

# Wind Turbine Generator Control Troubleshooting Learning System

950-TGC1



Wind Turbine Generator Control Troubleshooting Learning System



Interactive Multimedia and Student Reference Guide

## Learning Topics:

- Generation System Operation
- Commissioning Tests
- Troubleshooting
- Grid Power Interface
- Fiber Optic Communications
- Generator Control Software
- Revenue Meters
- Shunt Trip Circuit Breakers
- Line Contactors
- 3-Phase Inverters
- Power Distribution Panel
- Pad Mounted Transformers
- Rectifiers
- Computer Control Units
- Temperature Control

The generator control system is the heart of a utility-scale wind turbine, converting mechanical rotation of the hub into clean, 3-phase power that synchronizes with the utility grid. Keeping these turbines operational and well maintained requires a specialized skill set, and wind turbine technicians possess these skills. They know how to service, operate, and troubleshoot the generator control system, which includes the generator, rectifier, generator control unit, power distribution panel, pad mounted transformer, and generator control software.

Amatrol's Wind Turbine Generator Control Troubleshooting Learning System (950-TGC1) allows learners to gain adaptive skills for generator system operation, adjustment, and troubleshooting in a wide variety of situations. It helps learners to develop and practice both wind turbine component and system level skills and gives them the classroom instruction and hands-on experience that they need to succeed in this emerging and growing field. Wind Turbine Generator Control Troubleshooting also includes Amatrol's unique electronic fault insertion system, which lets learners gain hands-on experience with the troubleshooting of realistic generator control problems, as well as receive automatic feedback on their progress.

Furthermore, Turbine Generator Control Troubleshooting connects to Amatrol's Nacelle and Hub workstations to create a comprehensive wind turbine learning laboratory.



## Technical Data

Complete technical specifications available upon request.

### Mobile Workstation

- Dimensions: 96-in L x 74-in H x 28-in W
- Swivel locking casters (4)
- Square tube steel, welded and braced

### Generator System

- Start/Stop/Reset pushbutton
- Emergency stop pushbutton
- Local/remote selector switch
- Generator speed control knob
- LED readout of generator speed
- 3-phase variable speed AC motor
- 3-phase AC generator
- 3-phase rectifier
- DC capacitive filter

### Generator Control Unit

- Analog and digital I/O
- Sensors & transducers to measure current, voltage, and temperature
- Operational control of power generation
- Ability to communicate with Nacelle
- 3-phase bridge rectifier
- Electric heater w/ guard
- RTD temperature sensors
- Voltage divider network
- 3-phase inverter
- DC current transducer
- Electric fans (3)
- 24 VDC switching type regulated power supply
- Solid-state output relays (8)
- Contactors (4)
- RTD signal conditioner modules
- Fuses (4)
- CCU w/ (12) discrete 24 VDC inputs, (8) 24 VDC discrete outputs
- DIN Rail terminal strips

### Power Distribution Panel

- Monitoring and control of GCU power flow
- Distribution of power to sub circuits
- Circuit protection
- Lockout/tagout
- Power revenue meter
- Electric heater w/ guard
- Temperature sensing devices (2)
- AC current transducers (3)
- Electric fans (3)
- Shunt trip circuit breaker
- Contactors (3)
- Circuit breakers (2)
- Fuses (3)
- Main line contactor
- Power factor correction capacitors
- Grid current and voltage sense
- Inductive filter
- Control transformer
- Control transformer fuses (2)
- Inverter fuses (3)

### Pad Mount Transformer

- Replicate function/operation of utility scale pad mounted transformer
- Vented and enclosed

### Electric Motor Output

- 3-phase AC electric load motor
- Wired to the output of the GCU

### HMI Software

- Windows-based
- Local control and monitoring of a GCU
- Data monitoring screens for the GCU includes:
  - Analog inputs/outputs
  - Discrete inputs/outputs
  - Inverter output voltages and currents
  - Power generated
  - Inverter temperature
  - Cabinet temperature
  - System faults and history

### Fault Insertion System

- Faults to recreate actual component and system failure
- Troubleshooting test points without disassembling components
- Electrical fault insertion using a computer-based fault insertion system
- Fault troubleshooting tracking

### Instructor's Guide (C20014)

### Installation Guide (D20014)

### Student Reference Guide (H20014)

### Additional Requirements:

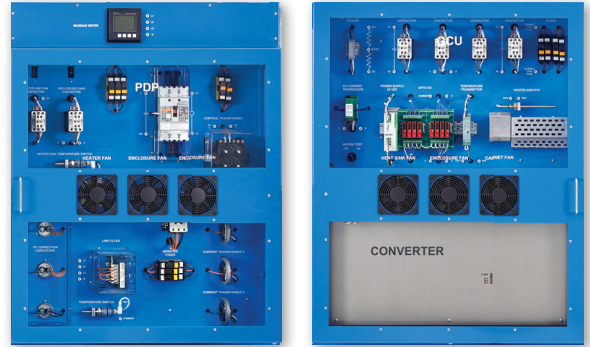
- PC, for requirements, see <http://www.amatrol.com/support/computer-requirements>
- Amatrol recommends 90-START-5 Engineering Services Start-Up and Installation – Wind Turbine Technology, as well as 950-WC1 Wind Concepts for basic concept preparation

### Utilities Required:

- Requires 208V/60Hz/3ph
- Customer supplied utility system grid interface
- (NOTE: Grid tie requirements vary widely and are the exclusive responsibility of the customer.)

## Real-World, Utility-Scale Turbine Generator Control Experience

Amatrol's Wind Turbine Generator Control Troubleshooting enables learners to develop operation and troubleshooting skills for wind turbine generator control systems. The system features generator control software that enables learners to start-up, test, and shut-down the wind turbine systems. Turbine Generator Control Troubleshooting includes major components and circuitry found in utility-scale wind turbine generator control systems such as a generator control unit, power distribution panel, transformer, transducers, main line contactor, power factor correction capacitor network, inductive filter, revenue meter, shunt trip circuit breaker, and 3-phase inverter.



Wind Turbine Generator Control Systems

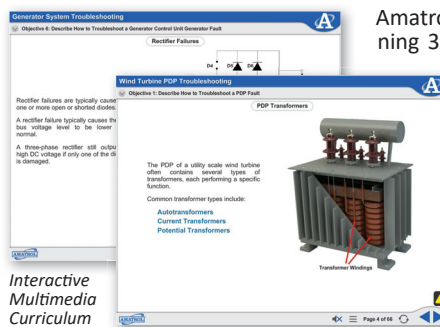
## Computer-Based Fault Insertion Across All Key Subsystems

Troubleshooting skills are essential for wind turbine technicians. At the heart of teaching wind turbine troubleshooting skills is an instructor's ability to create realistic problems that learners can identify and resolve, because the students will have to troubleshoot at the top of a wind turbine tower, by themselves, applying maintenance skills. Turbine Generator Control Troubleshooting includes twenty-nine (29) faults including six (6) different types of faults: Operational, Bus, Line, Drive, Temperature, and Generator faults. This allows instructors to create realistic troubleshooting situations that a wind turbine technician encounters on the job. Amatrol uses electronic fault insertion so that instructors can easily insert faults and track the learner's troubleshooting results. Electronic fault insertion prevents component damage and allows instructors to track and target specific areas in which the learners needs to improve. It also allows learners to perform self-directed study.

## Links to Amatrol's Turbine Nacelle and Hub Troubleshooting Learning Systems

Turbine Generator Control Troubleshooting is an independent learning system. However, it also links to Amatrol's Turbine Nacelle Troubleshooting and Turbine Electric Hub Troubleshooting Learning Systems. These three combined systems create a realistic operating and troubleshooting wind turbine environment. Fiber optic communications connect the controls of the three systems and control the entire line using the turbine control software to simulate realistic operation on a real wind turbine. With this setup, learners can actually bring the turbine online with the grid.

## Multimedia Curriculum Included



Interactive Multimedia Curriculum

Amatrol's unmatched multimedia utilizes text, audio, and stunning 3D animations that engage learners in both theoretical knowledge and hands-on skills. This thorough, exceptionally detailed curriculum is built to begin with the basics and steadily advance to more complex concepts and skills. Through partnerships with key industry leaders and leading edge educators, Amatrol developed the perfect balance of knowledge and applied skills needed to train learners to work in their chosen field.

## Student Reference Guide

A sample copy of this course's Student Reference Guide is included with the learning system. Sourced from the multimedia curriculum, the Student Reference Guide takes the entire series' technical content contained in the learning objectives and combines them into one perfectly-bound book. If you would like to inquire about purchasing additional Student Reference Guides for your program, contact your local Amatrol Representative for more information.

