

Power System Analysis Skills for Engineers and Technicians

Learn skills such as per-unit calculations, symmetrical components, and fault calculations to make you more effective in your job.

Manila, Philippines | 30th May – 1st June 2018



"RALPH FEHR'S UNIQUE PRESENTATION OF THE SUBJECT MATERIAL CUTS THROUGH THE THEORETICAL AND GIVES THE STUDENT AN UNDERSTANDING BASED ON THE CONCEPTS UNDERLYING THE EQUATIONS"
Senior Distribution Engineer, Utility

"GREAT JOB OF FILLING IN THE GAPS AND CLARIFYING AND EXPLAINING 'SO CALLED' ABSTRACT CONCEPTS. I liked the emphasis on conceptual thinking versus number crunching
Electrical Engineer, Consulting firm

"The instructor was great. Very good presentations. Very relevant information."
Associate Engineer, Natural Gas Company

"New knowledge regarding the fault calculations methods."
Engineer – Protection Section

Good conceptualization of derivation (mathematical)
Engineer – Planning Transmission

"Detail Explanation on the concept of the power system."
Engineer – Electrical Maintenance

Power System Analysis skills for Engineers and Technicians

(3 Days)

Power system engineers and technicians must know how to apply several analytical tools to understand and solve power system problems they regularly face on the job. Among the skills they need are basic phasor algebra, the per-unit system, and symmetrical components. These tools are at the heart of solving power system problems involving balanced and unbalanced loads and faults, and all power system engineers and technicians should be familiar with them.

Topics will begin at the fundamentals level and move to more advanced content as the course progresses. Prerequisites include a basic understanding of vector algebra and a familiarity with the voltage, current, watt, var, and phase angle measurement terms used in three-phase power systems.

There will be massive focus on topics like representation and modeling of three-phase systems, voltage drop calculations, symmetrical components and sequence networks. Fault calculation is a major topic as this topic is at the heart of protection studies and reliability improvement plans. **More emphasis will be given to allow solving of the important types of problems as well.**

MASTER the necessary knowledge and complexities of:

- Three-phase power calculations
- Phasor algebra
- The per-unit system for analyzing power systems
- Symmetrical components fundamentals and sequence networks
- Impedance and sequence network connections for system modeling
- Fault calculations for three-phase and unbalanced faults
- Open-phase fault calculations

Practical Involvement:

Classroom problem-solving sessions will give you the opportunity to apply your new skills and reinforce your learning. Bring a scientific calculator for classroom workshops that will show you how to create power system models and calculate fault currents.

Your calculator should have the capability to perform addition, subtraction, multiplication, and division of complex numbers in rectangular or polar form. The instructor recommends the Casio fx-115 series, since it is reasonably priced and easily performs all the necessary complex arithmetic functions required in the course.

- Three-phase power calculations
- Per-unit calculations
- Sequence network development
- Short-circuit fault calculations
- Open-circuit fault calculations

The trainer will cover a novel method of developing the sequence networks which virtually eliminates errors and assures proper calculated fault values.

This program is intended for:

This training course will be valuable to participants who work in the power industry from generator companies to transmission and distribution system operators. It is also valuable to engineers in building services where protection is applied to 25kV supply points and below to the LV distribution. Engineers working in oil and gas industry who are involved in electrical aspects of the industry such as HV & LV motors and electricity equipment will gain from the course. The methods / Skills covered in this course apply at all voltage, the trainer will target the examples to low and medium voltage so that people working in industrial capacities are familiar with the numbers. Utility, plant, or consulting engineers and technicians involved in transmission or distribution system protection, planning, operations, or engineering.

- Control and Protection technician
- Distribution Engineer.
- Engineer / Senior Engineer.
- Power Quality Engineer.
- Electrical Maintenance.
- Power System Manager.
- Reliability Engineer.
- System Protection Engineer.
- Engineers/technicians who want to improve reliability of the power system.
- Those who want to better understand symmetrical components.
- Those doing fault studies, maintaining computer fault study or power flow databases, or coordinating and setting overcurrent relays and fuses will especially benefit from this course.
- Experienced engineers will also benefit, particularly from the sequence network material.

Power System Analysis skills for Engineers and Technicians (3 Days)

DAY 1

Review of Phasors

- Phasor representation of voltage and current
- Phasor math
- Conversion to and from time domain

Review of Three-Phase Systems

- Phase Angle and Time Relationships

Delta and Wye Circuits

- Components of AC Power

Review of Per-Unit System

- Advantages of Per-Unit
- Definitions
- Base Quantities
- Changing Per-Unit Bases
- Per-Unit Transformer Impedance

DAY 2

Transformer Polarity and Phase Shift

- Additive and Subtractive Polarity

Analysis of the Delta-Wye Transformer

- Magnitude Change
- Leading versus lagging phase shift

Symmetrical Components

- Unbalanced Systems
- Development of the Symmetrical Components

DAY 3

Modeling of power system components

- Lines
- Transformers
- Rotating machines

Sequence Networks

- Sequence current behavior
- Sequence Network construction

Fault Calculations

- Short Circuit Faults
- Open Circuit Faults

Harmonics

- Causes and Effects
- Sequence Behavior of Harmonics
- Harmonic Mitigation



Energy1 is a sub-division of PETRO 1 focus on provide trainings & technical Consultancy services ranging from Revenue losses reduction, Maintenance & reliability, spares parts optimization, electrical & electronics and business related activities in the Energy & Utilities industry. We had successfully made impact to energy & utilities professional mainly the top players in the South East Asia Region.

- | | | |
|---|---------------------------------------|------------------------------|
| ▪ Metropolitan Waterworks Authority Thailand. | ▪ Star Energy Geothermal | • Sandisk Storage |
| ▪ Tenaga Nasional Berhad. | ▪ Perbadanan bekalan air pulau pinang | • Muehlbauer |
| ▪ San Fernando Electric Light & Power co, Inc | ▪ Aliran ihsan resources berhad | • Dominant OPTO Technologies |
| ▪ Sarawak Energy | ▪ Visayan Electrical company | • Finisar Malaysia |
| ▪ SP Powergrid Ltd. | ▪ Glow Company | • Sanmina System |
| ▪ Power Seraya | ▪ Suruhanjaya Tenaga | • Bose System |
| ▪ SMT Technologies | ▪ Indah Water Konsortium | • Amkor Technology |
| ▪ Electricity Generating Authority of Thailand. | ▪ Jimah O&M | • EDM Electronics |
| | ▪ Renesas Semiconductor | • AUO SUNPOWER |

Power System Analysis skills for Engineers and Technicians (3 Days)

Program Facilitator – Ralph Fehr, Ph.D., P.E.



Ralph's expertise

- 30 years of electric power engineering experience with 15 years of training experience in Southeast Asia.
- Transmission, Distribution, and Substation Planning – 500 kV, 230 kV, 138 kV, 115 kV, 69 kV, 46 kV, feeder planning and design.
- System Operations – operating studies, dispatcher training.
- Transmission Line Engineering – line routing, structure design, and design automation.
- Power Generation Engineering – Fossil and Nuclear – cable systems, voltage drop and short circuit calculations, annunciator design, balanced draft conversions

Ralph E. Fehr, PhD, PE, is an independent engineering consultant and instructor in power system engineering at the University of South Florida. He has more than 30 years of experience in the electric power industry and is a registered engineer in Florida and New Mexico. Fehr has held various positions in transmission and distribution engineering design, operations, planning, and maintenance at Tampa Electric Company, Florida Power Corporation, Public Service Company of New Mexico, the U.S. Air Force, and Gilbert/Commonwealth Engineers and Consultants.

He is an experienced instructor of university engineering courses and continuing education short courses. Fehr has written technical articles for EC&M magazine and is author of the textbook, *Industrial Power Distribution*. Fehr received a bachelor's degree in electrical engineering from the Pennsylvania State University, a master's degree in electrical power engineering from the University of Colorado at Boulder, and a Ph. D in electrical engineering from the University of South Florida.

Ralph's achievements and recognitions

Doctor of Philosophy – Electrical Engineering – University of South Florida at Tampa (2005)

Master of Engineering – Electrical Engineering (Power) – University of Colorado at Boulder (1987)

Bachelor of Science – Electrical Engineering – Pennsylvania State University (1983)

Institute of Electrical and Electronics Engineers (IEEE)

- Senior Member (1999), Member (1984), Student Member (1983)
- Power & Energy Society and Industry Applications Society member

IEEE Florida West Coast Section Engineer of the Year (2015)

IEEE Florida West Coast Section Power & Energy Society Outstanding Engineer (2014)

IEEE Region 3 Joseph M. Biedenbach Outstanding Engineering Educator (2011)

IEEE Florida Council Outstanding Engineering Educator (2009)

Transmission & Distribution World magazine Instructor of the Month (November 2008)

Authored *Industrial Power Distribution* (2nd Ed. – Wiley/IEEE Press, 2016; 1st Ed. – Pearson/Prentice Hall, 2002)

Dissertation: *An Integrated Optimal Design Method for Utility Power Distribution Systems* (2005)

Published papers: U.S., Thai Utilities Partner to Address Asset Health (2014)

Assessing & Improving Writing in the Engineering Curriculum (IJEE, 2008)

A Model Curriculum for Power Engineering (IEEE PES, 2008)

A High-Performance Distribution Substation Bus Topology (IASTED, 2004)

Magazine articles: Harmonics Made Simple – EC&M Magazine – January 2004

The Trouble with Capacitors – EC&M Magazine – December 2003 and January 2004

Back to Basics (monthly column) – EC&M Magazine – January - December 2003

Companies which have benefited from his expertise include:

Alliant Energy, American Superconductor, American Transmission Company, BP America, Inc., Conoco Phillips, Duke Energy, Eaton Corporation, Electricity Generating Authority of Thailand, Emerson Network Power, Hawaiian Electric Company, Idaho National Laboratory, John Deere and Company, Kenya Power and Lighting Company, Schlumberger, Schneider Electric, Southern California Edison, Taiwan Power Company, Tampa Electric Company, Tokyo Electric Company, Trane, Korea Electro-technology Research Institute, Lawrence Livermore National Laboratory, Metropolitan Electricity Authority of Thailand, Pacific Gas and Electric, Praxair, Proctor & Gamble, Provincial Electricity Authority of Thailand, Public Service Electric & Gas, Rochester Gas & Electric, S&C Electric Company, Salt River Project, Saudi Aramco, Saudi Electricity Company, U.S. Air Force, U.S. Army Corps. of Engineers, U.S. Coast Guard, U.S. Federal Aviation Authority, U.S. Navy, U.S. Nuclear Regulatory Commission and Xcel Energy.

Power System Analysis skills for Engineers and Technicians

Registration Form

Power System Analysis Skills for engineers and technicians	2 or More Participant	1 Participant	PROGRAM DETAILS Venue: Manila, Philippines Date: 30 th May – 1 st June 2018 REGISTER NOW CONTACT: Harn MAIN: +603 7727 3952 FAX: +603 7727 5278 Email: harn@petro1.com.my
Full 3 Days	USD 1599 ()	USD 1999 ()	
REGISTER 3 AND SENT THE 4TH FREE <ul style="list-style-type: none">Please note that all registrations must be made at the same time to qualify.Above investment fee inclusive of Material, tea breaks and lunch.			
() I would like to organize this training on-site and save at least 25% on the total course Fees! Please call +603 7727 3952 for more about our in-house training or email ihtraining@petro1.com.my (Terms & Conditions apply)			

Delegate Details

1. Name: _____ Mr Mrs Ms Dr

Job Title: _____

Email : _____

Contact No: _____

Department: _____

2. Name: _____ Mr Mrs Ms Dr

Job Title: _____

Email : _____

Contact No: _____

Department: _____

3. Name: _____ Mr Mrs Ms Dr

Job Title: _____

Email : _____

Contact No: _____

Department: _____

Head of Department: _____

Invoice Details

Invoice Attention to: _____

Company: _____

Industry: _____

Address: _____

Postcode: _____ Country: _____

Telephone: _____ Fax: _____

Email: _____

Authorized Signature : _____

Payment Method

By Direct Transfer: Please quote invoice numbers on remittance advice.

ACCOUNT NAME : PETRO1 LIMITED

BANK : MAYBANK

ACCOUNT NO : 715120013353 (USD)

SWIFT CODE : MBBEMYKL

All bank charges to be borne by payers. Please ensure that PETRO1 SDN BHD received the full invoice amount.

Payment Policy:

Upon receipt of a completed registration form, it confirms that the organization is registering for the seat(s) of the participant(s) to attend the conference or training workshop. Payment is required with registration and must be received prior to the event to guarantee the seat. Payment has to be received 7 working days prior to the event date to confirm registration.

Venue:

All of our training courses are held in 4 – 5 star venues. The course fee does not include accommodation or travel cost. It's recommended to book the hotel room early as there are only limited room available at the discounted corporate rate.

DATA PROTECTION

The information you provide will be safeguarded by Petro1 that may be used to keep you informed of relevant products and services. We take it seriously when it comes to protection of our client data.

Cancellation policy & Substitutions:

Upon receipt of a completed registration form, it confirms that the organization is registering for the seat(s) of the participant(s) to attend the conference or training workshop. Should you be unable to attend, substitutes are always welcome at no additional cost. Please inform us as early as possible. Payment is non-refundable if cancellation occurs 7 working days prior to event commencement. However a substitute is welcome at no additional charges. If cancellation occurs 5 working days prior to the registration date and there is no substitute, the organizer reserves the right to charge 50% of the total investment from your organization.

PETRO1 LIMITED is not responsible for any loss or damage as a result of a substitution, alteration or cancellation/postponement of an event. PETRO1 LIMITED shall assume no liability whatsoever in the event this training course is cancelled, rescheduled or postponed due to a fortuitous event, Act of God, war, fire, labor strike, extreme weather or other emergency.

Walk in Registration:

Walk-in participants with payment will only be admitted on the basis of seat availability at the event and with immediate full payment.

Program Change policy:

The organizer reserves the right to make any amendments and/or changes to the workshop, venue, facilitator replacements and/or modules if warranted by circumstances beyond its control.