

TURBINE NACELLE TROUBLESHOOTING LEARNING SYSTEM

950-TNC1



Operating and maintaining utility scale wind turbine nacelle systems requires unique skills. A wind turbine technician handles a wide breadth of operational and maintenance issues at the top of hundred meter towers. Their troubleshooting and problem solving skills have to be excellent to effectively handle their jobs and keep wind turbines operational.

Amatrol's 950-TNC1 Turbine Nacelle Troubleshooting Learning System teaches students adaptive skills for wind turbine operation, adjustment and troubleshooting in a wide variety of situations.

The 950-TNC1 allows students to develop and practice component, sub-system, and system level skills. It is fully functional like a utility scale nacelle. The Turbine Nacelle Troubleshooting Learning System includes Amatrol's unique electronic fault insertion system, which allows instructors to electronically create realistic nacelle problems and then track the student's progress in fixing it. Additionally, the 950-TNC1 will connect to Amatrol's 950-TEH1 Turbine Electric Hub Learning System as well as the 950-TGC1 Turbine Generator Control Learning System to create a complete wind turbine learning experience.

The 950-TNC1 is an effective training platform for wind turbine technicians. The Turbine Nacelle Troubleshooting Learning System includes a mobile workstation, turbine control unit, nacelle module, hydraulic brake system, wind simulator, monitoring and control software, fault insertion system, PC-based multimedia curriculum, and instructor's assessment guide. Amatrol's 950-TNC1 provides essential skills for wind turbine technicians.



CURRICULUM IS THE KEY TO LEARNING

Learning Topics:

- Nacelle Components & Operation
- Turbine Safety
- Turbine Control Functions, Software, Power
- Turbine Control Unit
- Turbine Hydraulics
- Yaw Brakes
- Parking Brakes
- Rotor Lock
- Yaw Drive
- Twist Box
- Meteorological Instrumentation
- Yaw System Operation
- Safety Loop Operation
- System Communications
- System Troubleshooting

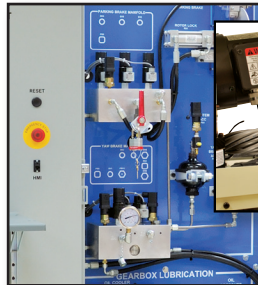
AMATROL[®]

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DESIGNED FOR LEARNING

Real World, Utility Scale Wind Turbine Nacelle Experience

Amatrol's Turbine Nacelle Troubleshooting Learning System enables students to develop operation skills essential to wind turbine technicians. The system features turbine control software that enables a student to learn how to start-up and shut-down wind turbine systems. The 950-TNC1 includes major components found in utility scale wind turbines such as a turbine control unit, hydraulic system with cartridge valves, brakes, yaw drive with dual motor drive, twistbox, and an ultrasonic anemometer. The wind simulator allows students to test the operation of the system under varying wind speed and direction conditions, teaching students to operate the yaw control and turbine safely.



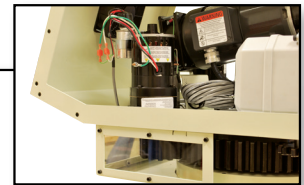
Cartridge Valve Manifolds



Twist Box



Anemometer



Yaw Drive

Computer Based Fault Insertion Across All Key Subsystems

Wind turbine technicians must have good troubleshooting skills. 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-TNC1 includes over 30 faults distributed across all key subsystems – electrical, mechanical and hydraulic. This will allow instructors to create realistic troubleshooting situations that a wind turbine technician will encounter on the job.



Student Troubleshooting Electrical Fault

Amatrol uses electronic fault insertion so that instructors 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 instructors to set-up faults ahead of time, allowing students to perform self-directed study when appropriate.

Links to Amatrol's 950-TEH1 Turbine Electric Hub Troubleshooting and 950-TGC1 Turbine Generator Control Learning Systems

While an independent learning system, the 950-TNC1 will also link to Amatrol's Turbine Electric Hub (950-TEH1) and Turbine Generator Control (950-TGC1) 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 107.5" (273 cm) L x 81" (206 cm) H x 29" (74 cm) W
- Swivel casters (4) with 2 locking
- Square tube steel, welded and braced
- Wind simulator providing direction and speed changes

Turbine Control Unit (TCU)

- Analog and digital I/O communications
- Pre-mounted and wired components:
 - Contactors
 - Electrical protection devices
 - Controller
 - Network communications interface
 - Signal conditioners
 - Circuit disconnects
- Sensors & transducers to measure:
 - Temperature
 - Wind speed
 - Wind direction
 - Pressure
 - Speed
- Operational control of:
 - Yaw system
 - Braking systems
 - Down tower communications
 - Control software
 - Turbine generator
 - Hub controls

Nacelle Module

- Semi-rectangular metal frame
- Yaw bearing mounted
- Operational capability of utility scale:
 - Yaw system
 - Braking system
 - Wind sensors
 - Hub control communications

Hydraulic System

- Hydraulic power unit
- Valve manifolds
- Rotor lock actuator

Gearbox Lubrication System

- Gearbox with transparent casing
- Cooling system
- Lubrication spray system

Monitoring Software

- Windows-based
- Simulates software used for down tower monitoring and control of utility scale wind turbines
- Network communications to the turbine control unit

Fault Insertion System

- Faults to recreate actual component and system failure
- Troubleshooting test points for systems-level troubleshooting without disassembling components
- Electrical fault insertion using a computer-based fault insertion system, which includes PC-based software for control and tracking

Multimedia, PC-Based Student Curriculum, M20015
Instructor's Assessment Guide, C20015
Installation Guide, D20015