EGSA George Rowley School of On-Site Power Generation

Basic School

The Basic School is geared for those that need an understating of the theory and application of the mechanical and electrical components within a generator system, starting with Basic Electricity. Many sales, marketing, management, applications engineers, engine technicians and administrative personnel have benefitted from this course.

Basic School Modules

INTRODUCTION TO ON-SITE POWER SYSTEMS

Online Module, a pre-requisite, included with registration.
This 30 minute broad overview should be taken by registered attendees prior to the classroom school. It covers the main reasons for on-site power demand, the main components of a generator set and the process by which most generator sets are purchased. It is especially useful to component suppliers and those who are new to the industry. (.5 Hr)

BASIC ELECTRICITY

This module will review fundamental electrical concepts and provide students who have little or no knowledge of electricity, electrical and magnetic circuit concepts and how they're applied to power generation. Covers resistance, impedance, Ohm's Law, AC and DC circuits, rectification, Faraday's Law, magnetism, electromagnetism, electromagnetic induction, different load types, linear and non-linear loads, capacitance, reactance, real and apparent power, power factor and load banking. (3.5 Hrs)

PRIME MOVERS

This session provides information on the basic types of prime movers found in On-Site Generator applications, and then focuses on reciprocating internal combustion engines. Students will gain an understanding of the two and four-stroke cycles that are the basis of engine operation. Further topics include spark-ignited (gaseous) and compression-ignited (diesel) engines and their internal components; fuel, lubrication, cooling and exhaust systems; engine ratings; mechanical to electrical power and fuel consumption calculations. (4 Hrs)

INTRODUCTION TO GENERATORS/ALTERNATORS

This module is an introduction to the general design and functions of rotating AC electric generators. Major topics covered include electrical safety; types of electric generating systems; definitions and descriptions of the wound components of an AC generator, including discussions of generator fields and armatures; the generation and frequency of the AC voltage wave form; exciters and excitation support systems. The instructor will also cover types and criteria of AC generators; design, including discussions of armature design features; generated harmonics and the methods of connection of both three-phase and single-phase armatures. (2 Hrs)

STARTING SYSTEMS

This module provides an overview of electrical start systems; general electrical sizing parameters; environmental considerations, and battery technologies commonly deployed to start engines or turbines. Topics include: parameters required to size electrical start systems; the effect of environmental conditions on battery performance and life; features, benefits and modes of failure of traditional battery technologies; dual battery starting systems with best battery selectors; and installation, maintenance and replacement best practices. (2 Hrs)

INTRODUCTION TO AUTOMATIC VOLTAGE REGULATORS

This section of the program covers the basic theory of operation for the voltage regulator, and its application and selection, for a synchronous generating system. It also includes a discussion of special regulator applications and the use of excitation accessories and control devices for improved performance and protection. (2 Hrs)

INTRODUCTION TO GOVERNORS/SPEED & LOAD CONTROLS

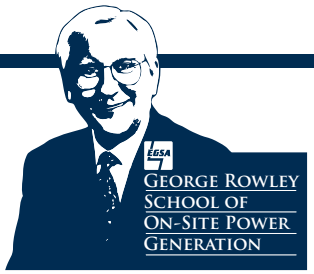
Today's generator sets demand the best in frequency control. Although not obsolete, mechanical governors have given way to either the electro-hydraulic or the all-electric governor, depending on the size of the set. In addition to covering basic engine governing, this session also covers electronic isochronous load sharing and automatic synchronizing. Utility paralleling, with its special considerations, is also covered. (2 Hrs)

Basic School Schedule

	Day 1	Day 2	Day 3	Day 4
8 - 9 a.m.	Introduction to On-Site Power Systems (.5 hr) Basic Electricity (3.5 hrs)	Introduction to Generators/Alternators (2 hrs) Starting Systems (2 hrs)	Introduction to Transfer Switches (2 hrs) Load Bank Fundamentals (2 hrs)	Generator Set Systems: Putting the Pieces Together (2 hrs) Understanding Bid and Specification Documents (2 hrs)
9 - 10 a.m.				
10 - 11 a.m.				
11 a.m. - Noon				
Noon - 1 p.m.	Lunch	Lunch	Lunch	
1 - 2 p.m.	Prime Movers (4 hrs)	Introduction to Automatic Voltage Regulators (2 hrs) Introduction to Governors/Speed & Load Controls (2 hrs)	Generator Set Instumentation (2 hr) Codes and Standards (2 hrs)	
2 - 3 p.m.				
3 - 4 p.m.				
4 - 5 p.m.				

Who was George Rowley?

Education has always been a key area of focus for our Association. George Rowley took the helm of EGSA's Education Program as its Director in 2001. With a Masters Degree in Education, and a background in Healthcare, he adapted very quickly to the power generation industry. He once said in a letter to members: "I didn't know a volt from a watt when I first came onboard!" Through his collaboration with the Education Committee as well as other members, he was able to develop and take our education program to unforeseen levels. It is through this hard work and dedication that EGSA's education program took shape resulting in the 2-tiered program that now bears his name.



INTRODUCTION TO TRANSFER SWITCHES

This module provides an overview of the definition and purpose of manual and automatic transfer switches, typical installations, applicable codes and standards and where they are applied in the on-site power system. The module will cover general reliable design concepts, operation, ratings and various switching configurations including Bypass-Isolation Switches. (2 Hrs)

LOAD BANK FUNDAMENTALS

Load Banks are a critical component for proper, reliable power system operation. This training session will expose the student to the different types of load banks, their applications, and will detail how a load bank tests a power source. This training module will also address the important topics of load bank safety and best practices. (2 Hrs)

GENERATOR SYSTEM INSTRUMENTATION

This module will define and describe the instrumentation required to monitor and control the operation of On-Site Power Systems. (2 Hrs)

CODES AND STANDARDS

On-Site Power systems and their installation must meet various codes and standards. This module reviews the codes related to these systems. You will learn the background for these standards as well as requirements for when and where they are needed, how generators must be installed, tested and maintained. Typical standards covered are issued by NFPA (National Fire Prevention Association), IEEE (Institute of Electrical and Electronic Engineers), UL (Underwriters Laboratories), ISO (International Standards Association) and others. (2 Hr)

GENERATOR SET SYSTEMS: PUTTING THE PIECES TOGETHER

This session addresses practical, environmental and economic considerations in sizing and installing power systems from the perspective of sales and service personnel. Topics include determining a customer's power requirements; basic load characteristics and their effects on generator set sizing; selecting the right engine and generator for the application and the types of fuel recommended and available; the accessories that should be included; selecting the right location for the set. Special emphasis will be placed on Installation, Testing and Commissioning of the system. (2 Hrs)

UNDERSTANDING BID AND SPECIFICATION DOCUMENTS

This session is designed for students with a solid understanding of on-site power systems that seek a basic understanding of the specification and bid process as it relates to the industry. Class work includes analyzing a sample set of plans and specifications. With these documents, students learn the roles of the individuals and companies that influence the design process. In addition, students will learn to identify the various documents, codes and standards used by engineers, contractors and others. (2 Hrs)

NOTICE: *EGSA reserves the right to change the content, sequencing and any other aspect of the EGSA George Rowley School of On-Site Power Generation at any time, and without notice.*

CEU Program

SERIOUS EDUCATION

EGSA takes your education, and your career success, very seriously. That's why we offer a Continuing Education Unit (CEU) Program for students of EGSA's George Rowley School of On-Site Power Generation.

With our CEU program, you have a way to demonstrate what you learned while attending the EGSA schools. Likewise, your employer will have the satisfaction of knowing that this investment in training has been money well spent.

THE VALUE OF CEUs

CEUs are tangible evidence of the knowledge you gained while attending the school. You can take pride in your accomplishment and in your increased value in the marketplace. Plus, CEUs demonstrate that you are serious about growing in our industry!

WHAT EXACTLY IS A CEU?

In compliance with internationally recognized criteria and standards, one (1) EGSA CEU is equal to ten (10) contact hours of participation in an organized continuing education experience under responsible sponsorship, capable direction and qualified instruction. Applying these standards to the current number of contact hours in our Basic and Advanced Schools, the following is true:

School	Number of CEUs*
Basic Power School	2.8
Advanced Power School	3.2

HOW DO I RECEIVE EGSA CEUs?

Apply for CEUs when you register for a Rowley School. A CEU checkbox appears on the school registration form. After you pay the $50 CEU fee, attend the school, and achieve a passing score on a test consisting of multiple choice and True/False questions, we will mail CEU Certificates directly to you.

LEARNING OUTCOMES

"Learning Outcomes" for each portion of the school have been developed. Learning Outcomes are directly related to the test items, and they give you specific and detailed information about what you are expected to learn. You complete the test at your convenience and, when finished, mail it to EGSA.

WHERE CAN I LEARN MORE?

You'll be given complete details about the CEU Program when you attend a Rowley School. In the meantime, visit our web site at *EGSA.org* where you can download EGSA's CEU Learning Outcomes, program requirements and procedures. If you have a specific question, or need more information, contact EGSA at (561) 750-5575 or e-mail us at *e-mail@EGSA.org*.

**Changes in the School may result in a change to the number of CEUs awarded. While not likely, EGSA reserves the right to change the content, sequencing and other aspects of the EGSA George Rowley School of On-Site Power Generation at any time and without notice.*

EGSA George Rowley School of On-Site Power Generation

Advanced School

The Advanced School is designed for those who have a good understanding of the basic mechanical and electrical systems found in an on-site generator set. A minimum of 3 years experience in the industry is recommended. It will be particularly useful for those employed in engineering, project management, service positions and technicians preparing to take the EGSA Journeyman level Technician Certification test.

Advanced School Modules

ADVANCED GENERATORS/ALTERNATORS

Understanding generator systems begins with understanding the alternator, commonly called the generator. This module presents the construction of the generator and its subsystems, operational theory and limitations and precautions required to keep it operating safely. The electro-mechanical components of the excitation system will be covered along with advantages and disadvantages of various excitation methods. Winding pitch will be discussed along with its importance to the system. The student will learn how to easily calculate the maximum short circuit available from a generator and its importance. We will cover possible consequences of power system faults and how to develop a maintenance and prevention plan. (3.5 Hrs)

GENERATOR SET AND CRITICAL POWER SYSTEM CONTROLS

Once the Alternator is combined with a Reciprocating Internal Combustion Engine (RICE) and becomes a generator set, automation is required for safe and reliable operation. This module will examine the control systems of the modern generator set, from the prime mover throttle to the kilowatt output, to maximize operational functionality and flexibility of the complete power system. Various Control Theories and Modes of Operation, including PID theory for closed loop control systems, the effects of power system faults, the role of the Dedicated Purpose Controller and the Programmable Logic Controller, Base Load, Peak Shaving, Load Management, Grid Support, and Fuel Optimization will be discussed in detail. The module wraps up with a look at industry trends and the effects on the future of the power generation business. We will discuss the Smart Grid and the importance RICE Distributed Generation will be to the grid in the future. (3 Hrs)

GENERATOR AND SYSTEM PROTECTION

The effects of a catastrophic electrical fault can cause loss of life and cost millions of dollars in damaged equipment and forced outages. During this two part series on protective systems, the student will be presented information on common electrical problems and the solutions most commonly used to minimize or protect equipment from damage. Circuit Breakers, Protective Relays, Current Transformers, and other equipment used to control power systems will be discussed. Positive Sequence, Negative Sequence, and Zero Sequence voltages and currents will be defined, and their importance to the art and science of protective relay application, discussed. Ground Fault Detection and Protection will be discussed and applied to generator protection as well as system protection. We will study commonly utilized protective relays for protection of the engine, the generator and the complete power system. (3 Hrs)

Advanced School Schedule

	Day 1	Day 2	Day 3	Day 4
8 - 9 a.m.	Introduction (.5 hrs)	Generator and System Protection, Part 2 (2 hrs)	Advanced Transfer Switches (2 hrs 30 mins)	Noise Control (2 hrs)
9 - 10 a.m.	Advanced Generators/ Alternators (3.5 hrs)	Advanced Automatic Voltage Regulators (AVRs) (2 hrs)	Multiple Generator Paralleling Switchgear (1.5 hrs)	
10 - 11 a.m.				Communications (2 hrs)
11 a.m. - Noon				
Noon - 1 p.m.	Lunch	Lunch	Lunch	Lunch
1 - 2 p.m.	Generator set And Critical Power System Controls (3 hrs)	Advanced AVRs *Continued* (1 hr)	Multiple Generator Paralleling Switchgear *Continued* (1 hr)	Communications (cont.) (1 hr)
2 - 3 p.m.		Advanced Governors/ Speed and Load Controls (3 hrs)	Engine Emissions (3 hrs)	Advanced Generator Systems: Sizing to Service (3 hrs)
3 - 4 p.m.				
4 - 5 p.m.	Generator and System Protection, Part 1 (1 hr)			

ADVANCED AUTOMATIC VOLTAGE REGULATORS (AVRs)

This session will provide an understanding of some of the more complex issues associated with controlling the voltage of a generator. It takes the student past the basic understanding of the AVR and into the actual application and commissioning of voltage regulators. Topics include basic automatic voltage regulator functionality; stability vs. transient response; paralleling generators - islanded: paralleling generators – utility: commissioning voltage regulators; troubleshooting; offline problems and troubleshooting on-line problems. (3 Hrs)

ADVANCED GOVERNORS/SPEED AND LOAD CONTROLS

Increased engine governing capabilities are achieved with modern generators by utilizing electro-hydraulic and the all-electric actuator

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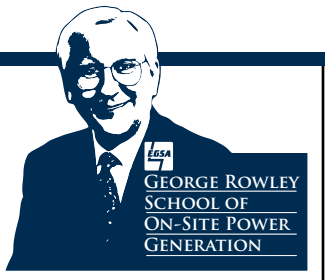

with programmable digital controls. This module will focus on engine governing with electronic controls, including governor-programming concepts and processes. It will also cover electronic isochronous load sharing and governing principles of gaseous fuel-powered generators. (3 Hrs)
(Students may wish to bring their laptops to this module in order to participate in a generator set simulation, demonstrating generator paralleling and load sharing.)

ADVANCED TRANSFER SWITCHES

This module provides a more in-depth description of transfer switches, with discussion of applications such as Closed-Transition, Delayed-Transition, Service Entrance Rated Switches, Soft Load Switches, motor load transfer, neutral conductor considerations and remote communication systems. (2.5 Hrs)

MULTIPLE GENERATOR PARALLELING SWITCHGEAR

This session covers synchronization of multiple sources of power, such as generators and utilities. The differences between switchgear and paralleling switchgear are defined, as well as where and why these systems are used. Standards for design, manufacturing and installation are detailed, emphasizing engineering considerations that impact systems configuration and the sequence of operation. (2.5 Hrs)

ENGINE EMISSIONS

This module discusses the main pollutants emitted from engine exhaust, their effects on the environment and current methods of reduction. Topics covered include emissions regulations; how pollutants are created during combustion and pollution reduction solutions before, during and after combustion. Post combustion technologies including SCR, Diesel Particulate Filters and Oxidation Catalysts will be examined. (3 Hrs)

NOISE CONTROL

The Noise Control module covers a broad and in-depth overview of important sound-related issues and concepts. The module is presented in 5 sections:

1. **Basic Acoustics** covers logarithmic nature of hearing and the decibel; the weighting curve; relative loudness; sound power vs. sound pressure; noise behavior vs. frequency; predicting the effects of distance and reflection on sound attenuation; and how to apply the inverse square law.
2. **Mechanical Noise** covers sources of mechanical noise and their noise signatures; fundamentals of enclosures; and properties of noise at enclosure openings.
3. **Engine Exhaust Noise** covers characteristics of raw engine exhaust noise; silencer types and styles; insertion loss performance; design and validation of exhaust systems.
4. **Airflow Generated Noise** covers characteristics of fan and airflow noise and the concept of volume flow, velocity and pressure differential.
5. **System Review** covers the effects of noise from multiple sources; responsibility for compliance; writing proper noise control specifications and noise measuring techniques. (2 Hrs)

COMMUNICATIONS

This module will include in-depth examination of data communication techniques in modern reciprocating engine powered generator sets. The session will cover generator level data, derived from the Generator Set Control, and also engine-level data derived from the Engine Control Unit (ECU). Modbus communication will be covered, including the hardware variants of RS232, RS485 and TCP/IP. The ECU segment, J1939 CANbus will be discussed. Remote communications techniques, including cellular, satellite, and Ethernet TCP/IP, will also be covered. Security risks and benefits of network-connected generators will also be reviewed. (3 Hrs)

ADVANCED GENERATOR SYSTEMS: SIZING TO SERVICE

This session addresses specific considerations in sizing and installing power systems from the perspective of a design professional or advanced sales and service personnel. Topics include determining a customer's power requirements; an in-depth explanation of load types; characteristics and staging and their effects on generator set sizing and performance; selecting the right engine and generator for the application and what type of fuels should be recommended; environmental variables; noise and sound abatement and the associated impact on cost; selecting the right location for the set; and specific installation considerations and requirements, start up and service; and national code relevance and compliance. (3 Hrs)

Q&A

Where is the school held?

Schools are held at the individual hotels listed in the brochure. Each attendee is responsible for making his/her hotel reservations to attend a Rowley School. You are not required to stay at the hotel; however EGSA negotiates lower rates and added benefits (such as free internet or parking) at our school hotels.

What do I need to bring with me to the school?

Nothing! You'll receive a memory stick with the handouts as well as 5th Edition reference book, *On-Site Power Generation: a Comprehensive Guide to On-Site Power.* *(Students may bring a laptop, but it is not required.)*

What do I need to wear to the school?

EGSA Power Schools are classroom based schools. You will not physically interact with any equipment while attending the school so business casual is encouraged. We also suggest that you bring a jacket in case the classroom temperature varies.

What is included with my registration fee?

By registering for an EGSA School, you reserve a seat and receive all the session handouts on memory stick, along with the 700-page 5th Edition reference book, *On-Site Power Generation: a Comprehensive Guide to On-Site Power.* Your registration fee also includes breakfast, coffee and beverages along with a hot buffet lunch each day. Continuing Education Unit (CEU) tests may be purchased for an additional $50 per person. Please note your registration fee DOES NOT include transportation/travel to and from the school, hotel/lodging, and meals (other than the provided lunches).

Who are your Instructors?

Instructors for the EGSA George Rowley School of On-Site Power Generation come from these leading firms:

- ABB Inc.
- Alban CAT Power Systems
- ASCO Power Technologies by Schnieder Electric
- Basler Electric Co.
- Caterpillar, Inc.
- Chillicothe Metal Co.
- Generac Power Systems, Inc.
- Gitrz Industries
- Governor Control Systems, Inc.
- MTU Onsite Energy Corp.
- Omnimetrix, LLC.
- Onsite Power, Inc.
- PowerSecure International, Inc.
- Power Telematics, Inc.
- Pritchard Brown, LLC
- Stored Energy Systems (SENS)