

## General information about the Woodward Micronet control system training course



### WOODWARD MICRONET CONTROL SYSTEM TRAINING COURSE

Week 41, 9 – 13 October 2017  
5 days, Elst – The Netherlands  
reference: 36601669

This training course has been developed in order to fill in customers' need to get the highest level of training needed for operating and maintaining the LM2500/+DLE - LM6000DLE gas turbines and deals with all I&C aspects when working with these complex installations.

#### For whom?

I&C Technicians and Supervisors, Operators and Operation Managers. In general for those who need an in-depth understanding of the Woodward Micronet Control System.

The training course is meant for employees of end users of gas turbines (companies with one or more operating LM-type gas turbines or companies that are going to operate LM-type gas turbines).

#### Entry level

Thorough understanding of the gas turbine equipment and its operation. Familiarity with control system basics. The training participants should be familiar with analog and digital control techniques. VBR advises that participants have followed the mechanical LM2500/PGT25 and LM6000 training course, or have gained similar knowledge.

#### Course manual

Each trainee will receive a training manual in full color, covering the relevant subjects of the training course. The text in the course manual, supplied by VBR turbine partners, will be in English and they will cover all subjects handled in the course.

#### Language

The training will be conducted in English. The manuals are in the English language as well.

#### Trainer

A qualified English speaking senior instructor with over 15 years' of experience will present the course.

#### Training location

The training course will be held at the VBR premises in Elst, The Netherlands.

#### Training duration

Monday/Tuesday/Wednesday/Thursday 08:30 – 16:00  
Friday 08:30 – 14:00  
Lunch 12:00 – 13:00 *provided by VBR*

#### Pricing / payment conditions

For the Familiarization Woodward Micronet & Engine Control training course, in Elst, The Netherlands, the cost will be: € 2.500,- per person. (excl. VAT, lodging and travel expenses)  
Payment in advance after receipt of our invoice.

#### Registration

If you wish to participate in the course please use the registration form at least three (3) weeks prior to the start of class. You can also request a registration by e-mail (refer to the e-mail address below. VBR requests to send a PO (purchase order) with or immediately after the registration. Receipt of the registration form will be formally confirmed by mail. An invoice will be included if prepayment is required.

#### Cancellation

If you have received a registry confirmation but are forced to cancel due to circumstances beyond your control, you can cancel the registration up to two (2) weeks before the course commencement date. The paid amount will then be refunded. After this date, or in the event of a no-show, no amount will be refunded. VBR reserves the right to cancel or defer the course. Cancellation or deferment of the training course will be notified by VBR two (2) weeks prior to the course date. VBR is not responsible for any expenses incurred due to non-refundable airline tickets or hotel accommodations.

#### Hotel accommodation

As an attachment to the registry confirmation, you will receive a list of hotels in the vicinity of Elst, and a map showing the route to the training location.

#### Further information

If more information concerning the training course is required, or if you need information about other training possibilities, please do not hesitate to contact the VBR Turbine Partners training department.

e-mail: [training@vbr-turbinepartners.com](mailto:training@vbr-turbinepartners.com)

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Reference number: **35601443**

### Course objective:

- Understand the basic construction of the GE LM gas turbines and their auxiliary systems.
- Understand Woodward controls hardware for effective maintenance and trouble shooting.
- Understand how engine sequencing, fuel control and monitoring is applied to the LM2500/PGT25 and LM6000 gas turbines within the MicroNet GAP and DCS. Dynamic simulation will be used where appropriate to help visualize some of the intricate issues. This will help operations to improve availability, performance and reliability, and to reduce operating and maintenance costs.
- Understand real-life engine problems for improved troubleshooting and problem solving. Dynamic simulation will be used where appropriate to help visualize some of the intricate issues.

### Course content:

#### Day 1

- Make acquaintance and presentation of the program
- An introduction to LM gas turbines
  - Gas Turbine Basics
  - Introduction to the LM Gas Turbines
- An introduction to the Major Components of the LM2500/PGT25 and LM6000
  - Low Pressure Compressor (LPC)
  - High Pressure Compressor (HPC)
  - Variable Geometry Control System compressor (IGV, VSV, VBV)
  - Combustion System (SAC - DLE)
  - High Pressure Turbine (HPT)
  - Low Pressure Turbine (LPT)
  - 6 Stage GE Power Turbine (PT)
  - Bearings, Sumps and Frames
- An introduction to the Auxiliary Equipment and Systems
  - Device summary
  - Flow and Instrumentation Diagrams (F&ID's / P&ID's)
  - Hydraulic starting system

- Gas turbine lube oil system
- Turbine hydraulic system
- Compressor/load gearbox lube oil system
- Fuel systems
- Inlet air and ventilation system
- Fire protection system
- Compressor water wash system

#### Day 2

##### Controls hardware & software

##### Instrumentation & Control

- On- and off engine instrumentation
  - Pressure - speed - temperature - LVDT's - RTD - CHPDT - vibration - air inlet filter dP sensor, PS3 and its specialities, Overspeed devices,
- Control elements and related components
  - Main fuel System components, such as gas fuel metering valve and liquid fuel metering valves, fuel shut-off valves
  - Actuators variable geometry
- I&C measuring methods
  - Single Ended versus differential measurement and why is this important for sensitive signal loops and control systems
  - Calibration of special instrumentation
  - EMC Principles and the Pitfalls
- Introduction to Woodward hardware
  - Digital controls philosophy vs analog
  - Purpose built hardware platform evolution
  - Woodward hardware platforms – Netcon5000 – MicroNet
  - Customers relevant rack, I/O modules, cables, FTM's and power supply
  - Customers relevant fuel valve and other accessories
- Familiarization GAP
  - Dedicated control software evolution
  - Woodward GAP software description
  - GAP architecture and navigation
  - System Logic Flow
  - Special GAP blocks
  - Fault accommodation
- Technical Interface
  - Safely connect to the CPU

For more information or a request for registration please contact [training@vbr-turbinepartners.com](mailto:training@vbr-turbinepartners.com).

#### VBR Turbine Partners headquarters & warehouse

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Independent ISO 9001/2008 certified O&M improvement experts for GE LM gas turbines, auxiliaries & packages LM1600 | LM2500 | LM5000 | LM6000



## General information about the Woodward Micronet control system training course



- Control Assistant – AppManager – MicroPanel – Two Line Display – WatchWindow – Service Panel
- MonitorGAP – how to adjust or force signals and tunable values
- Analogue and I/O calibrations
- Configuring trends in Control Assistant
- Up-download tunables
- Loading Application
- Troubleshooting alarms, shutdowns and other fault conditions (using simulator)
- Maintenance
  - Rack maintenance and hardware
  - Card / FTM cable handling
  - Power supplies
  - Fuel valve maintenance

#### Day 3

##### LM Controls and monitoring techniques

##### Introduction to LM Gas Turbine Control and Monitoring

- Control fundamentals, parameters, closed and open loops
- Basic of sequencing and fuel control
- Basics of compressor control and load sharing
- Basics of performance and monitoring

##### Generic Control and Monitoring

- I/O requirements
- Package sequencing requirements
- Fuel control requirements
- HMI's for operational monitoring
- Anti-icing control system
- Performance / condition monitoring
- Control and Monitoring implementation in GAP
  - Review of package P&ID and identification of instrumentation
  - I/O implementation in GAP
  - Package sequencing in GAP
  - Load control in GAP
  - HMI screens, trends, alarms & shutdowns
  - Performance and condition monitoring in DCS
- Practical Exercises with GAP

#### Day 4 and 5

##### Troubleshooting and real-life cases

- Real life examples and Exercises
  - Pre-start checks
  - Start-up and shutdown sequencing
  - Loading, load sharing, load steps and rejections
  - Under-speed and over-speed events
  - Stall and flameouts
  - Compressor washing
- Exercise with GAP software, Compile and load application, loading tuneables
  - Package P&ID's
  - I/O options and benefits
  - Fuel control and load issues
- Evaluation of the training course
  - Course evaluation and issue of certificates

##### After completion of this training the student knows:

Woodward controls hardware for effective maintenance and trouble shooting.

How engine sequencing, fuel control and monitoring is applied to the LM gas turbines within the MicroNet GAP.

Real-life engine problems for improved troubleshooting and problem solving.

##### Certificate

Each participant will receive a personal certificate at the closing of the course.

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Independent O&M improvement experts for GE aero-derivative gas turbines and their auxiliary systems, control systems and packages