

Power System Protection

By Mr. Charles Henville

November 26-29, 2018 in Gothenburg, Sweden



Protection systems play a vital part in the reliable operation of power systems. Participants' understanding of the relevant issues will assist them in planning, designing and operating more reliable system.

Mr. Charles Henville is a specialist in Electric Power System Protection with more than 30 years of utility experience.

Register until September 25, 2018

Cost: 25 000 SEK excl. VAT for early registrations until August 20, 2018
28 000 SEK excl. VAT for registrations after August 20, 2018

For **PhD student discount**, please contact course administrator.

Course administrator: Mrs. Cecilia Rahm
education@solvina.com
+46 709 64 64 25 / +46 70 160 89 10

Limited number of participants!

Course homepage: www.solvina.com/courses

INTRODUCTION

A course intended to introduce the subject of power system protection, to enable engineers to understand techniques of applying and setting protective relays. It will cover short circuit analysis, symmetrical components, overcurrent protection, distribution system protection, differential protection and trans-former protection. Further, transmission line protection, including directional overcurrent and distance protection systems will be discussed. It will also cover communications assisted transmission line protection, including line differential protection, generator protection and interconnection issues, special protection schemes, under voltage and under-frequency load shedding.



SPEAKER'S PROFILE

Charles F. Henville

After a thirty-year career with BC Hydro in Canada, he retired in 2005 from the position of principal engineer. Charles now runs his own consulting company in power system protection, and he is well experienced in training engineers in power systems worldwide. He is adjunct faculty at the University of Wisconsin and the University of British Columbia, and is well recognized in the IEEE, being a Fellow member and a past chairman of the Power Systems Relaying Committee of the Power and Energy Society.

WHO SHOULD ATTEND?

The course is of interest to power system and protection engineers interested in understanding fault studies and applying protective relays to utility and industrial power systems. Utility engineers, consulting engineers and industrial engineers will benefit from the discussions on overcurrent and differential protection and transmission and power systems.

WHAT IS INCLUDED IN THE SEMINAR?

Lecture notes will be given to each participant during the course. Morning and afternoon breaks will include refreshments and lunch will be served daily at the conference center. In addition, all course participants will receive an invitation to a welcome dinner.

COURSE SCHEDULE *Preliminary course schedule*

Monday November 26

09.00-09.30 Registration
09.30-12.30 Course lectures
12.30-13.30 Lunch
13.30-17.00 Course lectures
19.00-21.00 Welcoming dinner

Tuesday November 27

08.30-12.30 Course lectures
12.30-13.30 Lunch
13.30-17.00 Course lectures

Wednesday November 28

08.30-12.30 Course lectures
12.30-13.30 Lunch
13.30-17.00 Course lectures

Thursday November 29

08.30-12.30 Course lectures
12.30-13.30 Lunch
13.30-16.00 Course lectures/
Summary

LOCATION

Lilla Bommens Konferens Center

Address: Lilla Bommen 4A
411 04, Göteborg, Sweden

Phone: +46 31 771 28 00



REGISTRATION

Course administrator: Mrs. Cecilia Rahm
Registration to the course can be made on-line at: www.solvina.com or in writing to education@solvina.com

Contact telephone no: +46 709 64 64 25/
+46 70 160 8910

Include your **name, company name, telephone number, e-mail, and the invoice address plus your VAT-number** in the registration mail.

Registration will be open **until September 25, 2018.**

The number of participants is limited.

Course fee: 25 000 SEK for registrations until August 20, 2018 and **28 000 SEK** for registrations after August 20, 2018
PhD students can apply for discount*.

**Special rules apply, please contact the course administrator for further information.*

DETAILED SCHEDULE

Day 1

Short Circuit Analysis of Power Systems

- Impact of short circuits on power systems. Relevant factors with respect to power system stability, reliability, power quality and protective relaying
- Use of per unit systems and comparison with physical units
- Manual calculations of balanced short circuits
- Fundamentals of symmetrical components and their application in calculations of unbalanced short circuits
- Manual calculations of unbalanced short circuits
- Sources of network and machine data for short circuit calculations.
- Impact of rotating machines on short circuit calculations.
- Renewable energy sources contribution to short circuits.
- Short circuit model validation from event analysis.
- Uses and abuses of fault studies.

Day 2

Distribution Protection

- Why overcurrent protection works.
- Overview of grounding practices for distribution system neutrals (ungrounded, high, or low impedance grounded or solidly grounded) and impact on protection and “unfaulted” phase voltages.
- Time/current characteristics of overcurrent protection devices and coordination with equipment damage curves.
- Discussion of measured quantities, phase, ground, or negative sequence currents Time Current Characteristics.
- Measuring principles, selection and setting of time and instantaneous overcurrent relays.
- Selective Clearing coordination of fuses and relays.
- Comparing apples and oranges.
- Complicating factors:
 - Techniques for “load blinding”
 - networked systems

- distributed resources connected to traditional radial distribution systems
- Using a computer program to set overcurrent protection systems in a coordinated scheme.
- Relaying accuracy of current transformers.
- Differential protection, overcurrent, high impedance, percentage restrained (with and without CT saturation detector):
 - Busbar protection
 - Transformer protection
 - Arc flash issues

Backup protection

Day 3

Transmission Protection

- Directional overcurrent protection.
- Directional relay polarization techniques, zero and negative sequence voltage, current, and impedance, memory polarizing.
- Setting and coordinating directional overcurrent relays in networks and loops.
- Limits to sensitivity of ground overcurrent relays.
- Principles of distance protection. Measuring principles of phase and ground distance relays.
- Setting and coordinating distance relays in networks.
- Multi terminal transmission line protection.
- Transmission line protection example case study.
- Using a computer program to set transmission protection systems in a coordinated scheme.
- Complicating factors (infeed, outfeed, transformer phase shifts, series capacitors, single phase tripping and reclosing).
- Communications assisted transmission line protection systems, direct underreaching transfer trip, permissive overreach transfer trip, directional comparison blocking, hybrid systems, line current differential systems.

Day 4

Generator and motor protection

- Beyond short circuit protection – abnormal operating conditions.
- Motor protection.
- Generator protection.
- Generator interconnection.

System protection and general items

- System integrity protection, special protection schemes, reliability and regulatory issues.
- Frequency and voltage stability and under frequency and under voltage load shedding.
- Fault and disturbance analysis.
- Multifunction IEDs – how much functionality is too much?
- Making a business case for protection upgrades.
- Recent developments and future trends in power system protection.
 - IEC 61850 and manufacturers' proprietary communications
 - Increased penetration of renewable resources and battery storage
 - Formation of microgrids
 - Smart grids
 - Asset management
 - Precise time applications

ADDITIONAL INFORMATION CONFIRMATION

Within a week of your reservation you will receive a confirmation. The number of participants is limited. If the course is filled, you will be placed on a waiting list.

Payment

Course fee: 25 000/28 000 SEK excl. VAT depending on registration date, see REGISTRATION.

Accommodation is not included.

Terms of payment: 30 days net.

The fee will be invoiced prior to the course.

Cancellation

If you are not able to participate in the course, you may transfer your registration to another person within your company free of charge. There will be a 100 % charge of the course fee if cancellation is made 0-6 weeks prior to the course.

Solvina reserves the right to cancel the course until 4 weeks prior to the course. Any registered participant will be notified. Solvina shall not be held responsible for any damages, repercussions, or financial losses in such case.

Hotel Reservation

The accommodation is not included in the course fee. However, Solvina will be happy to assist you in your hotel reservation. Please, contact the course administrator.

Force Majeure

Solvina AB/Solvina International AB is not liable for damages due to Swedish or domestic law, Swedish or foreign authority, war, strike, blocking or other similar circumstances, and shall not be held responsible for damages in case the course, in parts or in full, cannot be completed due to disease. Solvina claims the right to make any changes in the course program or for the location of the course.