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 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 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)

Advanced School Schedule

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

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.*

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)

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