Proc. of International Conference on Engineering Application, Physics, and Sciences, July 2017.
- Taufik, Z. Eldredge, Z. Hay, "A Single Board Buck and Boost Bidirectional DC-DC Converter for DC House Energy Management System", Proc. of the 2017 International Conference on Technology and Applications, July 2017.
- Taufik, A. Luan, "Bidirectional Flyback DC-DC Converter for the DC House Project", Proc. of the 2017 International Conference on Technology and Applications, July 2017.

- A. Tjahjono, D. O. Anggriawan, A. K. Faizin, A. Priyadi, M. Pujiانتارا, Taufik, and M. H. Purnomo, "Adaptive modified firefly algorithm for optimal coordination of overcurrent relays", IET Generation, Transmission & Distribution, Vol. 11 Iss. 10, pp. 2575-2585, July 2017.

5) Short Courses and Conferences Attended

- Keynote Speaker, International Conference on Technology and Applications, Universitas Bhayangkara, Surabaya, July 2017.
- Lecture, Short Course on Introduction to Magnetic Design, Politeknik Negeri Malang, July 2017.
- Guest Speaker, "The DC House Project for Rural Electrification", Institut Teknologi Nasional, Malang, July 2017.
- Guest Speaker, "The DC House Project for Rural Electrification", Universitas Indonesia, July 2017.
- Guest Speaker, "The DC House Project for Rural Electrification", Universitas Cokroaminoto Makassar, July 2017.
- Guest Speaker, "The DC House Project for Rural Electrification", Syarikat Islam, Jakarta, June 2017.
- Visiting Professor, Electrical Engineering Department, Universitas Padjadjaran, Jatinangor, August 2016.
- Guest Speaker, "Cal Poly at a Glance", Universitas Pendidikan Indonesia, Bandung, August 2016.
- Guest Speaker, "The DC House Project as an Alternate Solution to Rural Electrification", Universitas Pertamina, Jakarta, August 2016.
- Keynote Speaker, "Intelligent Systems in DC House for Residential Electricity", International Seminar on Application for Technology of Information and Communication Science and Technology, Semarang, August 2016.
- Invited Lecture, "Seminar on How to Write a Successful Paper", Universitas Muhammadiyah Yogyakarta, August 2016.
- Keynote Speaker, "Residential Electricity the DC House Way: Progresses, Challenges, and Opportunities", the 6th International Annual Engineering Seminar, Yogyakarta, August 2016.

6) Cash Donations

- Total Alumni cash donation \$9,380.86
- Total Company cash donation \$23,100.00

7) Equipment Donations

- 6 units of GE Multilin 369 Relays from Aera Energy
- 8 units of Low Dropout Regulators from Texas Instruments
- 8 units of Buck Regulators from Texas Instruments
- 8 units of Boost Regulators from Texas Instruments
- 8 units of Buck-Boost Regulators from Texas Instruments
- 8 units of Synchronous Buck Converters from Monolithic Power Systems
- Power System Digital Relays from Schweitzer Electric Laboratory

8) Grants

- Power Quality Monitoring and Protection System of Adjustable Speed Drives, R-IDC College of Engineering, Cal Poly, \$4,600
- Performance Analysis and Study of a Novel Voltage Regulator Module for Powering Modern Processors, Summer 2018 College of Engineering Summer Undergraduate Research Program (SURP), \$8,000
- Battery Energy Storage System for Building 20 Microgrid, Chevron, \$10,000
- AC LED Direct Drive Circuit Modeling and Simulation, SLOANLED, \$2,500
- Reducing Residential Electrical Energy Consumption with Hybrid DC and AC Electrical System Using Multiple-Input Single-Output Power Converter, Summer 2017 College of Engineering Summer Undergraduate Research Program (SURP), \$8,000

9) MS Theses

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

Student's Name	MS Thesis Title
Richard Liu	Smart DC Wall Plug for the DC House Project
Matthew Guevara	Modeling and Analysis of Cal Poly Microgrid
Zoe Hay	A Modified Multiphase Boost Converter with Reduced Input Current Ripple: Split Inductance and Capacitance Configuration
Zack Eldredge	The Modified Multiphase Boost Converter: Combined Inductors and Capacitors Topology
Omri Nissan	A Multiphase Modified Boost Converter with Reduced Input Current Ripple: Combined Capacitors
Calin Bukur	A Fully Solid-State DC Circuit Breaker
Kevin Hua	Analysis and Study of Power System Design for Same Polytechnic College in Tanzania
Ariel Montoya	Protection Against Ungrounded Single Phase Open Circuit Faults in 3-Phase Distribution Transformers
Eric Osborn	Protection, Automation, and Frequency Stability Analysis of A Laboratory Microgrid System

10) Visiting Scholar and International Student Visitors

- Rosmaliati

Ms. Rosmaliati came to Cal Poly in Fall 2017 as a Visiting Scholar to work with Professor Taufik for 2 month. Ms. Rosmaliati is a Ph.D. student at Institut Teknologi Sepuluh Nopember in Surabaya, Indonesia. Her research work dealt with the real time monitoring system of Power Transformers.

- **Jirapat Boontum and Sucheewa Srisuchat**

In Spring 2018, two electrical engineering undergraduate students from Rajamangala University of Technology in Thailand came to Cal Poly as an interns to conduct projects with Professor Taufik for 3 months. Their project was entitled: Harmonic Power Quality Study and Testing of Adjustable Speed Drives Using SEL-735. It was a successful project, which fulfilled their course requirement at their home university.

11) Club Activities

Professor Taufik is the advisor for the Cal Poly Chapter of the Power and Energy Society (PES) with Kyle Tom as the president of the club for AY 2017-2018. The club holds bimonthly meetings, arranges industry field trips, and brings in industry speakers for seminars. They made field trips to several companies including Pacific Gas & Electric Technology Center, LADWP Sylmar HVDC substation, Tesla Factory, and Monolithic Power Systems. 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 were completed in AY17-18 with some are still ongoing and will continue in its present form. Specific plans for the upcoming year are indicated below:

1. **Power Engineering Presentations and Seminars**

EPI continues to host professional power engineering 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. **Power Laboratories.**

The Institute will continue to support the development of several power laboratories, which include the Industry & Automation Lab, the relays lab, the microgrid lab, and the lighting lab.

3. **Professional Development**

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

4. **Student Projects**

EPI continues to support senior projects, master theses, and research efforts related to power systems, renewable energy, and power electronics.

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 sponsored projects for graduate students and senior projects.

FINANCIAL STATEMENT

The following financial statement is a reflection of the 2017-2018 operating statement of EPI as provided by the Cal Poly Corporation:

BEGINNING BALANCE			\$ 75,474.95
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INCOME	Donation – Companies	23,100.00	
	Donation – Individuals	9,380.00	
	TOTAL INCOME		\$32,480.86
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EXPENSES	Operational Expense	3,949.50	
	Sustainable Energy Lab	0	
	Power Electronic Lab	890.63	
	Power Electronic Project	1,056.57	
	Meetings	167.48	
	Salary	0	
	Travel Expense	559.62	
	TOTAL EXPENSES		\$10,045.99
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REMAINING BALANCE			\$98,077.28
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PROJECTED BUDGET FOR AY 2018-2019

INCOME	Industry and Individual Gifts	\$20,000.00
	TOTAL INCOME	\$20,000.00
EXPENSES	Administrative Support Services	750.00
	Benefits	750.00
	Operational Expenses	2,000.00
	Equipment	5,000.00
	Travel Expenses	5,000.00
	Seminar/Short Courses	5,000.00
	SUBTOTAL	18,500.00
	Corporation Fiscal Charges	1,500.00
	TOTAL EXPENSES	\$20,000.00