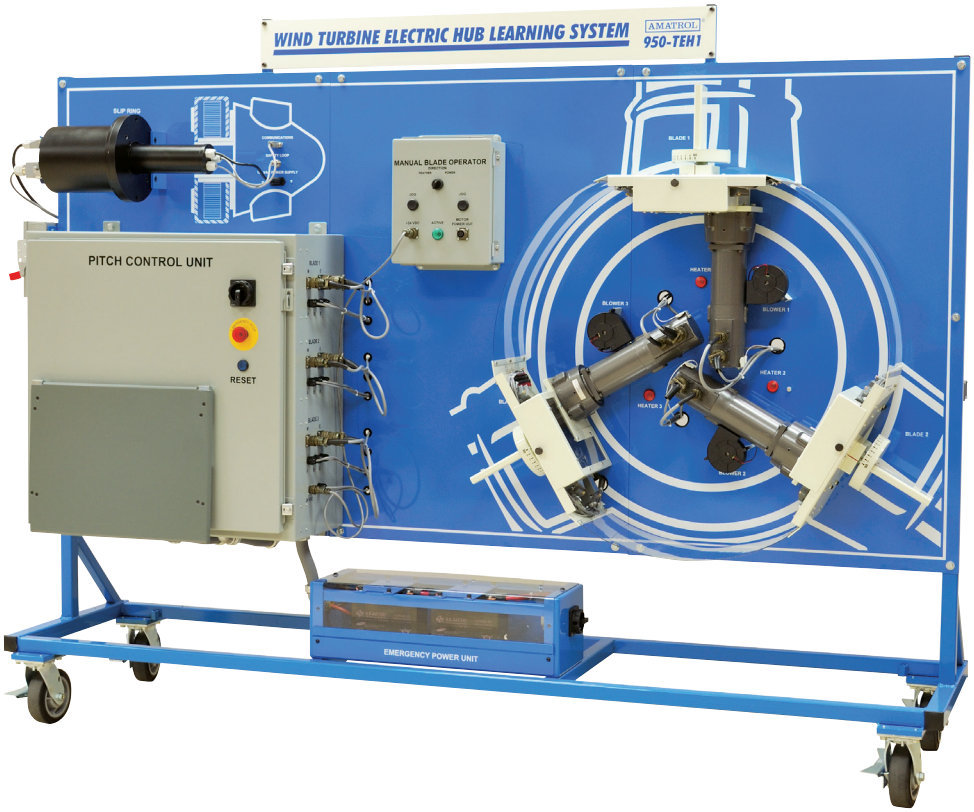
TURBINE ELECTRIC HUB TROUBLESHOOTING LEARNING SYSTEM

950-TEH1



Wind turbine electric hubs present unique operation and maintenance challenges. Wind turbine technicians must be able to pinpoint and resolve a wide variety of situations where the hub is key, especially in changing load conditions. Their troubleshooting and problem solving skills have to be excellent to effectively handle their jobs and keep wind turbines operational.

CURRICULUM IS THE KEY TO LEARNING

Learning Topics:

- Hub Functions
- Hub Safety
- Pitch Control Software
- Hub Power
- Servo Pitch Operation
- Servo Reference Position Adjustment
- Sensor Operation
- Emergency Feather Operation
- Battery Operation & Capacity
- Battery Types & Banks
- Battery Charging
- Emergency Feather Control
- Power Voltage Verification
- Hub Fault Messages
- Individual Blade Troubleshooting
- System Troubleshooting
- Battery Maintenance

Amatrol's 950-TEH1 Turbine Electric Hub Troubleshooting Learning System teaches students adaptive skills for wind turbine operation, adjustment and troubleshooting in a wide variety of situations. The 950-TEH1 allows students to develop and practice component, sub-system, and system level skills. It is fully functional like a utility-scale turbine electric hub. The Turbine Electric Hub Troubleshooting Learning System includes Amatrol's unique electronic fault insertion system, which allows instructors to electronically create realistic hub problems and then track the student's progress in fixing it. Additionally, the 950-TEH1 will connect to Amatrol's 950-TNC1 Turbine Nacelle Learning System to create a complete wind turbine learning experience.

The 950-TEH1 is an effective training platform for wind turbine technicians. The Turbine Electric Hub Troubleshooting Learning System includes a mobile workstation, blade simulator with 3-axis servo system, pitch control unit, emergency power unit, blade simulator, pitch control software, fault insertion system, PC-based multi-media curriculum, and instructor's guide. Amatrol's 950-TEH1 provides essential skills for wind turbine technicians.

AMATROL®

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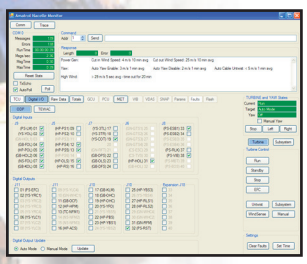
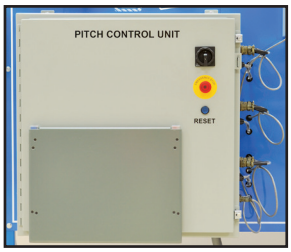
DESIGNED FOR LEARNING

Real World, Utility Scale Turbine Electric Hub Experience

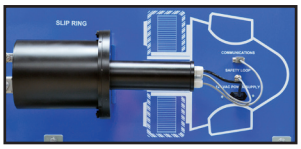
Amatrol's Turbine Electric Hub Troubleshooting Learning System enables students to develop operation skills essential to wind turbine technicians. The system features pitch control software that enables a student to learn how to start-up, test, and shut-down the hub portion of wind turbine systems. The 950-TEH1 includes major components found in utility scale wind turbine electric hubs such as a pitch control unit, pitch control software, electric servo drives, brakes, slip ring, battery-powered emergency power unit, pitch position encoders, and feather position sensors. The system features 3 axes so students can gain visual understanding of the synchronized positioning of blade operation.



Pitch Control Software



Pitch Control Unit



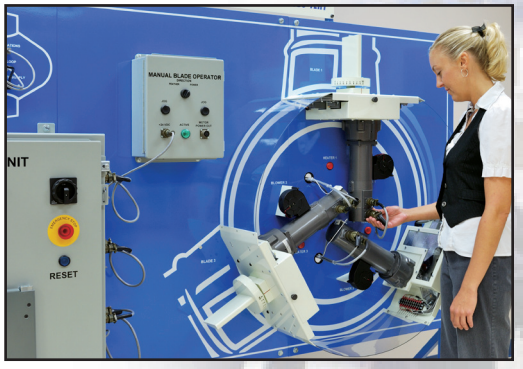
Slip Ring

Battery Bank

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-TEH1 includes over 30 faults distributed across all key subsystems – electrical and mechanical. 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 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.



Student Reacting to Mechanical Fault

Links to Amatrol's 950-TNC1 Turbine Nacelle Troubleshooting and 950-TGC1 Turbine Generator Control Learning Systems

While an independent learning system, the 950-TEH1 will also link to Amatrol's 950-TNC1 Turbine Nacelle Troubleshooting and Turbine Generator Control 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 74" (188 cm) H x 28" (71 cm) W
- Swivel casters (4) with 2 locking
- Square tube steel, welded and braced

Pitch Control Unit
- Analog I/O
- Digital I/O
- Blade pitch system operation
- Contactors
- Electrical protection
- Controller
- Signal conditioners
- Circuit disconnects
- Able to communicate with turbine control unit

Emergency Power Unit

Slip Ring

Blade Simulator
- Components for three wind turbine blades
- Servomotors
- Gearboxes
- Electromechanical brakes
- Electronic position encoder feedback
- Industrial grade limit switches

Pitch Control Software
- Windows-based
- Simulate 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, M20013
Instructor's Assessment Guide, C20013
Installation Guide, D20013

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