

WIND TURBINE GENERATOR CONTROL TROUBLESHOOTING LEARNING SYSTEM

950-TGC1



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. To operate and maintain a wind turbine effectively, wind turbine technicians must have the special skills needed 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.

CURRICULUM IS THE KEY TO LEARNING

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 950-TGC1 Turbine Generator Control Troubleshooting Learning System teaches students adaptive skills for generator system operation, adjustment and troubleshooting in a wide variety of situations. It allows students to develop and practice component and system level skills and gives them the classroom instruction and hands-on experience they need to succeed in the emerging and growing field. The Turbine Generator Control Troubleshooting Learning System includes Amatrol's unique electronic fault insertion system, which allows students to experience troubleshooting of realistic generator control problems and receive automatic feedback on their progress.

The 950-TGC1 provides an effective training platform with a workstation containing a fully-operational generator system; fault insertion system; PC-based interactive, multimedia curriculum; instructor's assessment guide; and installation guide. Additionally, the 950-TGC1 connects to the Amatrol's Nacelle and Hub workstations to create a comprehensive wind turbine learning laboratory.



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DESIGNED FOR LEARNING

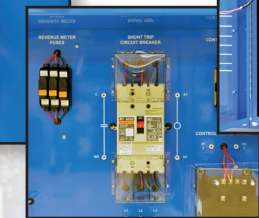
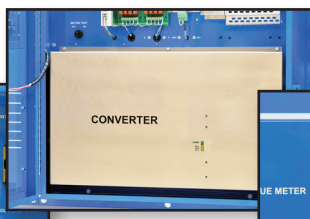
Real World, Utility Scale Turbine Generator Control Experience

Amatrol's Turbine Generator Control Troubleshooting Learning System enables students to develop operation and troubleshooting skills for wind turbine generator control systems. The system features generator control software that enables a student to learn how to start-up, test, and shut-down the wind turbine systems. The 950-TGC1 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.

Line Contrator



3-Phase Inverter



Shunt Trip Circuit Breaker



Revenue Meter

Computer Based Fault Insertion Across All Key Subsystems

Troubleshooting skills are essential for wind turbine technicians. At the heart of teaching troubleshooting skills is the ability of an instructor to create realistic problems or faults that students must identify and resolve. It is what they will have to do, by themselves, on top of a wind turbine tower. The 950-TGC1 includes 29 faults including six different types of faults: Operational, Bus, Line, Drive, Temperature, and Generator faults. This will allow instructors to create realistic troubleshooting situations that a wind turbine technician will encounter on the job. Amatrol uses electronic fault insertion so students can easily insert faults and track the student's troubleshooting results. Electronic fault insertion prevents component damage while allowing instructors to see student progress. Instructors can identify specific areas the student needs to improve and target those areas. It also allows students to perform self-directed study.

Links to Amatrol's Nacelle and Hub Troubleshooting Learning Systems

While an independent learning system, the 950-TGC1 will also link to Amatrol's 950-TNC1 Turbine Nacelle Troubleshooting and the 950-TEH1 Turbine Electric Hub Troubleshooting Learning Systems. These three systems combine to create a realistic operating and troubleshooting wind turbine environment. Fiber optic communications connect the controls of the three systems and control the entire system using the turbine control software, just as they would on a real wind turbine. Students can actually bring the turbine online with the grid.



TECHNICAL DATA

Mobile Workstation

- Dimensions 96" (244 cm) L x 72" (183 cm) H x 28" (71 cm) W
- Swivel locking casters (4)
- Square tube steel, welded and braced
- Lockable disconnect switch for all power

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 Assessment Guide, C20014

Installation Guide, D20014

Multimedia, PC-Based Student Curriculum, M20014