



48th ANNUAL REPORT

TAUFIK
Director of Electric Power Institute
Professor of Electrical Engineering

Table of Contents

LETTER FROM DIRECTOR	2
INTRODUCTION	3
ORGANIZATION	4
Director	4
Advisory Boards	4
Members of the Electric Power Institute	4
INSTITUTE ACTIVITIES	5
1) Seminars & Workshops	5
2) Summer and Permanent Job Program	6
3) Conference Paper Publications	6
4) Journal Publications	7
5) Short Courses and Conferences Attended	7
6) Cash Donations	8
7) Equipment Donations	8
8) Grants	8
9) MS Theses	8
10) Visiting Scholar and International Student Visitors	9
11) Club Activities	10
INSTITUTE PLANS	11
FINANCIAL STATEMENT	12
PROJECTED BUDGET FOR AY 2019-2020	13

LETTER FROM DIRECTOR

Greetings,

This document contains Electric Power Institute's annual report at Cal Poly State University covering the academic year 2018 – 2019.

EPI has the mission to develop the best possible educational research and services in the area of power system, renewable energy, and power electronics. The EPI faculty initiates and carries out an expanded program of undergraduate 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 alumni 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 48th EPI Annual Report primarily summarizes the Institute's activities for the 2018-2019 academic year. A projection of activities and budget for the 2019-2020 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

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

Jeff Wilkinson, Procurement & Obsolescence Engineering, Pacific Gas & Electric

Members of the Electric Power Institute

Electrical Engineering Department

Bill Ahlgren

Dale Dolan

Ali Deghan Banadaki

Helen Yu

Majid Poshtan

Joseph Callenes-Sloan

Ahmad Nafisi

Ali Shaban

Faculty At Large

Tali Freed

Andrew Kean

Administrative Assistant

2019 – 2020: Erin O'rourke

INSTITUTE ACTIVITIES

1) Seminars & Workshops

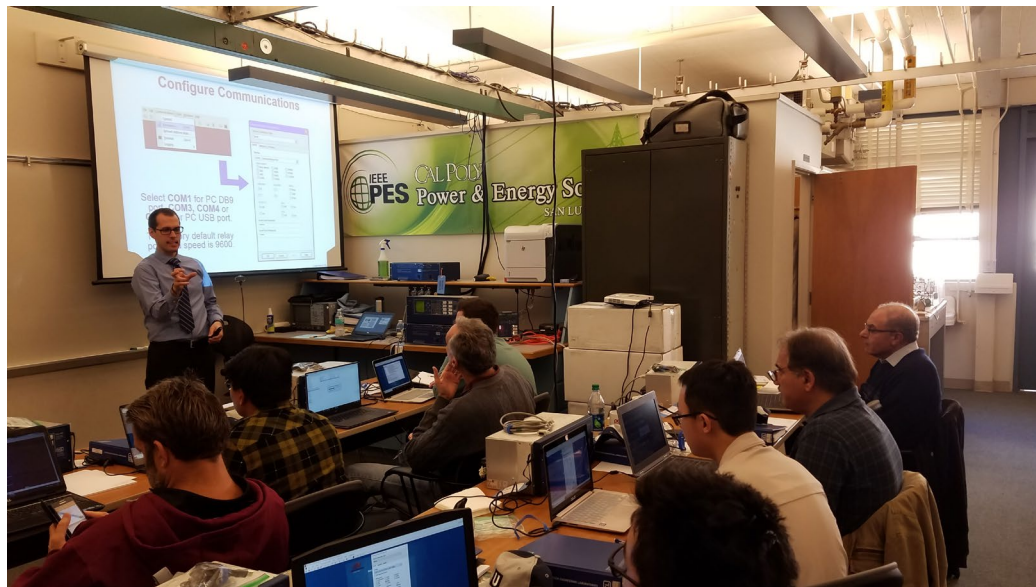
As part of the Institute's continuing education program, the Institute brings industry to campus to provide professional seminars for students and faculty held at Cal Poly. Below are the seminars sponsored by the EPI in AY 2018-2019:

SEL Digital Relay, 1/31/19 – 2/1/19 **Building 20-101, 8:00 am – 4:00 pm**

Instructors:

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

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



Hands-on Power Electronics Workshop for First Year EE Students

Building 20-136, 11/9/2018, 9:00 am to 12:00 pm

Instructor:

- Mark Thoren, Analog Devices

Hands-on Power Electronics Workshop for Senior EE Students

Building 20-130, 5/17/2019, 9:00 am to 12:00 pm

Instructors:

- Mark Thoren, Analog Devices
- Eric Horsma, Analog Devices



GaN Technology and Magnetic Design

Building 20-136, 4/12/2019, 10:00 am to 12:00 pm

Instructors:

- Paul Gipe, Texas Instruments
- Ron Ishii, Texas Instrument
- Quentin Payan, Wurth Elektronik

2) Summer and Permanent Job Program

EPI seeks and assists students in acquiring summer and full-time positions whenever possible. Professors Ali Shaban and Taufik obtained summer employment with San Diego Gas and Electric from June 2019 to September 2019.

3) Conference Paper Publications

- O. Setyawati, Taufik, and A. Satriya, "Energy Harvesting System with Multiple Inputs", Proc. of International Conference on Smart Power & Internet Energy Systems, April 2019.
- Taufik, R. Hasanah, and O. Setyawati, "Impact of transformer's leakage inductance on duty cycle in isolated dc-dc converters", Proc. of International Conference on Smart Power & Internet Energy Systems, April 2019.
- Taufik, R. Halbach, C. Cross, and M. Poshtan, "Development of Versatile Buck Converter Module for Laboratory Experiment in Power Electronic Course", Proc. of 2019 ASEE PSW Conference.
- Soeprapto, R. Hasanah, and Taufik, "Battery Management System on Electric Bike using Lithium-Ion 18650", Proc. of 2019 International Conference on Engineering and Computing.
- M. Head, Taufik, O. Setyawati, A. Satriya, "Flexible Computer Simulation for Power Loss Analysis of Direct AC LED Drive Systems", Proc. of 5th Annual Conference on Computational Science & Computational Intelligence.

- A. Satriya, O. Setyawati, Taufik, "Method of Moment Analysis of Truncation Number in a Homogeneous Spheroid Model", Proc. of 5th Annual Conference on Computational Science & Computational Intelligence.
- A. Banadaki, Taufik, A. Feliachi, "Big Data Analytics in a Day-Ahead Price Forecasting Using TensorFlow in Restructured Power Systems", Proc. of 5th Annual Conference on Computational Science & Computational Intelligence.
- Taufik, and R. Hasanah, "Light Sensing Smart Blinds", Proc. of 2018 Electrical Power, Electronics, Communications, Controls and Informatics Seminar, October 2018.
- Taufik, W. Xiong, J. Sato and Saidah, "Ambient Light Adaptive LED Light Dimmer", Proc. of 2018 1st International Conference and Workshop on Telecommunication, Computing, Electronics and Control, September 2018.
- R. Hasanah, Y. D. Handari, Soeprapto, and Taufik, "LED-Lamp Design for Renewable Energy-Based DC House Application", Proc. of 12th International Power Engineering, Optimization and Computing Conference, July 2018.

4) Journal Publications

- M. D. Surindra, W. Caesarendra, T. Prasetyo, T. M. Mahlia, and Taufik, "Comparison of the Utilization of 110° C Heat Sources in a Geothermal Energy System Using Organic Rankine Cycle (ORC) with R245fa, R123, and Mixed-Ratio Fluids as Working Fluids", Modeling and Simulation of Energy Systems, Special Issue, June 2019.
- A. Abubakar, W. Utomo, Taufik, and A. Ponniran, "Modelling of FPGA and DSP-based Pulse-Width Modulation for Multi-Input Interleaved Dc/dc Converter", International Review of Electrical Engineering (I.R.E.E.), Vol. 14, N. 1, April 2019.
- M. Surindra, W. Caesarendra, T. Prasetyo, T. Mahlia, and Taufik, "Comparison of the Utilization of 110C and 120C Heat Sources in a Geothermal Energy System Using Organic Rankine Cycle (ORC) with R245fa, R123, and Mixed-Ratio Fluids as Working Fluids", Processes, Vol. 7, Issue 2, February 2019.
- Taufik, W. Xiong, J. Sato and Saidah, "Ambient Light Adaptive LED Light Dimmer", TELKOMNIKA Telecommunication, Computing, Electronics and Controls.
- J. N. Jumadri, W. Utomo, A. Ponniran, A. A. Bakar, E. Sulaiman, and Taufik, "Harmonic Current Reduction Using Soft-Switching Active Power Filter", Advanced Science Letters, Volume 24, Number 12, pp. 9203-9208(6), December 2018.
- R. Hasanah, Y. D. Handari, Soeprapto, and Taufik, "LED-Lamp Design for Renewable Energy-Based DC House Application", International Journal of Power Electronics and Drive Systems, Vol 9, No 3, September 2018.
- R. I. Putri, I. Mahmudi, M. Pujiantara, A. Priyadi, Taufik, M. H. Purnomo, "Modified Firefly Algorithm for Improved Maximum Power Extraction on Wind Energy Conversion System", International Journal of Renewable Energy Research, Vol. 8, No. 3, September 2018.
- W. Utomo, A. Abubakar, S. Alias, S. Yi, M. Setiawan, S. Mudjanarko, A. Sukoco, Y. Buswig, Taufik, "Modeling of A Single Phase 7-Level Cascaded H-Bridge Multilevel Inverter", International Journal of Engineering & Technology, Vol. 7, No. 2.6., 2018.

5) Short Courses and Conferences Attended

- Taufik, Guest Speaker on Technical Seminar, "Harmonics in Power Systems", PGE Diablo Canyon, October 2018.

- Taufik, Guest Speaker, "DC Electricity" and "ABET Accreditation", Politeknik Elektronika Negeri Surabaya, Indonesia, September 2018.
- Taufik, Presenter of Tech Talk, "Harmonics in Power Systems", Distributed Energy Resources, San Diego Gas & Electric, August 2018.

6) Cash Donations

- Total Alumni cash donation \$6,858.24
- Total Company cash donation \$18,932.95

7) Equipment Donations

- SIMPLIS software from Maxim Integrated, Inc.
- Omicron Relay Tester, Omicron.
- Magnetic Components, Wurth Elektronik
- 6 units of PLCs, Schneider Electric

8) Grants

- (Taufik, Poshtan) Power Quality Monitoring and Protection System of Adjustable Speed Drives, R-IDC College of Engineering, Cal Poly, \$4,600
- (Taufik) 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
- (Dolan) Design and Development of Laboratory Dual Axis Single PV Module Tracker, Summer 2018 College of Engineering Summer Undergraduate Research Program (SURP), \$8,000
- (Dolan) Design and Development of PV Emulator, Summer 2018 College of Engineering Summer Undergraduate Research Program (SURP), \$8,000
- (Callenes-Sloan) Cyber-Security Attack Models and Algorithmic Approaches for Protecting Critical Infrastructure, Summer 2018 College of Engineering Summer Undergraduate Research Program (SURP), \$8,000
- (Taufik) Battery Energy Storage System for Building 20 Microgrid, Chevron, \$10,000
- (Taufik) AC LED Direct Drive Circuit Modeling and Simulation, SLOANLED, \$2,500
- (Taufik) SEL Relay Two-Day Workshop, Chevron \$5400
- (Taufik) Southern California Edison, \$1,800
- (Taufik) Monolithic Power Systems, \$1,000

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

- **Onny Setyawati**

Dr. Setyawati visited Cal Poly in Fall 2018 as a Fulbright Scholar to work with Professor Taufik for 3 months. She is a faculty member in the electrical engineering department at Universitas Brawijaya, Indonesia. Her research while at Cal Poly dealt with Energy Harvesting system for Wireless Sensor Network.

- **Alfredo Satriya**

Mr. Satriya came to Cal Poly to conduct research for 2 months as a Islamic Development Bank Scholar. He works a faculty member in the electrical engineering department at Universitas Negeri Jember, Indonesia. He conducted research on electromagnetic sensor for biomedical application.



11) Club Activities

Professor Taufik is the advisor for the Cal Poly Chapter of the Power and Energy Society (PES) with Jacob Butler as the president of the club for AY 2018-2019. 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, Tesla Factory, and San Diego Gas & Electric. 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 AY18-19 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 2018-2019 operating statement of EPI as provided by the Cal Poly Corporation:

BEGINNING BALANCE			\$ 97,683.20
<hr/>			
INCOME	Donation – Companies	18,932.95	
	Donation – Individuals	6,858.24	
	TOTAL INCOME		\$25,791.19
<hr/>			
EXPENSES	Operational Expense	2,003.22	
	Power Labs	5400.00	
	Power Project	492.60	
	Meetings	154.48	
	Salary	0	
	Travel Expense	203.13	
	TOTAL EXPENSES		\$17,964.04
<hr/>			
REMAINING BALANCE			\$105,510.35
<hr/>			

PROJECTED BUDGET FOR AY 2019-2020

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