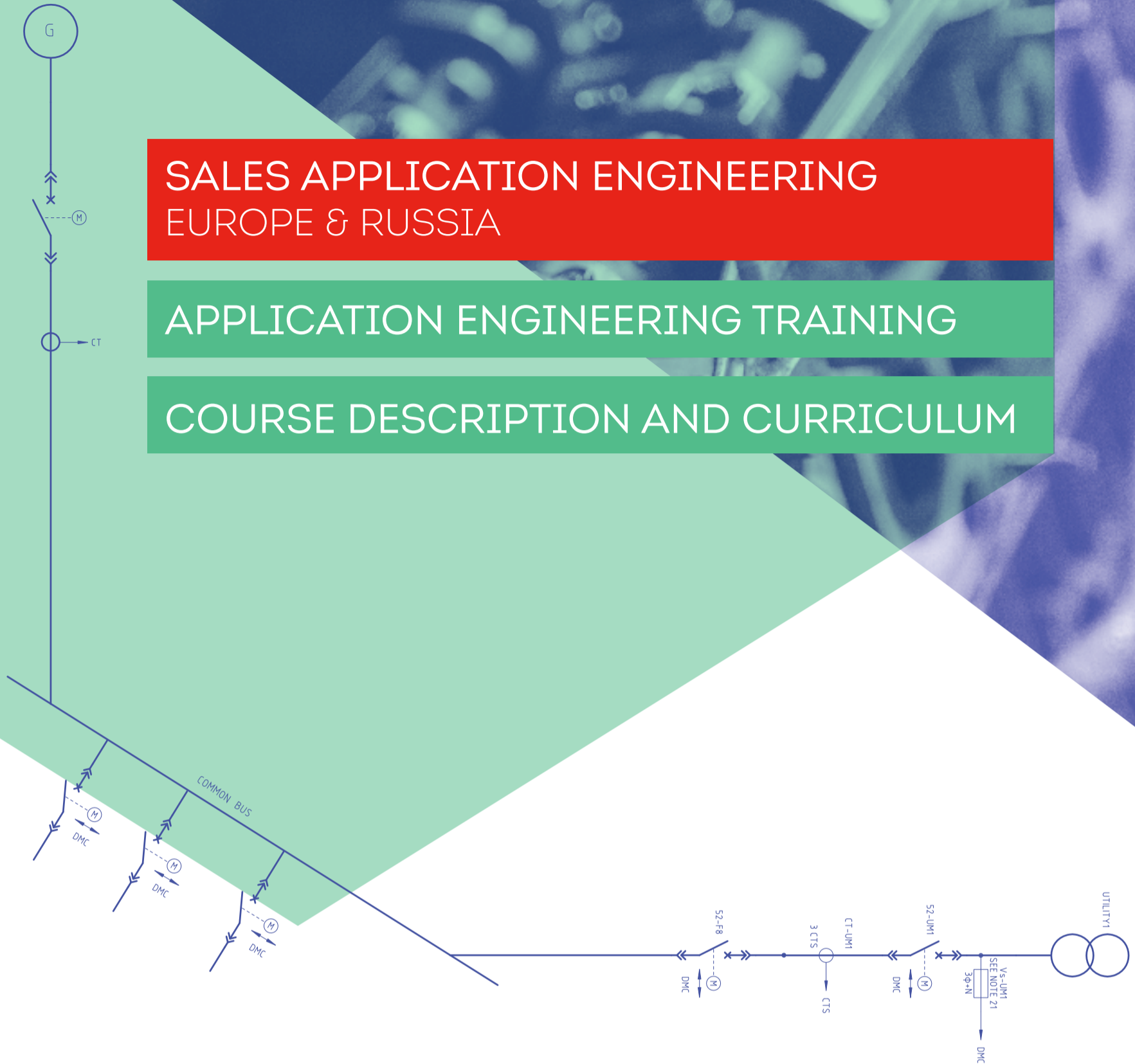


SALES APPLICATION ENGINEERING EUROPE & RUSSIA

APPLICATION ENGINEERING TRAINING

COURSE DESCRIPTION AND CURRICULUM



AIM OF THE COURSE

The objective of this Application Engineering training is to provide a comprehensive study on the technical aspects of selection and installation of Diesel and Gas generating sets and related sub-systems. Divided into three different parts, this training aims to provide engineers, from varied backgrounds or responsibilities, with the necessary skills and tools to leverage sales and select and install effectively Cummins Power Generation products. At the same time this course also encourages the discussion and exchange of experiences between application engineers from different locations.

METHODOLOGY

The training will be delivered in a classroom format and will be focused on real case studies and practical examples. Attendees are expected to participate actively in the training by engaging in the discussions and by sharing their own view or experiences. Extensive documentation for each part will be provided with manuals, white papers, application bulletins and more. There will be a knowledge check session at the end of each training day followed by an exam at the end of each section.

COURSE REQUIREMENTS

To attend any of the Application Engineering training parts the course participants must:

- Have completed the On-Line AE classes in Cummins Learning Centre
- Be recognized Cummins Distributors / Dealers

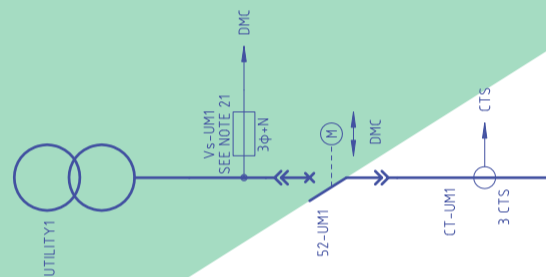
CONTACT

sae.europe@cummins.com

COURSE STRUCTURE

This course is structured in three different and separate parts, Product Selection, Mechanical Design and Electrical Design. These parts are to be delivered across different dates providing the attendants the flexibility and the option to attend only one, two or three parts of this training.

PRODUCT SELECTION		MECHANICAL DESIGN		ELECTRICAL DESIGN	
PS01	ISO8528 Genset Ratings Definitions & Typical Genset Applications	MD01	Foundation and Mounting	ED01	Alternator performance
PS02	Fuel requirements	MD02	Exhaust systems	ED02	Wiring & connections
PS03	Location considerations and operation in harsh environments	MD03	Engine Cooling	ED03	Networking & Communication
PS04	Systems topologies	MD04	Ventilation	ED04	Low Voltage Systems & Associated protections
PS05	Additional considerations for product selection	MD05	Fuel Systems	ED05	Medium Voltage & Associated protections
PS06	Project requirements	MD06	Noise	ED06	Power Gen Installation Review - Electrical Installations
PS07	Codes & Standards	MD07	Installation layouts		
PS08	Emissions	MD08	Power Gen Installation Review - Mechanical Installations		
PS09	Understanding loads and Transient Performance				
PS10	Gensize™				



WHO SHOULD ATTEND?

Product Selection is mostly focused on the several aspects to be taken into consideration whilst selecting both diesel and gas generating sets and their related sub systems. Due to its diversified content, it is targeted at both technical sales and application engineers.

Mechanical Design and **Electrical Design** focus on all the mechanical and electrical considerations required for project design and implementation. Due to its purely technical nature these two parts are mainly targeted to engineers looking to develop and improve their skills and knowledge in these fields.

RESOURCES

During the Application Engineering training the course participants will be required to access different data bases to gather information. Prior to the training attendants must ensure that they have access to the following databases and tools:

- Matrix (CPG PLM) – access to drawings
- GCE (Global Customer Engineering) – access to G-Drive technical data
- Power Suite™ – access to technical data, drawings, Gensize™, GenSpec™ amongst others.
- Power Zone – online ordering tool for CPGK gensets
- QuickServe Online – aftermarket and service database
- InPower – Service diagnostic tool

EVALUATION AND CERTIFICATION

For each part a Certificate will be attributed to those who attend the training days and that successfully pass on exam. Pass criteria on each exams is 85% minimum.

Attendees who successfully complete the three parts will receive the Application Engineering training course diploma.

Those attending the training that do not pass an exam will be allowed to review any failed topics and the opportunity to repeat the exam. Exam repetitions can be done either during the training or at a later date, subject to agreement with the course facilitator(s) and depending upon the grade obtained.

PRODUCT SELECTION

PS01

ISO8528 GENSET RATINGS DEFINITIONS & TYPICAL GENSET APPLICATIONS

Ratings definition as per ISO 8528 and standard conditions defined. What parameters impact the genset rating? How to select the right rating for standard and specific conditions. Discussions on competitor's optional ratings. What are site specific ratings (SSR) and when they should be used. Typical project requirements and characteristics for different applications: Critical Applications, Telecom, Rental, Rail, Nuclear, Oil Industry, Marine, Combined Heat and Power (CHP), Grid support and Black start applications.

PS02

FUEL REQUIREMENTS

Recommended fuel properties for Cummins Engines and impact of fuel properties on product performance. Biodiesel fuel blendings. Eurodiesel. Diesel and Gas typical applications, what parameters should be considered for decision making? Advantages and typical applications of dual fuel engines. Alternative fuel considerations. Fuel storage regulations and recommendations. Fuel consumption VS Lubricating oil consumption.

PS03

LOCATION CONSIDERATIONS AND OPERATION IN HARSH ENVIRONMENTS

The impact of altitude and temperature on the genset components. Altitude and temperature derate calculations. Outdoor or Indoor applications. Noise requirements, Cold weather application considerations Hot weather application considerations. Operation at high altitude. Sandy environments. Coastal and other corrosive environments. Site security.

PS04

SYSTEMS TOPOLOGIES

Symbols and schematic drawing. Switchgear topology and genset grounding: Isolated Bus, Common Bus Island Mode, Common Bus and Utility Paralleling, Transformer options. Selecting a Digital Master Controller (DMC): decision factors and product limitations. Automatic Transfer Switches (ATS).

PS05

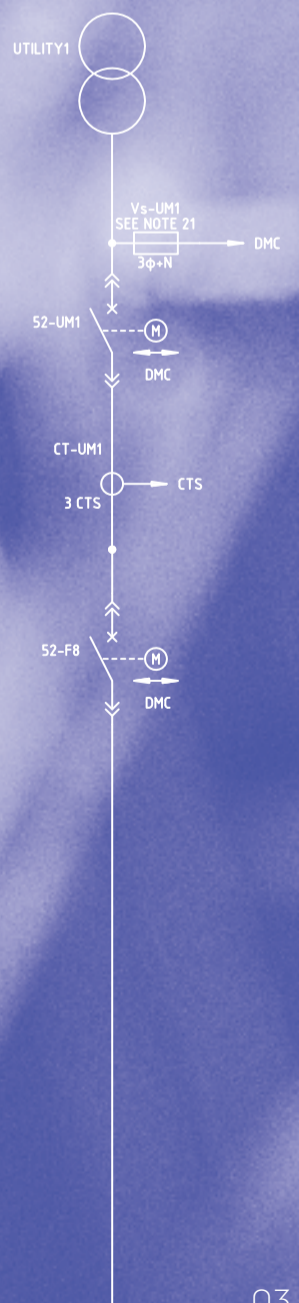
ADDITIONAL CONSIDERATIONS FOR PRODUCT SELECTION

Engine selection: emissionized / non emissionized, engine cooling configurations, type of governors, starting systems, Advantage engines. Alternator selection: Voltage and winding options, bearing, excitation, temperature rise and insulation class. Controller functionalities and features. Radiator selection: Limiting Ambient Temperature (LAT), remote cooling applications and alternative cooling options. Battery and Battery charger selection. Additional options. Combined Heat and Power equipment selection.

PS06

PROJECT REQUIREMENTS

Considerations for Low Voltage (LV) and Medium Voltage (MV) applications and implication on product selection: paralleling applications and grounding. LV Generator with step-up Transformer or MV generator. Single Genset versus Parallel Gensets. Power density.



PS07

CODES & STANDARDS

Definitions: Codes, Standards, Directives and Regulations. An overview on ISO 8528. Other Codes and Standards applicable to gensets, engines, alternators and systems. CE compliance. ANSI codes. Factory certifications.

PS08

EMISSIONS REGULATIONS

Comparison on the different emission regulations currently applicable in Europe. Interpretation of emission data sheets, emission requirements and how to compare these with published data. Conversions and corrections for comparison of requirements. Aftertreatment solutions and their impact on emission reductions, installation/design considerations.

PS09

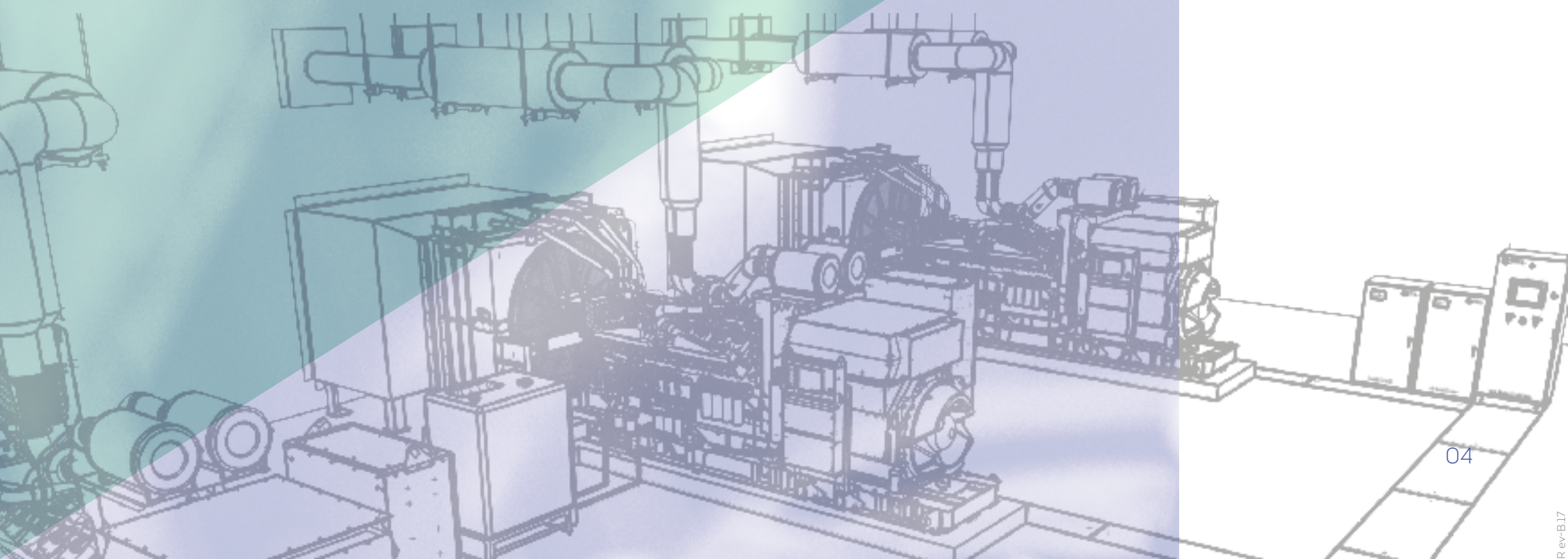
UNDERSTANDING LOADS AND TRANSIENT PERFORMANCE

Impact on generating set performance from the different type of loads: lighting, transformers, motors, pumps, UPS and regenerative loads. Power factor considerations. How some loads impact alternator performance and how some other impact on engine performance. Starting methods, starting sequence, and customer specified starting requirements for load stepping. Transient performance classes as per ISO 8528-5. Customer requirements versus ISO 8528. Beyond ISO 8528-5. Transient performance on Gas Generating sets.

PS10

GENSIZE™

Gensize™ software overview, capabilities and functions. Sizing parameters of single and multiple generating set applications. Results interpretation and correlation to selectable parameters. Project sizing optimization.





MECHANICAL DESIGN

MD01

FOUNDATION AND MOUNTING

Vibration isolating foundation calculations. Vibration isolators (single isolation and dual isolation). Seismic isolation requirements. Common issues and solutions.

MD02

EXHAUST SYSTEMS

Exhaust system considerations. Exhaust backpressure calculations. Common issues and specific solutions. Exhaust systems in Combined Heat and Power applications.

MD03

ENGINE COOLING

Engine cooling requirements: coolant, installation considerations, maintenance and serviceability. Radiator arrangements and radiator performance. Remote cooling applications: types of systems, how to decide, calculating static and friction heads. Deaerating tanks. Heat exchangers sizing calculations. Limiting Ambient Temperature.

MD04

VENTILATION

System design recommendations: requirements, single and multiple sets, inlet and outlet louvers. Calculating airflow requirements. Airflow restriction calculation, and recommendations. Common issues and solutions.

MD05

FUEL SYSTEMS

Fuel Supply and fuel properties. Day tanks sizing and recommendations. Bulk tanks sizing and recommendations. Fuel Systems layout considerations: day and bulk tanks location and recommendations. Fuel cooling: identify the need for fuel cooling, fuel cooler calculations and use of a day tank as a heat sink. Fuel maintenance: fuel shelf life and fuel polishing.

MD06

NOISE

Sound Power and Sound Level and sources of noise. Adding multiple noise sources. Noise attenuation over distance. Noise reduction techniques and solutions. Understanding silencer attenuation.

MD07

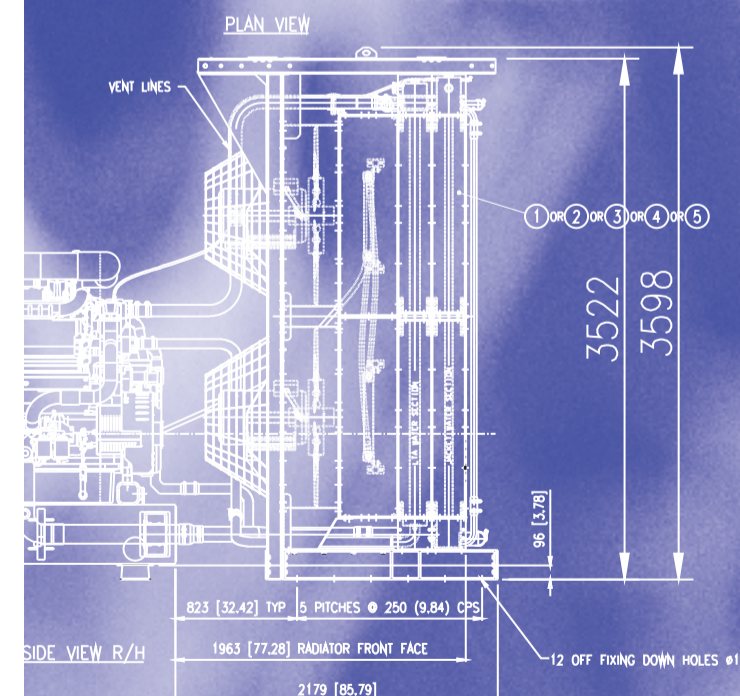
INSTALLATION LAYOUTS

Room layout recommendations. Room sizing for single or multiple gensets. Main considerations and requirements from serviceability and operation perspective. Outdoor applications requirements and recommendations. Power stations layout. Environmental considerations. Related systems: fuel Systems and lubricating oil systems.

MD08

POWER GEN INSTALLATION REVIEW - MECHANICAL INSTALLATIONS

Guidelines for review of mechanical aspects of an installation and functional testing. Cooling capability and Limiting Ambient Temperature (LAT). Vibration isolation. Exhaust systems inspection and back pressure testing. Ventilation systems inspection and testing.



ELECTRICAL DESIGN

ED01

ALTERNATOR PERFORMANCE

Alternator fundamentals: construction, principals of operation, configuration. Single phase application and conversion. Alternator curves: locked rotor, short circuit, thermal damage, operating chart, magnetization curve. Reactance's & Short Circuit Capability calculations. Examples of Load currents & Fault currents. Leading power factor considerations.

ED02

WIRING & CONNECTIONS

Auxiliary connections. Engine heaters, radiator fan. Battery and Battery chargers. Control inputs and outputs, settings and setup. Power cable connections and sizing. Current Transformers (differential and measurement). Paralleling genset interconnections: Master First Start Sensor (MFSS), Masterless Load Demand (MLD), Load Sharing and third party controller's interaction.

ED03

NETWORKING & COMMUNICATION

Fibre optic rings. Redundancy and out-stations. Modbus, Ethernet, Profibus, BACNet.

ED04

LOW VOLTAGE SYSTEMS & ASSOCIATED PROTECTIONS

Low Voltage System grounding. Application of fuse switch, MCB and ACB. Low voltage Switchgear and associated protection devices. Single and multiple genset applications. Selective coordination. G59 protection relay.

ED05

MEDIUM VOLTAGE & ASSOCIATED PROTECTIONS

Health & Safety (H&S) in MV applications. Arc Flash (AFLR). MV system grounding: Neutral Earth Resistor (NER) VS Earthing transformer. Generator fault contributions to switchgear, fault current calculations. Utility synchronizing with MV generators. Generator protection relays. Energising transformers. Lightning and surge protection.

ED06

POWER GEN INSTALLATION REVIEW - ELECTRICAL INSTALLATIONS

Health & Safety (H&S) interlocking. Grounding inspection and testing. Electrical clearances. Test on load.

