



## Course Information Letter ---- TG516

# BENTLY NEVADA 3500 MONITORING SYSTEM

## TG521

### COURSE DESCRIPTION

Why does the turbine expand? Knowing why and how the turbine expands is invaluable knowledge when it comes to interpreting the information provided by a Turbine Supervisory Instrumentation System. The modular, software programmable Bently Nevada 3500 Machinery Protection System provides this information concerning not only the expansion of the turbine but vibration as well. This course provides a thorough working knowledge of the criteria involved in turbine expansion along with the many reasons for abnormal vibration levels, which may not be even related to the bearings. Once the physical attributes of the turbine are discussed, the Bently Nevada 3500 Machinery Protection System is thoroughly discussed from the aspect of its software programmable options, verification, operation, and troubleshooting. With the added bonus of utilizing the Rack Interface Software interactive demo, all of the items discussed associated with the configuration of the rack will be reinforced through the visualization of the real-time feedback, thereby providing the potential of having a very pleasant experience when you encounter your Bently Nevada 3500 Machinery Protection System at your workplace.



With this knowledge, the participant has the information needed to reliably configure a rack, configure the individual modules that make up the rack, and troubleshoot the Bently Nevada 3500 Machinery Protection System. Additionally, this information enables the participant to qualify the accuracy of the TSI indications to an operator; thereby providing confidence to the operator when important decisions have to be made.

Recommended for technicians, electricians, and/or engineers who have a responsibility to maintain this equipment at any fossil or nuclear turbine generator installation. Turbine experience is desirable but not necessary.

### COURSE DATES/LOCATION/FEE (3-DAY COURSE LENGTH)

For current dates / locations / prices, please see HPC's website, [www.hpcnet.com](http://www.hpcnet.com).

### RECENTLY SATISFIED CUSTOMERS:

Doosan Heavy Industries, Korea Midland Power, Koreas Plant Services

**OBJECTIVES:** Upon completion of this course the participant will be able to:

1. Explain how the turbine expands and why this is important.
2. Explain the purpose of each turbine supervisory instrument.
3. State the general physical location of each turbine supervisory instrument.
4. State the primary function of the Bently Nevada 3500 Machinery Protection System.
5. Name the two modules that must be in every rack, and state their respective position within the rack.
6. Name the two modules that have the responsibility of communicating with the rack monitors. (Note: Only one can be used at a time.)
7. Identify the three software packages associated with the BN 3500 Machinery Protection System and explain the function of each.
8. Identify the module to which incoming power is connected.
9. Explain the two positions of the Grounding Select Switch.
10. Identify the module through which the Power Supply Module is software configured.
11. State the status description on each of the front panel LEDs on the Rack Interface Module.
12. Identify the correct positions of the dip switches for a given address number.
13. Explain the purpose of the two passwords that are entered during configuration.
14. State the function of the Keyphasor® Module when its receiving one event per revolution.
15. State the grounding requirement when using Test Equipment.
16. Identify the ALERT condition that must be known prior to performing the Keyphasor® Module self-test or any other monitor self-test.
17. Name four functions that the Proximator®/Seismic Module can be programmed for utilizing the Rack Configuration Software.
18. State the status description on each of the front panel LEDs on the Proximator®/Seismic Module.
19. In reference to the Proximator®/Seismic Module, state the location of the jumper and its purpose.
20. Name the three items that can be used as an aid when troubleshooting the Proximator®/Seismic Module or its I/O Module.

## COURSE OUTLINE

### I. Day One

- A. Steam Plant Fundamentals
  1. The Plant Cycle
  2. Basic Turbine Theory
    - a. Rotor
    - b. Blading
    - c. Nozzles
  3. Turbine Sections
  4. Turbine Components
    - a. Nozzles
    - b. Turbine Blading
    - c. Turbine Arrangements
    - d. Steam Seals
    - e. Journal Bearings
    - f. Thrust Bearing
    - g. Standards
    - h. Valves
    - i. Auxiliary Valves
- B. Turbine Supervisory Instruments
  1. Introduction
  2. Description of Turbine Supervisory Instruments
    - a. Eccentricity
    - b. Speed
    - c. Valve Position
    - d. Vibration
    - e. Shell Expansion
    - f. Differential Expansion
    - g. Steam and Metal Thermocouples

### II. Day Two

- A. Bently Nevada 3500 System Overview
  1. Introduction
  2. System Essentials
    - a. Full Size or Mini Size Rack (3500/05)
    - b. Power Supply (3500/15)
    - c. Rack Interface Module (3500/20)
    - d. Transient Data Interface (3500/22M)
    - e. Software (3500)
  3. Additional System Components
    - a. Monitors
    - b. Relay (3500/32)
    - c. TMR Relay (3500/34)
    - d. Keyphasor Inputs (3500/25)
    - e. Communication Gateway Module (3500/92)
    - f. Displays
    - g. Intrinsic Safety Barriers or (3500/95)
  3. Features
    - a. Digital and Analog Communications
    - b. Flexible Display Options
    - c. Software Configurable
  4. Applications
- B. Putting The System Together
- C. Bently Nevada 3500 Power Supply
  1. General Information
  2. Power Input Module (PIM)
    - a. Connecting Single Point Ground
  3. Configuration

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4. Maintenance
    - a. Installation
    - b. Removal
  5. Troubleshooting
    - a. LED Fault Conditions
  6. Ordering Information
- D. Rack Interface Module
1. General Description
    - a. LED Descriptions
    - b. Triple Modular Redundant (TMR)
  2. Rack Interface I/O Modules
    - a. OK Relay
    - b. RACK RS-422
    - c. External Contacts
    - d. Connecting Rack Interface I/O Modules
  3. Transient Data Interface (TDI)
    - a. Triple Modular Redundant (TMR)
  4. Configuration
    - a. Options Explained
    - b. Software Switches
    - c. Hardware Switches
  5. Data Manager I/O Modules
  6. Maintenance
    - a. Performing Firmware Upgrades
    - b. Performing Real-Time Clock Replacement
  7. Troubleshooting
    - a. Verification
    - b. LEDs
    - c. System Event List Messages
    - d. Alarm Event List Messages
  8. Ordering Information
- III. Day Three
- A. Keyphasor® Module
1. General Description
    - a. LED Descriptions
    - b. Available Statuses and Where Found
    - c. Triple Modular Redundant (TMR)
  2. Keyphasor® I/O Modules
    - a. Keyphasor® Internal Termination
    - b. Keyphasor® Internal Barrier I/O Module
    - c. Keyphasor® External Termination I/O
    - d. Keyphasor® External Terminal Strip
- Module
3. Configuration
    - a. Options Explained
    - b. Software Switches
  4. Maintenance
    - a. Verifying Keyphasor® Module
    - b. Verifying Keyphasor® Channel
    - c. Performing Firmware® Upgrades
  5. Troubleshooting
    - a. Self-test
    - b. LEDs
    - c. System Event List Messages
    - d. Alarm Event List Messages
  6. Ordering Information
- B. Proximator®/Seismic Module
1. General Description
    - a. LED Descriptions
    - b. Available Statuses and Where Found
    - c. Triple Modular Redundant (TMR)
  2. Proximator®/Seismic I/O Modules
    - a. Setting The I/O Jumper
    - b. Proximator®/Seismic Internal Termination
    - c. Proximator®/Seismic Internal Barrier
    - d. Proximator®/Seismic External Termination
  3. Configuration
    - a. Options Explained
    - b. Software Switches
  4. Maintenance
    - a. Verifying Proximator®/Seismic Module
    - b. Performing Firmware Upgrades
  5. Troubleshooting
    - a. Self-test
    - b. LEDs
    - c. System Event List Messages
    - d. Alarm Event List Messages

## FREQUENTLY ASKED QUESTIONS

- Will HPC Technical Services bring this course to our location for our personnel only? YES, call or email Stephen Parker, [stparker@hpcnet.com](mailto:stparker@hpcnet.com) for a price quotation.
- Will HPC Technical Services customize the presentation at our site to suit our particular needs? Yes.
- Is HPC Technical Services' textbook available for purchase as a reference document? No, this book is not yet available for purchase.
- What is the cost for HPC Technical Service to deliver this course at our location? Well, of course that can vary, but generally speaking, if you're planning on having 6+ attend, when considering your T&L, it is to your advantage to perform the course at your plant (office). You gain from the customization and price.
- Can HPC Technical Services perform a functional checkout and calibration of your control system during the upcoming outage OR provide troubleshooting support should it be required? Yes we can. Call or contact Harold Parker, [hparker@hpcnet.com](mailto:hparker@hpcnet.com) for our rate sheets and any further information required.

## WHAT YOU WILL RECEIVE:

1. 1 copy of HPC Technical Services' textbook, Bently Nevada 3500 System, as written by Mike Whisnant.
2. A "Certificate of Completion" with 1.9 CEUs, authorized for issue by the International Associate of Continuing Education/Training.

## STEAM TURBINE I&C MAINTENANCE CERTIFICATION:

Those who attend this course are automatically qualified to take HPC Technical Services' Certification Examination. This examination is offered at no additional expense to the participant. An 80% passing grade is required. The examination length will not exceed 2-hours. Those who complete this examination will receive a revised "certificate of completion" that recognizes this accomplishment along with two-copies of a "To Whom It May Concern" letter that states their accomplishment. (Two copies are provided, one for the participants' employer and one for the participants' personal file.)

Consult HPC's website, [www.hpcnet.com](http://www.hpcnet.com), for detail on this certification program.

## INSTRUCTOR/CONSULTANT (S):



**Mike Whisnant.** Mr. Whisnant's career in the power industry began in May 1970. Mike, while employed by Duke Power, Oconee Nuclear Station, was assigned as the lead tech for the EHC along with all of the support systems for the turbine gave Mike the opportunity to not only learn the EHC System but to master the system during his 31 years with Duke. His involvement with the turbine enabled Mike to gain a working knowledge of the steam cycle within a power plant. During his time in training at Oconee, Mike developed numerous system classes that were created on the "how". In other words, even though a well-qualified technician needs to know the purpose of a system to broaden their understanding in the big scheme of things within the power plant, the "how" of the system is what makes the system work to perform its intended function. This is the part that breaks; therefore, the technician needs a working knowledge of the "how" so that he/she is better equipped to perform troubleshooting. This "how" is what Mike worked to accomplish above and beyond regular duties. His wide-ranging knowledge of the different systems within a power plant gave Mike the opportunity to travel to other non-Duke plants as a consultant to ensure system readiness after the NRC shut down these plants. After his retirement in June 2001, he joined the staff of H. Parker & Company in September 2001 as their E&I Training Specialist, who provides training courses on steam turbines, generators, electrical operating systems, protective systems, etc.

**Robert Johndrow.** Bob Johndrow hired into GE as a field engineer in 1969. Since that date, Bob Johndrow has been a GE Field Engineer specializing in many disciplines including Generator Maintenance and Testing. Bob completed GE's Generator Specialist Training Program early in his career. Since then he has been involved in the commissioning of several steam turbine generators where he was responsible for the turbine controls, auxiliaries, startup sequence and the generator. Bob earned a BS in Industrial Distribution from Clarkson University in Potsdam NY and also has GE Six Sigma Green Belt Certification. Bob accepted an early retirement package late 2003 and has worked as an independent as well as being associated with HPC Technical Services since then. He resides in Rhode Island.

**HPC TECHNICAL SERVICES**  
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**Telephone: 941-747-7733 .... FAX: 941-746-5374**  
**Website: [www.hpcnet.com](http://www.hpcnet.com)**

**REGISTRATION FORM**

Company: \_\_\_\_\_

Plant: \_\_\_\_\_

Address: \_\_\_\_\_

City/State/Zip: \_\_\_\_\_

Telephone: \_\_\_\_\_ FAX: \_\_\_\_\_

Course Number/Title: \_\_\_\_\_

Course Dates: \_\_\_\_/\_\_\_\_/\_\_\_\_ Thru \_\_\_\_/\_\_\_\_/\_\_\_\_

Course Location: \_\_\_\_\_ Course Fee: \_\_\_\_\_

**Please enroll the following individual(s) listed below:**

Student #1: \_\_\_\_\_

Student #2: \_\_\_\_\_

**Taking advantage of HPC's 3-4-2 Policy: Send 3, Pay for 2 when paying in advance.**

Student #3: \_\_\_\_\_

**Enrolled by:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**METHOD OF PAYMENT**

- Check to Follow
- Check Enclosed #: \_\_\_\_\_
- MC/Visa/AMEX #: \_\_\_\_\_  
Expiration Date: \_\_\_\_\_ CV Code: \_\_\_\_\_
- Purchase Order #: \_\_\_\_\_

**HOW DID YOU LEARN OF THIS COURSE?**

- Attended other HPC Courses.
- Received Fax
- Email Promotion
- Website Search
- Received info from others in plant.