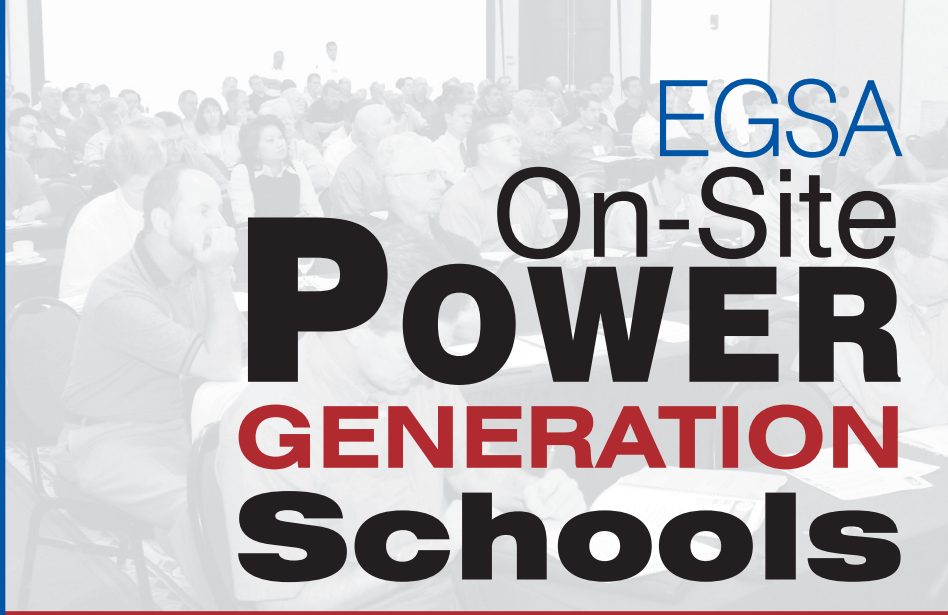
CEU Learning Outcomes



EGSA On-Site POWER GENERATION Schools

26 Years of On-Site Power Education

Basic School

The Basic School is a general, but still technical, overview of On-Site Power Generation equipment. The Basic School is designed for those who are working in non-technical positions (such as Sales or Marketing, Administrative, or Company Management positions) and for those with less than three years experience working in the industry.

Advanced School

In comparison to the Basic School, the Advanced School offers more highly technical and in-depth coverage of the equipment. The Advanced School is designed for those who have attended the EGSA Basic On-Site Power Generation School; those who are employed in Engineering, Project Management, or Service positions; and for those with over three years working in the industry.

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The Voice of the Global On-Site Power Industry
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Some Basic Information About CEUs

Why CEUs?
Earning CEUs is a great way to demonstrate that you have learned what you went to the school to learn. You can take pride in this tangible evidence of your knowledge, and your employer may consider the CEUs you have earned as evidence of your increased value to the company when compared to those who have not earned CEUs. Plus, your employer can rest assured that the company's investment in your training and development was well spent.

How many CEUs can I earn?
CEUs will be awarded to applicants who demonstrate an acceptable level of learning. EGSA follows a formula developed by the International Association of Continuing Education and Training. Based on this formula and the current number of contact hours in our Schools, two point four (2.4) CEUs will be awarded for the Basic School and three point two (3.2) CEUs will be awarded for the Advanced School.

How can I get CEUs?
If you wish to receive CEUs for participating in our On-Site Power Generation School, you must apply for the award of CEUs, must register for and attend the school, and pay the administrative fee associated with the award of CEUs. You may apply for CEUs by filling out the appropriate portion of the school registration form.

How do I earn CEUs?
To receive CEUs, you must demonstrate that you have satisfactorily completed the requirements by passing a test. If you do not meet the requirements, CEUs will not be awarded. CEUs will be awarded for the entire program only; CEUs will not be awarded for individual modules within the School.

We take your learning seriously and we take your success just as seriously. We want to make it as easy as possible for you.

Learning outcomes are provided for each school module. The learning outcomes identify what you are expected to learn and what you should know after the school. Because the test questions are directly related to the learning outcomes, there should be no surprises.

Testing—Tests will be distributed to applicants at the school in most cases. Applicants will take the test at their convenience (not necessarily while they are attending the school) and they may refer to handouts and Reference Book that are distributed at the school, while they take the tests. The test must be returned to

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EGSA within 30 days of the last day of the school. Returning the test in a timely manner is the applicant's responsibility – EGSA will assume no responsibility for ensuring that tests are returned in a timely manner.

Acceptable Passing Scores—The acceptable ('passing') score thresholds for the CEU tests are subject to change. The most current information about the EGSA CEU passing score policy will be distributed at each of our schools and those policies will be used to determine eligibility for CEUs at the time of testing.

Retesting—One retest will be allowed if an applicant fails to make an acceptable passing score. If the student fails the retest, the course must be repeated if the applicant wishes to continue to pursue the award of CEUs.

How soon will I know if I have earned CEUs?
Within 60 days of EGSA receipt of the completed examination, the Director of Education will notify you if you have successfully met the requirements. If you have met the requirements, a CEU certificate will be sent to you. If you have not met the requirements, you will be informed of the options you have (see "Testing" above)

Will EGSA maintain my CEU Record? How long will you keep it?
A record of all individuals who apply for award of EGSA CEUs will be kept on file in the EGSA offices. The record will be initiated the first time an individual applies for the award of EGSA CEUs and amended when and if that individual attempts to earn additional EGSA CEUs. A record of all individuals who apply for award of EGSA CEUs will be kept on file in the EGSA offices for a minimum of seven years from the date of the last entry.

Retention and Release of CEU Information and/or Records
Individuals may obtain a copy of their records by submitting a written request. The copy will be mailed to the individual within six weeks of the date of EGSA's receipt of the request. EGSA will not release any information (verbal, electronic, or written) about an individual's CEU history or record, nor will it release a copy of an individual's CEU record, without the express written permission of the individual to whom the record belongs.

How do I get Additional information?
Any time you need additional information or have a question about our CEU program, contact George W. Rowley, EGSA Director of Education, by phone at 561-237-5557; by e-mail to G.Rowley@EGSA.org or by mail to George W. Rowley, EGSA Education Office, 1067 Woodruff Street, The Villages, FL 32162.

Basic School Module Descriptions and Learning Outcomes

The Basic School is designed for those that are working in non-technical positions (such as Sales or Marketing, Administrative, or Management positions) and for those with less than three years experience working in the industry.

Basic Electricity—This module provides a review of fundamental electrical concepts, preparing students with little or no knowledge of electricity with the basics of electrical and magnetic concepts prior to the Day 2-4 Core Program. Covers: Ohm's Law; AC and DC circuits; magnetism and magnetic concepts, including permanent and electro-magnetism. If you are not well versed in these subject areas, you should probably plan to attend this session.

Upon completion of this module, the student will be able to:

- Define the following basic concepts of electrical current, conventional and electron flow, Alternating Current, Direct Current, half wave and full wave rectification of AC to DC, polarity in DC circuits, frequency in AC circuits, electrical voltage, and resistance.
- Be conversant with both RMS and Average methods of measuring an AC sine wave.
- Understand single and three phase electric circuits.
- Be conversant with the effects of resistance on temperature and current flow in an electrical circuit.
- Identify the differences between permanent and electromagnets, and understand the concepts of a magnetic field, flux density.
- Understand Faraday's Law of electromagnetic induction.
- Understand inductors, and be conversant with the concept of Inductive Reactance (XL), and it's effect on current flow.
- Understand capacitors, and be conversant with the concept of Capacitive Reactance (XC) and its effect on current flow.
- Identify the differences between Resistance (R) in DC circuits, and Impedance (Z) in AC circuits.
- Define the Power Law, and the Power Law as it pertains to power in electric circuits.
- Understand the effect upon power demand by a change in voltage.
- Define the Work Law.
- Be conversant with the concepts of Apparent Power - Voltamperes (VA), Real Power - Watts (W), and Power Factor (PF).
- Understand the concept of leading and lagging power factor, and the effect of both leading and lagging Power Factor upon AC electrical systems.

Prime Mover Fundamentals—This module provides information on the two basic types of prime movers (spark ignited and compression ignited) found in the majority of On-Site Generation applications, allowing the student to appreciate the basic mechanical components found in a package generator set. Topics covered include: Core engine components; engine terminology; governors; ancillary engine equipment; fuel properties and fuel systems; coolant properties and coolant systems; and oil properties and lube systems.

Upon completion of this module, the student will be able to:

- Recognize common prime movers.
- Differentiate between different prime mover types.
- Recognize design characteristics of common prime movers.
- Name the various main subsystems of a Prime mover.
- Recognize altitude and temperature effects on prime mover power output.
- Recognize the various parts of the cooling system and their function.
- Recognize the basic internal parts of a reciprocating engine.
- Recognize the various parts of the air induction system.
- Recognize the various parts of the fuel system.

Basic Generator/Alternators—Basic Generator/Alternators is intended to be an introduction into the general design and functions of rotating AC electric generators. Major topics to be covered will be 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 of the AC voltage wave form, and frequency of the voltage wave form; exciters and excitation support systems. There will also be coverage of the types and criteria of AC generators, design including discussions of armature design features, generated harmonic voltages, and the methods of connection of both three phase and single phase armatures.

Upon completion of this module, the learner will be able to:

- Define basic electrical terms and expressions as they apply to on-site electrical power generation in general, and AC generators (alternators) in particular.
- Identify the various non-electrical components of a rotating electric generator.
- Define the wound components of an electric generator in both terms of location and function.
- Define and/or identify the differences between brush type, and brushless generators, static and rotating exciters.
- Understand the generation of an alternating current sine wave, and identify the effects of shaft rotative speed and the number of pairs of field poles on the frequency of the generated AC sine wave.
- Define Pitch Factor as it applies to armature windings, and have a basic understanding of harmonic content in a generated voltage sine wave.
- Define and identify the differences between single and two circuit armature windings.
- Identify the differences between single phase and three phase electrical power systems.
- Define and/or identify the differences between three phase Wye and Delta connections.
- Differentiate between NEMA and IEC systems of lead wire identification.

Basic Automatic Voltage Regulators—This module covers basic theory of operation for the voltage regulator and its application and selection for a synchronous generating system. It also includes discussion of special regulator applications and the use of excitation accessories and control devices for improved system performance and protection.

Goal 1: Give student a basic working knowledge of excitation system functions, including automatic voltage regulator (AVR), manual excitation control, AVR stability, frequency compensation, current boost.

Terminal Objective: Upon Completion of the Automatic Voltage Regulator module, the student will be able to select excitation system functions to specify the AVR needed to meet application requirements or specifications.

Learning Outcomes

- Student will be able to identify elements of the AVR.
- Student identifies the use and benefits of manual voltage control.
- Student identifies the purpose of AVR adjustable stability.
- Student recognizes the process of adjustment of AVR stability.
- Student recognizes the use and benefits of frequency compensation.
- Student identifies applications where current boost is required with the AVR.

Goal 2: Give student a working knowledge of parallel generator operation with AVR systems.

Terminal Objective: Student must be able to identify need for parallel compensation and generally understand what is needed to implement an AVR with parallel compensation.

Learning Outcomes

- Recognize the causes of circulating current when generators are paralleled.
- Recognize the difference between real and reactive power.
- Select a current transformer for implementing reactive load sharing with an AVR.
- Identify the critical connections needed to have an effective reactive load sharing operation.

Goal 3: Introduce student to digital technology applied to AVR systems.

Terminal Objective: Make student aware of the existence of digital AVR technology in the marketplace.

Learning Outcomes—N/A

Basic Governors/Speed and 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, 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.

Upon completion of this module, the student will be able to:

- Identify the function of an engine governor.
- Identify the function of the flyweights, in a mechanical governor.
- Define the functions of Droop and Isochronous modes in a governor system.
- Identify problems associated with the governor linkage.
- Identify the function of the Magnetic Pickup (MPU).
- Define the expression "Closed Loop Speed Control".
- Identify the advantage of Isochronous Baseload over Droop Baseloading.

Basic Automatic Transfer Switches—This module provides a basic overview of what a transfer switch does, how it operates, and where it is applied in the On-Site Power System. It will describe general applications, codes and standards, ratings, accessories, as well as concepts of reliability.

Upon completion of this module, the student will be able to:

- Describe the main difference between an automatic transfer switch and manual transfer switch.
- Understand the main differences in qualification testing for transfer switches listed to UL67 & 98 and those listed to UL1008.
- Identify the main UL Standard for transfer switches.
- Identify the major component modules which make up a transfer switch.
- Name the various ratings of a transfer switch.
- Differentiate between Interrupting Rating and Withstand Current Rating.
- Explain the reasoning for the need for various withstand ratings for the same switch.
- Describe the standard time delays included in most transfer switch designs.
- Identify the most common transfer switch operators.
- Describe the typical controls and annunciation devices mounted on the door of an Automatic Transfer Switch.
- Differentiate between Open Transition and Closed Transition Transfer Switches.
- Explain the need for Bypass-Isolation switches.
- Describe the sequence of operation of a Bypass-Isolation switch.

Basic Generator Systems: From Sizing to Service—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 customers power requirements; basic load characteristics and their effects on genset sizing, selecting the right engine and generator for the application and what types of fuels are available and should be recommended; the accessories that should be included; selecting the right location for the set; installation consideration, start up and service, including common requirements and issues and basic national code relevance and compliance.

Learning Outcomes
Upon completion of this module, the learner will be able to:

- Name the 3 main ratings for generator sets.
- Differentiate between standby, prime and continuous duty ratings.
- Recognize different capacity characteristics of generator sets.
- Recognize the different fuel source options and advantages of each.
- Name the main components of a generator set.
- Recognize altitude and temperature de-rating factors on generator sets.
- Recognize the different types of loads and their affects on generator sets.
- Recognize different methods of cooling engine generator sets.
- Recognize the symptoms of light load.
- Recognize basic load sizing characteristics of different load types and the impact on generator set sizing.
- Recognize the basic components in diesel and gaseous fuel systems.
- Identify the basic maintenance requirements for legally required standby power systems.
- Recognize the relevance of NEC and NFPA-110 to standby power systems.
- Recognize methods of sound attenuating generator sets.

Understanding Bid and Specification Documents—This module is designed for students with a solid understanding of on-site power systems, but who seek a basic understanding of the specification and bid process as it relates to on-site power. 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, standards, and codes used by engineers, contractors, and others.

Upon completion of this module, the student will be able to:

- Identify the entities involved in the creation of project plans and specifications.
- Identify (or recognize) the needs, roles and motivations of entities involved in the creation of project plans and specifications.
- Locate the specific written codes referenced in the specifications from reference sources.
- Identify the NFPA codes most relevant to generation systems.
- Recognize the UL codes most relevant to generator projects.
- Identify the preferred sources of plans and specifications.
- Recognize documents included in a typical plan set.
- Recognize items in technical specifications essential to accurately bid projects.
- Identify typical problems areas in specifications.
- Recognize common symbols used in drawings.
- Recognize Military specifications and their origins.
- Identify common mistakes made in interpreting bids and specifications.

Advanced School Module Descriptions and Learning Outcomes

The Advanced School is designed for those who have attended the EGSA Basic On-Site Power Generation School; those employed in Engineering, Project Management, or Service positions; and for those with over three years working in the industry.

Advanced Generators/Alternators—This module will contain a review of Power Factor (Cosine Theta), and the effects of load operating power factor on generator performance. Major topics discussed are Generator grounding conductors and grounded neutral conductors, harmonics, generator insulation systems; operating temperatures, and temperature related considerations, and the effects of environment on generator operation; basic conditions of generator loading including transient and steady state loading; criteria of loading - linear and nonlinear, with discussions on the effects of these two criteria of loading on generator performance; along with a brief review of induction motor starting, and generator sizing considerations for starting and running induction motors.

Upon completion of this module, the student will be able to:

- Define "Neutral" as it applies to electric power generators and distribution systems.
- Define the grounding (earthing) conductor, and understand the circumstances where a grounding conductor may also act as a grounded neutral conductor.
- Understand the effects of harmonic voltages imposed upon an alternator's output voltage sine wave.
- Describe coil pitch and pitch factor.
- Define ambient temperature, and temperature rise as used with both electric generators and motors.
- Identify the Classes of insulation systems used with both electric generators and motors, and define "continuous duty" and "standby duty" ratings of rotating electric generators.
- Be conversant with the NEMA and IEC "Index of Protection (IP)" system.
- Understand that site altitude, ambient temperature, and environment are to be taken into account when selecting the proper generator for a specific application.
- Describe leading, lagging, and purely resistive electrical loads.
- Define Power Factor.
- Understand the effects of lagging and leading power factor loads upon rotating electrical generators in particular, and electrical distribution systems in general.
- Understand the difference between mechanical kW (kWm) and electrical kW (kWe).

- Define generator efficiency.
- Understand the difference between steady state and transient loading of a generator set.
- Distinguish between linear and non linear loads.
- Understand the effects of erroneous voltage zero crossings on automatic voltage regulators and other switching power supplies.
- Be familiar with both static and rotary UPS systems.
- Understand the impact on a generator's output voltage sine wave by load induced harmonics.
- Be familiar with NEMA system of induction motor Starting Code Letters.
- Understand the effects of reduced voltage upon induction motor starting, and generator sizing for induction motor starting.
- Be familiar with the effects of soft start starters as regards to selecting a generator to start and run induction motors with soft start starters.

Engine/Generator Instrumentation and Control—This module covers instrumentation and control from the most basic systems through more elaborate systems, including SCADA applications. Major topics will be traditional vs. latest technology instrumentation, communication options for remote sites, and future instrumentation.

Upon completion of this module, the student will be able to:

- Recognize the most common causes of premature failure of engine/generator controls & devices.
- Identify common types of analog signals.
- Identify common types of digital/discrete signals.
- Identify common types of pressure measurement devices in engine driven systems.
- Identify common types of temperature measurement devices in engine driven systems.
- Identify common types of fluid level measurement devices in engine driven systems.
- Identify common types of vibration measurement/protective devices in engine driven systems.
- Identify common types of speed sensing/measurement devices in engine driven systems.
- Define the term "SCADA".

Advanced Governors/Speed and Load Controls—Increased engine governing capabilities are achieved on modern generators by utilizing electro hydraulic governors 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. This session also covers electronic isochronous load sharing and governing principles of gaseous fuel powered generators.

Upon completion of this module, the student will be able to:

- Identify the function of the electric actuator in an electro hydraulic governor.
- Recognize the summing point in an electronic control system.
- Identify an Air/Fuel Ratio category of Gas Engines.
- Define the function of ignition timing control in a governor system for spark ignited engines.
- Identify the operation of a multi-point gain curve used with a gas engine.
- Define the functions of the Gain Window and Gain Ratio terms in a digital control system.

Advanced Automatic Voltage Regulators—This module is intended to provide the student with an understanding of some of the more complex issues associated with controlling 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 to be discussed:

- Basic Automatic Voltage Regulator functionality.
- Stability versus Transient Response.
- Paralleling Generators - Islanded.
- Paralleling Generators - Utility.
- Commissioning of voltage regulators.
- Trouble shooting off line problems.
- Trouble shooting on line problems.

Introduction: This module covers basic theory of operation for the voltage regulator and its application and selection for a synchronous generating system. It also includes discussion of special regulator applications and the use of excitation accessories and control devices for improved system performance and protection.

Goal 1: Give student a basic working knowledge of excitation system functions, including automatic voltage regulator (AVR), manual excitation control, AVR stability, frequency compensation, current boost.

Terminal Objective: Upon Completion of the Automatic Voltage Regulator module, the student will be able to select excitation system functions to specify the AVR needed to meet application requirements or specifications.

Learning Outcomes

- Student will be able to identify elements of the AVR.
- Student identifies the use and benefits of manual voltage control.
- Student identifies the purpose of AVR adjustable stability.
- Student recognizes the use and benefits of frequency compensation.

Goal 2: Give student working knowledge of the various ways to adjust an AVR to achieve steady state stability and acceptable transient response.

Terminal Objective: Student must be able to recognize the terms associated with AVR adjustment and understand the testing required in making the necessary the adjustments.

Learning Outcomes

- Student will be able to identify the basic elements of the AVR stability network.
- Student identifies the use of various AVR stability adjustment methods.
- Student recognizes the process of adjustment of AVR stability.
- Student understands the various tools required to perform necessary adjustments.

Goal 3: Give student a working knowledge of parallel generator operation with AVR systems.

Terminal Objective: Student must be able to identify need for parallel compensation and understand what is needed to implement an AVR with parallel compensation.

Learning Outcomes

- Recognize the causes of circulating current when generators are paralleled.
- Recognize the difference between real and reactive power.
- Select a current transformer for implementing reactive load sharing with an AVR.
- Identify the critical connections needed to have an effective reactive load sharing operation.
- Troubleshoot problems associated with paralleled generators.

Goal 4: Give student a working knowledge of parallel generator operation with the utility network.

Terminal Objective: Student must be able to identify the need for different AVR controls when the generator is paralleled to a network versus another generator.

Learning Outcomes

- Identify options for AVR control when paralleled to a utility network.
- Recognize the need for excitation limiters when paralleled.
- Understand the differences between VAR and Power Factor Control.
- Understand setting limiters as they apply to generator performance.

Goal 5: Give the student and understanding of the steps required in commissioning an AVR and troubleshooting problems.

Terminal Objective: Student must be able to identify the AVR's effect on generator performance and how to determine if the AVR is properly connected and configured.

Learning Outcomes

- Recognize the various settings available in a typical AVR and their effect on the generator.
- Identify the tool required to help commission the AVR.
- Understand the specific interconnection of the AVR, generator and any associated components which effect performance.

Electrical Start Systems—This module provides an overview of electrical and air-start systems, including general electrical sizing parameters, environmental considerations and battery technologies commonly deployed to start engines or turbines. Topics include:

- Electrical versus air-start systems.
- Parameters required to size electrical start systems.
- The effects of environmental conditions on battery performance and life.
- Features, benefits and modes of failure of traditional battery technologies.
- System reliability, life cycle costing (LCC) and return on investment (ROI).
- Installation, maintenance and replacement best practices.

Upon completion of this module, the student will be able to:

- List five commonly used battery plate technologies.
- Identify how a battery is affected by low electrolyte temperature.
- Identity three common causes of electrical start system failure.
- Name two benefits of lead-acid and nickel-cadmium technologies.
- Differentiate between the effects on battery capacity of high battery end-of-discharge voltage and low battery end-of-discharge voltage.
- Identify why the engine management system may fail or send a 'no start' signal when the battery has been correctly sized to start an engine.

Introduction to Generator Protection—Electrical problems occur in power generation systems, endangering the equipment. You will learn about common electrical problems known to occur and solutions commonly used to protect equipment from damage caused by these problems. Short circuits, control system failures, operator errors, all should be considered in genset protection. Methods of providing protection for all of these problems will be covered in the class.

Upon completion of this module, the student will be able to:

- Identify various potential causes for damage to power system equipment.
- Select protection devices commonly used to limit damage to power system equipment.
- Identify protection equipment from power system drawings.
- Choose protection elements appropriate to common power system configurations.

Upon completion of the module, the student may also be able to:

- Identify protection function based on IEEE device number.
- Propose the use of directional relays for more complex application.
- Explain the benefit of using the differential protection scheme.
- Propose the use of directional relays for larger power system applications.

Advanced Automatic Transfer Switches—This module provides more in-depth description of transfer switches, applications such as Closed-Transition, Delayed-Transition, Bypass-Isolation, Softload switches, Motor load transfer, neutral switching and communications systems.

Upon completion of this module, the student will be able to:

- Identify the differences between selective normal and non-selective automatic transfer switch operation.
- Identify the differences between a closed transfer switch and an open transition transfer switch.
- Recall the operation of a Closed Transition Transfer Switch and the benefits of Closed Transition Transfer.
- Identify the differences between soft load and closed transition transfer switches.
- Recall the reason remote communications are important in transfer applications and the type of monitoring and control information is typically available.
- Recall the importance of Bypass/Isolation switches to testing and maintenance of an on-site power system.
- Identify the various methods of terminating or switching the neutral conductor at the transfer switch.
- Identify the typical methods of handling the transfer of large motors and recall the advantages and disadvantages of each method.

Multiple Generator Paralleling Switchgear and Controls—This portion of the school covers switchgear and controls for generator sets, with particular emphasis on synchronizing and paralleling multiple generators and the considerations that must go into design of such a system. Peak shaving, load shed, threshold demand, SCADA communication, and protective relaying are covered. Types of switchgear construction, low and medium voltage systems, transfer systems, UL891 and UL1558 construction will be reviewed and compared.

Upon completion of this module, the student will be able to:

- Indicate why Paralleling Switchgear is used.
- Describe Paralleling Switchgear.
- Identify the difference between Synchronizing and Paralleling.
- Define Low and Medium Voltage.
- Select typical sequences of Paralleling Switchgear operation.
- Determine full load current of Generators based on KW rating.
- Select what are typical applications of Paralleling Switchgear.
- Identify the parameters necessary for synchronization.
- Identify the correct Switchgear layout Lineup including Generator Sections, Master Controls and Distribution.
- Choose common constructions of Paralleling Switchgear.
- Recognize different types of Paralleling Switchgear.
- Differentiate between UL 891 and UL 1558.

Troubleshooting Field Problems—This module is designed to help those of you who are expected to solve electric power generation field problems. When the usual problem solving techniques do not lead to a lasting resolution, use the more formal process presented in this entertaining and fast-paced session. After presenting the formal model, the instructor guides the students through numerous real-world examples illustrating the smooth, confident application of this formal process. This session will provide another arrow in your professional quiver and empower you to solve complex problems.

Upon completion of this module, the student will be able to:

- Recognize the limitations of the typical troubleshooting process (i.e.; fixing a symptom instead of solving the problem).
- Identify basic troubleshooting and testing tools.
- Identify the 7 steps in the troubleshooting process.
- Identify the 4 basic reasons for using a formal troubleshooting process.
- Recognize, or identify, three (3) acceptable data gathering techniques.
- Identify three (3) reasons why data should be questioned.
- Identify two (2) reasons why multiple hypotheses should be developed.
- Identify the two (2) main pitfalls in the process.
- Identify three (3) basic testing concepts.
- Identify four (4) key considerations when developing solutions.
- Define "Root Cause".
- Identify what to do if the troubleshooting process fails.

Engine Emissions—This module discusses the main pollutants emitted from engine exhausts, their effects on the environment and current methods of reducing them. Topics covered include: emissions regulations, how pollutants are created during combustion, pollution reduction solutions before, during and after combustion. Post combustion technologies including SCR, EGR, Diesel Particulate Filters and Oxidation Catalysts will be examined.

Upon completion of this module, the student will be able to:

- Identify four pollutants emitted by prime movers in the power generation industry that are regulated by various government bodies.
- Identify three negative effects of engine emissions on the environment.
- Understand current and proposed regulations of exhaust emissions.
- Identify the stages of the combustion process that creates the pollutants.
- Identify three advances in engine design that are reducing harmful emissions.
- Recognize the difference between rich-burn and lean-burn natural gas engines.
- Identify the current methods of post-combustion technologies that are available, including SCR, EGR, diesel particulate filters and oxidation catalysts.
- Recall the three main components in a catalyst.
- Name the three most commonly used precious metals in catalysts.

Noise Control—The Noise Control module will provide a broad and relatively in-depth overview of important sound-related issues and concepts. The module is presented in five sections:

1. Basic Acoustics (covers: logarithmic nature of hearing and the decibel, the A 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; properties of noise at enclosure openings).
3. Engine Exhaust Noise (covers: characteristics of raw engine exhaust noise, silencer types, styles, insertion loss performance, design and validation of exhaust systems).
4. Airflow Generated Noise (covers: characteristics of fan and airflow noise; 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).

Upon completion of this module, the student will be able to

Section 1 - Basic Acoustics:

- Define sound, vibration, magnitude, frequency, decibel, attenuation, and free-field.
- Identify relative loudness of common noise sources.
- Differentiate between Sound Power and Sound Pressure.
- Recognize industry standard noise level reporting formats.
- Explain weighting curves, specifically the "A" curve and its relationship to human auditory response.
- Predict the propagation characteristics of noise at various frequencies.
- Understand the inverse square law.

Section 2 - Mechanical Noise:

- Define barrier, transmission loss, absorption, structure-borne.
- Identify 3 fundamental properties of an enclosure as a barrier.
- Identify 3 fundamental properties of an enclosure as an absorber.
- Recognize behavior of noise at openings and interfaces.

Section 3 - Engine Exhaust Noise.

- Define raw engine noise, exhaust temperature, exhaust flow, maximum allowed engine backpressure.
- Identify silencer types, styles, grades, and insertion loss.
- Specify engine exhaust silencers and validating the exhaust system.
- Understanding flow velocity and self generated noise.

Section 4 - Airflow Generated Noise:

- Define volume flow, velocity pressure differential, lined elbow, and plenum.
- Recognize the characteristic noise signature of fan and airflow noise.
- Analyze the relationship between volume flow, velocity, and area.
- Analyze trade-off between opening size, acoustic performance, and static pressure drop.

Section 5 - System Review:

- Calculate the effect of noise from multiple sources.
- Identify critical elements of a noise control specification.
- Understand noise measurement procedure.

Advanced Generator Systems: from 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 customers power requirements; in depth explanation of load types, characteristics and staging, and their effects on genset 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; specific installation considerations and requirements, start up and service, and national code relevance and compliance.

Learning Outcomes
Upon completion of this module, the learner will be able to:

- Name the three main ratings for generator sets.
- Differentiate between standby, prime and continuous duty ratings.
- Recognize different characteristics of generator sets.
- Recognize different fuel source options and advantages and disadvantages of each.
- Name the main components of the generator set.
- Recognize altitude and temperature de-rating factors on generator sets.
- Recognize the different types of loads and their affects on generating sets.
- Recognize ways to counteract adverse effects of certain types of loads on generator sets.
- Recognize different methods of cooling engine generator sets.
- Recognize causes of wet stacking as well as corrective actions.
- Recognize basic load sizing characteristics of different load types and the impact on generator set sizing.
- Recognize the importance of staging loads and motor starting methods used to reduce generator size requirements.
- Name the basic components in diesel and gaseous fuel systems.
- Identify the basic maintenance requirements for legally required standby power systems.
- Have a working knowledge of industry-wide resources for information, NEC and NFPA-110 and their relevance to standby power systems.
- Recognize methods and relative costs associated with sound attenuating generator sets.

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