



Course Information Letter ---- G301

GENERATOR CONTROL CONCEPTS

G301

There are NO SMALL PROBLEMS when it comes to your GENERATOR!! Be prepared. Make sure you fully understand Design, Construction, Operations, and how /why the controls function as they do. Don't be surprised. Be prepared. Register for this course today. We begin with the big-picture, proceed with component identification (including how these components may be of risk in abnormal conditions), discussion of normal/abnormal operations, and how the generator controls should respond to these conditions. This course is designed for plant engineers who have a specific need to better understand how the generator controls function. Plant electrical and operations technicians benefit as well.

Topics include: Generator Theory • System Operation • Generator Construction • Exciters • Voltage Regulators • Speed Controls • Generator Protection • Industry Events

- How does a generator function?
- Why is it designed as it is?
- What happens if the generator is synchronized out-of-phase?
- What happened in the control room such that one would make such a large error when synchronizing?
- How can we avoid such an error?
- Just how bad (and what is) negative phase sequence currents?
- Why have we (recently) heard of hydrogen explosions? How do we avoid?
- ...And the list of answered questions goes on!!

OBJECTIVES: Upon completion of this course, participants will be able to:

1. Describe how a generator functions. (Learn why and how the voltage drops with an application of a load and learn why and how the rotor speed and angle change as that load is applied).
2. Describe active and reactive power. (Learn how active power is generated, how reactive power is generated, and how these loads are shared from one generator to another.)
3. Describe the major components used in the construction of an AC generator.
4. Learn how these components are at risk during mis- or abnormal operations.
5. Explain operation and maintenance of the most common excitation systems.
6. Explain how a speed governor alters generator output in response to a frequency deviation. (Learn why the speed changes when a load is applied. Learn what is the role of the governor in response to this speed/frequency change).
7. Explain how the voltage regulator alters generator output in response to a voltage deviation. (Furthermore, learn why the voltage drops, how a voltage drop is detected, where it is detected, and how the voltage regulator responds as it does).
8. Discuss the causes and effects of both voltage and frequency oscillations and the impact they each have on power system dynamics.
9. Describe generator normal/safe startup and shutdown procedures.
10. Describe why the generator synchronizing process is as it is. (Learn what are the results of not checking phase rotation, of mismatching voltages, of mismatching frequencies, and closing the circuit breaker out-of-phase.)
11. Discuss abnormal generator operation and recommended actions for generator protection.
12. Given an unfortunate abnormal condition, describe possible results to equipment and/or system.

COURSE SYNOPSIS

Monday

Generator Theory: Armature Reaction, Resistive Loads, Inductive Loads, Capacitive Loads, Power Transfer and Load Angle, Reactive Power, Net Air Gap, Developed Torque, Watt and VAR Control, Generator Capability, Stator Winding Heating, Field Heating, Core End Iron Heating, Power System, Power Transfer Between Generator Rotor and Stator, Short Circuit Ratio

System Operations: Structure of the Power System, Interconnections, Power Balance, Operation of the System, State of the Power System.

Tuesday

Generator Construction: Stator Frame, Core, Windings, End Shield, Rotor Body, Field Windings, Retaining Rings, Collector Rings, Diesel and Hydroelectric Differences

Excitation Systems, Voltage & Frequency Control: Speed Governor Response to Frequency Deviations, Automatic Voltage Regulator Response to Voltage Deviations, Manual Regulator, URAL, Impedance Compensator, Volts/Hertz, Maximum Excitation Limit, Transfer & Tracking, PSS, De-Excitation, Steady State Operation, Transient Conditions, Earlier Excitation Systems, Rotating AC Exciters, Alterrex, SCRs, Brushless Excitation Systems, Static Excitation Systems, SCPT, SCT-PPT, Bus Fed Exciters

Generator Auxiliary Systems: Purpose and Operations of the Generator Hydrogen Control System, Generator Seal Oil System, and Stator Liquid Cooling System (as required).

Wednesday

Normal Operations: Preparation for Start-Up, Synchronizing, Load Changes, Use of Reactive Capability Curve, Shutdown.

Abnormal Operations: Relationships Between Operations, Protection and Alarms; Alarms, Protection when Off-Line, Tripping Methods, Protective Actions for Generator Faults and Abnormal Operations & Protection Recommendations: System Steady & Dynamic Conditions, Frequency Deviations, Voltage Deviations, Instabilities, Loss of Synchronism, Stator Overcurrent, Field Ground, Stator Ground Fault, Stator Phase-to-Phase Fault, Over Voltage, Over Volts-per-Hertz, Field Overheating, Loss of Excitation, Bearing Vibration, Synchronizing Errors, Motoring, Seal Oil System Pressure, Stator Coolant System, Local Overheating, Unbalanced Armature Currents, Breaker Failures, System Back Up, Voltage Surges, Transmission Line Planned Switching, High Speed Reclosing, Accidental Energization

Certification Examination

"10+... The seminar did a good job of meeting my expectations" - Connectiv

"Excellent course, would (will) recommend to others" - US Army Corps of Engineers

COURSE DATES/LOCATION/FEE

For current dates / locations / prices, please see HPC's website, www.hpcnet.com.

* Schedule Notes: Generator Control Concepts (G301) is the first 3-days of G401 Generator Technologies.

FREQUENTLY ASKED QUESTIONS

- Will HPC Technical Services bring this course to our location for our personnel only? YES, call or email Stephen Parker, stparker@hpcnet.com for a price quotation.
- Will HPC Technical Services customize the presentation at our site to suit our particular needs? Yes.
- Is HPC Technical Services' textbook available for purchase as a reference document? Yes. \$195 + S&H.
- What is the cost for HPC Technical Service to deliver this course at our location? Well, of course that can vary, but generally speaking, if you're planning on having 6+ attend, when considering your T&L; it is to your advantage to perform the course at your plant (office). You gain from the customization and price.
- Can HPC Technical Services provide "Technical Assistance" in the troubleshooting generator related issues? Yes we can. Call or contact Harold Parker, hparker@hpcnet.com for our rate sheets and any further information required.

WHAT YOU WILL RECEIVE:

1. 1 copy of HPC Technical Services' textbook, Generator Control Concepts, a \$129 value, as written by Harold Parker. This text contains a significant number of equipment photographs, graphics and data tables. It is a valuable desktop reference in addition to being able to enhance the learning process. (This valuable text is available for purchase if you cannot attend – US\$129).
2. A "Certificate of Completion" with 1.9 CEUs, authorized for issue by the International Associate of Continuing Education/Training.

GENERATOR CERTIFICATION:

There are two levels of certification (All levels require this course):

1. Mechanical Maintenance Technician
2. Electrical Maintenance Technician

Those who attend this course are automatically qualified to take HPC Technical Services' Certification Examination. This examination is offered at no additional expense to the participant. An 80% passing grade is required. The examination length will not exceed 2-hours. Those who complete this examination will receive a revised "certificate of completion" that recognizes this accomplishment along with two-copies of a "To Whom It May Concern" letter that states their accomplishment. (Two copies are provided, one for the participants' employer and one for the participants' personal file.)

Consult HPC's website, www.hpcnet.com, for detail on this certification program.

RECENTLY SATISFIED CLIENTS:

AES, Alstom Power, AmerGen Energy, Arizona PSC, Associated Electric Cooperative, ATCO Electric, Braintree (MA) Electric Lighting Dept., Cardinal Operating Company, Cayman Islands Utilities, Chelan County PUD, Chevron Geothermal Salak, Connectiv Operating Services, Detroit Edison, Dynegy Power, Eastman Chemical, Edison Mission Energy, El Paso Electric, Enron, Entergy-Arkansas, Entergy-Louisiana, Entertainment & Engineering Operations, Exelon Nuclear, Exxon-Mobil, Foster Wheeler, Georgia Power, Hawthorne Power Services, Hovensa Oil Refinery, Iberdola (Spain), Institute for Nuclear Power Operators (INPO), International Paper, Kansas City Board of Public Utilities, Korea Midland Power Company, Korea Nuclear & Hydro Company, Korea Plant Services & Engineering, L&S Industries, Madison Gas & Electric, MidAmerican Energy, New England Power, North America Energy Services, Northern Star Generation, NRG, Nuclenor (Spain), Oklahoma Gas & Electric, Orange County Sanitation Department, Orrville City (OH) Utilities, Ottumwa (IA) Water Works, Portland G&E, Progress Energy, Pyro-Pacific Cogen, SaskPower (Canada), Seattle City Lighting, Sierra Pacific Power, Sithe Energies, Southern California Edison, Southwestern Electric Power, Standard Aero Energy (Canada), Syncrude Canada, Tennessee Valley Authority, Texas Municipal Power Agency, Tolko (Canada), University of Texas, Trigen Cnergy Solutions, US Army Corps of Engineers, US Bureau of Reclamation, US Navy, US Power Gen, Vermont Yankee, Wisconsin Public Service

HPC INSTRUCTOR / CONSULTANT (S):



Harold Parker has worked in the "Power Generation" industry for 40 years, 14-years with GE as a Field Engineer, Start-Up Engineer, Technical Training Specialist and Manager. In 1983 Mr. Parker resigned from GE and started a training company, Schenectady Learning Systems, in Schenectady NY, which evolved into H Parker & Company, Inc. today. During this post-GE period, Mr. Parker was briefly employed as Manager Turbine-Generator Services with General Physics (2-years) and as a Field Engineer with Mechanical Dynamics & Analysis (2-years). Mr. Parker is the primary contributor to the development of the text used in this course presentation. Mr. Parker holds a BSME ('69), a MBA ('81) and is a member of ASME, IEEE and ASTD.



John Mitchell. John Mitchell is a multi-talented leader with over 33 years management, engineering, installation and maintenance experience in thermoelectric power plants. He is especially an expert in steam turbines, generators and their controls. Prior to June 2003 (when he accepted an early retirement package from GE), John was a Customer Training Specialist with the GE International Department. Other past responsibilities included being Manager, Engineering Services, Senior Application Engineer, Senior Service Engineer, Lead Training Specialist, Program Support Engineer, Instructor Technical Training, and Field Engineer. All of this on operation & maintenance of steam turbine generator hardware and controls. John resides in Schenectady NY.



John Marshall. Mr. Marshall, worked for GE 35 years in the power system service and installation business. 25 years of this time was in the international service business. During his career, Mr. Marshall's positions included Field Engineer, Service Supervisor, Technical Training Instructor and Senior Application Engineer. Mr. Marshall's work covered electrical power distribution and control of power generation equipment. His expertise is GE manufactured excitation systems for large and medium size generators used on gas and steam powered turbines. As a Technical Training Instructor for over 20 years, Mr. Marshall developed and presented training programs for GE manufactured excitation systems. As a Senior Application Engineer, Mr. Marshall's work included the upgrading/replacement of older excitation systems with GE's digital excitation system. His Field Service work was worldwide. BSEE degree from Virginia Polytechnic Institute and State University in Blacksburg, Virginia.

Robert Johndrow. Bob Johndrow hired into GE as a field engineer on the same day as HPC's founder, Harold Parker. That was 36-years ago. Since that date, Bob Johndrow has been a GE Field Engineer specializing in many disciplines including Generator Maintenance and Testing. Bob completed GE's Generator Specialist Training Program early in his career and has been involved in many generator design issues, mechanical maintenance, electrical testing, and troubleshooting O&M problems since then. Bob earned a BS in Industrial Distribution from Clarkson University in Potsdam NY and also has GE Six Sigma Green Belt Certification. Bob accepted an early retirement package late 2003 and has worked as an independent as well as being associated with HPC Technical Services since then. He resides in Rhode Island.

Stuart Fasser. Mr. Fasser earned his BSEE from Union College, Schenectady, NY, in 1967. He retired in 2002 after 37 years of service with GE, including an early career in factory and field testing of power generation equipment and concluded with 10 years of field engineering in the installation and service of excitation systems. As a field engineer assigned to GE International he installed new GE excitation systems on generators as well as trouble shooting and maintaining existing installations. His most recent installations included 21 EX2000 exciters on units in Egypt, Thailand, Korea and the United States. In these assignments he was responsible for installation of the exciters as well as their checkout and start-up. These activities included component checks, initial calibration, pre-roll simulation of operation and both off-line and on-line alignment and checkout. Stuart is associated with HPC Technical Services in the areas of generator maintenance, testing, excitation systems and instruction.

Bob Fleming. Provides support in electrical engineering topical areas. Specifically instructs HPC voltage regulator courses such as the Westinghouse WTA, WMA, and WDR Exciters. Up until mid-2004 Bob was employed by TCSA and was responsible for developing voltage regulator upgrades, troubleshooting system problems, calibrating WTA/PRX systems as well as Basler systems. From 1969 thru 1996 Mr. Fleming worked for Westinghouse Electric Corporation, Power Generation Service Division. Here he was a Generator/Exciter Specialist with extensive experience with installation, testing, rewinds and repairs of generators from 1-MW to 1500-MW.

HPC TECHNICAL SERVICES
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REGISTRATION FORM

Company: _____

Plant: _____

Address: _____

City/State/Zip: _____

Telephone: _____ FAX: _____

Course Number/Title: _____

Course Dates: ____/____/____ Thru ____/____/____

Course Location: _____ Course Fee: _____

Please enroll the following individual(s) listed below:

Student #1: _____

Student #2: _____

Taking advantage of HPC's 3-4-2 Policy: Send 3, Pay for 2 when paying in advance.

Student #3: _____

Enrolled by: _____ **Date:** _____

METHOD OF PAYMENT

Check to Follow: _____

Check Enclosed #: _____

MC/Visa/AMEX #: _____

Expiration Date: _____ CV Code: _____

Purchase Order #: _____

HOW DID YOU LEARN OF THIS COURSE

Attended HPC courses in the past.

Received a fax

Received an email

Internet search

Received HPC mailing

Other: _____