Bentley Nevada 3500 System Architecture and Rack Configuration

Presented by:
Arfan Ali
The Oscillatory (back and forth) motion of a machine from its normal position of rest.

Any motion that repeats itself after a specific interval of time.

**Vibration Example**:
Importance of Vibration Monitoring System

- Essential for
  - Protection against machinery faults
  - Predict and diagnose crucial machinery Problems
    - Imbalance
    - Misalignment
    - Shaft crack
    - Bearing Failures and etc.

- Parameters to measure
  - Thrust
  - Vibration
  - Speed
  - Temperature
we have two types of vibration monitoring system the Bently nevada 7200 series vibration monitoring system. It is a dial monitoring analog system installed at our plant on Air Compressor partially and on Most of the TPs etc.

The second one is bently nevada 3500 series vibration monitoring system it is computer based digitized system installed at Syn compressor, Ammonia compressor, CO2 compressor and on Air compressor partially. The scope of presentation my presentation is limited to 3500 system only.
Features of 3500 Monitoring System

- State of art vibration monitoring system
- Processor based system
- Modular & Flexible Architecture
- Tight integration with DCS using Industry Standards Interfaces
- Hot Insertion or Removal of Modules
- Provides Enhanced Operator Information
  - Windows based operator display
  - Data can be displayed at multiple locations
- Improved Reliability due to
  - Redundant power supply and distribution network
  - Triple Modular Redundant Relay Modules
3500 Monitoring System Components and Layout

- Transducers
- 3500 Rack
- 3500 Software
- Computers
Vibration Monitoring System Overview

- Shaft
- Probe
- Extension Cable
- Proximator
- Junction Box
- Barrier
- Processing Unit
- 3500 Rack
- Host Computer

www.arfanali.webs.com
3500 System Monitor

One or two Power Supplies

Any combination of the following 14 slot positions
• Monitor Module
• Key Phasor Module
• Relay Module
• Temperature Modules
• Communication Gateway Module

Rack Interface Modules
3500 Software Packages

Software Package

- Rack Configuration
- Data Acquisition DDE Server
- Operator Display

www.arfanali.webs.com
3500 Software Sequence

START

Configure Rack Using Rack Configuration

Download Rack Configuration

Design Train Diagram Using Software Configuration Utility

Connect Data Acquisition/DDE Server

Monitor Data using Operator Display Software
Common Pitfalls

- Not Ok
- By Pass
- Internal Faults
Question & Answers
3500/15 AC & DC Power Supplies

- Half Height Modules
- Always Installed in the left most slot
- Upper Module.. Primary Supply
- Lower Module.. Backup Supply
- Removing & insertion of one Supply at one time will not disrupt operation.
3500/20 Rack Interface Module (RIM)

- Must be located in the 1\textsuperscript{st} Slot
- Interface card between the rack & monitoring computer
- Works as a communication server
3500/42 Proximititor/Seismic Monitor

- Four Channel Monitor
- Accepts input from proximity and seismic transducers
- Monitor acceleration, velocity and absolute shaft measurement as well
3500/32 The 4 Channel Relay Module

- Full Height Module
- Provides Four Relay outputs
- Provide Alarm on Alert & tripping on Danger situations
- Programmable for AND/OR voting of trip Relays
3500/40 Proximitior Monitor

- Four Channel Monitor
- Accepts input from proximity transducers
- Monitors Radial Vibration and Thrust Position
  - Vibration 0-500μm or 0-20 mil Max.
  - Thrust 40-0-40mil Max.
- Hold Alarm set points (Alert & Danger)
- Compare monitored values with Alarm set points
- Provide Input signal to Relay module, when the monitored value exceed from the set point
3500/25 Key Phasor Modules

- Half Height module with 2-channels
- Measure RPM of the observed shaft
- View either Notch or Projection on the Shaft
- Association of key Phasor signal with peak to peak vibration is used to determine Vibration spectrum
- Range 1 to 99,999 RPM
- Maximum 4 key Phasor signals are possible in 3500 System

Front View
1. **OK** and **TX/RX**
2. Buffered O/P
3500/61 Temperature Monitoring

- Full Height module
- Six channel Monitor
- Accepts both Thermocouple & RTD type inputs
- Provide 4 to 20 mA recorder outputs
- Not in use at FFC-MM
Rack Configuration Software

- Configuration radial Vibration Channel
- Configuration Axial vibration channel
- Configuration of Keyphasor
- Configuration of Relay module
Configuration of Radial Vibration Channel

- Transducer field installation
- Range
- Set points
- Key phasor
- Alert latching / non latching
Configuration of Axial vibration channel

- Transducer field installation
- Towards / away
- Zero position
- Range
- Set points
- Key phasor
- Alert latching / non latching
- Time delay
- 1X, 2X and not 1X
Configuration of Key phasor

- Association
- Range
- Notch
Configuration of Relay Card

- Identify the XTs and VTs required for alarms and danger
- Type of voting
Software Configuration Utility

- Used to create Machine Train Displays
- Specify Historic trend parameters
  - Enabling/Disabling
  - Time B/W two consecutive points
  - Memory Size
- Generate Report on Machine Train Displays
Data Acquisition/DDE Server

- Collects machinery monitoring Data, Alarm, and System Events data
- Provides data to Operator Display Software
- Stores historical and real-time trend data
Operator Display Software

- Displays machine monitoring data using
  - Current values
  - Bargraphs
  - Trends (Historical/Real)
  - Machine Train Diagrams

- Used to view
  - System Event List
  - Alarm Event List
## Current Values

**Point Name:** Rad. Vib 08/03/04  
**Point Location:** R8S3C4

<table>
<thead>
<tr>
<th>TYPE</th>
<th>VALUE</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>5.9 mls pp</td>
<td>OK</td>
</tr>
<tr>
<td></td>
<td>9.4 volts</td>
<td>OK</td>
</tr>
<tr>
<td></td>
<td>5.7 mls pp</td>
<td>OK</td>
</tr>
<tr>
<td></td>
<td>233 degrees</td>
<td>OK</td>
</tr>
<tr>
<td></td>
<td>0.14 mls pp</td>
<td>OK</td>
</tr>
<tr>
<td></td>
<td>NA</td>
<td>Invalid</td>
</tr>
<tr>
<td></td>
<td>0.22 mls pp</td>
<td>OK</td>
</tr>
</tbody>
</table>

**Point Status:** OK  
**Kph Status:** OK  
**Speed:** 113 rpm  
**Trip Multiply Status:** Inactive  
**Inhibit Status:** Inactive

- [Update Bargraph](#)  
- [Adjust Setpoints](#)  
- [Set Ch Switch](#)  
- [Help](#)  
- [Close](#)
Bargraphs
Trends

Display Trends

Point Identification

POINT: Rack01 Slot02 Ch01 Direct
From 18JUN95 18:09:37 To 18JUN95 18:10:37

Use this button to select different trend time periods to display.

Alert (Alarm1) setpoint

Danger (Alarm2) setpoint

TIME: 10 Secs /div
Increasing Time →

Local Connection
www.arfanali.webs.com
Machine Train Diagram
System Event List

Each Event has a date and time tag.

Complete explanations for events are included in the 3500 Monitoring System Manuals.

<--Scroll through events by 'dragging' the indicator with the mouse pointer.
### Alarm Event List

<table>
<thead>
<tr>
<th>Sequence Number</th>
<th>Point Address</th>
<th>Point Name</th>
<th>Date</th>
<th>Time</th>
<th>Alarm Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000006318</td>
<td>01/04/01</td>
<td>VT-1</td>
<td>07/01/2004</td>
<td>16:24:56:41</td>
<td>Left</td>
</tr>
<tr>
<td>0000006317</td>
<td>01/04/03</td>
<td>XT-3</td>
<td>07/01/2004</td>
<td>16:24:27:64</td>
<td>Left</td>
</tr>
<tr>
<td>0000006316</td>
<td>01/04/03</td>
<td>XT-3</td>
<td>07/01/2004</td>
<td>16:24:26:60</td>
<td>Entry</td>
</tr>
<tr>
<td>0000006315</td>
<td>01/04/03</td>
<td>XT-3</td>
<td>07/01/2004</td>
<td>16:24:12:04</td>
<td>Left</td>
</tr>
<tr>
<td>0000006314</td>
<td>01/04/03</td>
<td>XT-3</td>
<td>07/01/2004</td>
<td>16:24:11:00</td>
<td>Entry</td>
</tr>
<tr>
<td>0000006313</td>
<td>01/04/03</td>
<td>XT-3</td>
<td>07/01/2004</td>
<td>16:24:08:55</td>
<td>Left</td>
</tr>
<tr>
<td>0000006312</td>
<td>01/04/03</td>
<td>XT-3</td>
<td>07/01/2004</td>
<td>16:24:07:19</td>
<td>Entry</td>
</tr>
<tr>
<td>0000006311</td>
<td>01/04/01</td>
<td>VT-1</td>
<td>07/01/2004</td>
<td>16:24:07:19</td>
<td>Entry</td>
</tr>
<tr>
<td>0000006310</td>
<td>01/04/01</td>
<td>VT-1</td>
<td>07/01/2004</td>
<td>15:41:41:99</td>
<td>Left</td>
</tr>
<tr>
<td>0000006309</td>
<td>01/07/04</td>
<td>Rad. Vib 01/07/04</td>
<td>07/01/2004</td>
<td>15:41:18:32</td>
<td>Entry</td>
</tr>
<tr>
<td>0000006308</td>
<td>01/07/03</td>
<td>Rad. Vib 01/07/03</td>
<td>07/01/2004</td>
<td>15:41:18:32</td>
<td>Entry</td>
</tr>
<tr>
<td>0000006307</td>
<td>01/07/02</td>
<td>VT-209 STAND BY</td>
<td>07/01/2004</td>
<td>15:41:18:32</td>
<td>Entry</td>
</tr>
<tr>
<td>0000006306</td>
<td>01/07/01</td>
<td>VT-208 STAND BY</td>
<td>07/01/2004</td>
<td>15:41:18:32</td>
<td>Entry</td>
</tr>
<tr>
<td>0000006305</td>
<td>01/06/04</td>
<td>VT-202 STAND BY</td>
<td>07/01/2004</td>
<td>15:41:18:19</td>
<td>Entry</td>
</tr>
<tr>
<td>0000006304</td>
<td>01/06/03</td>
<td>VT-201 STAND BY</td>
<td>07/01/2004</td>
<td>15:41:18:19</td>
<td>Entry</td>
</tr>
</tbody>
</table>
Configuration of Radial Vibration Channel

Four Channel Proximity/Seismic Monitor

- **Slot**: 3
- **Rack Type**: Standard
- **Configuration ID**: Blank
- **Slot Input/Output Module Type**:
  - [ ] Discrete Internal I/O
  - [ ] TMA I/O (Discrete)
  - [ ] Discrete External I/O
  - [ ] TMA I/O (Bussed)

**Channel Pair 1 and 2**
- **Channel Pair Type**: Radial Vibration
- **Keyphasor Association**: No Keyphasor
  - **Primary Upper**:
    - [ ] Channel 1
    - [ ] Channel 2
  - **Backup Upper**:
    - [ ] Channel 1
    - [ ] Channel 2
  - **Lower**:
    - [ ] Channel 1
    - [ ] Channel 2

**Channel Pair 3 and 4**
- **Channel Pair Type**: Radial Vibration
- **Keyphasor Association**: No Keyphasor
  - **Primary Upper**:
    - [ ] Channel 1
    - [ ] Channel 2
  - **Backup Upper**:
    - [ ] Channel 1
    - [ ] Channel 2
  - **Lower**:
    - [ ] Channel 1
    - [ ] Channel 2

**Channel 1**
- [ ] Active
  - Options...

**Channel 2**
- [ ] Active
  - Options...

**Channel 3**
- [ ] Active
  - Options...

**Channel 4**
- [ ] Active
  - Options...
Configuration of Radial Vibration Channel (contd)
Configuration of Radial Vibration Channel (contd)
Configuration of Axial Vibration Channel
Configuration of Axial Vibration Channel (contd)
KeyPhasor Module Configuration

Channel 1:
- **Active**
- **Signal Polarity**: Notch
- **Type**: Proximitron
- **Hysteresis**: 2.0
- **Threshold Type**: Auto
- **Events Per Rev**: 1
- **Orientation Degrees**: 0
- **Upper RPM Limit**: 99,999
- **RPM Clamp Value**: 0

Channel 2:
- **Active**
- **Signal Polarity**: Notch
- **Type**: Proximitron
- **Hysteresis**: 2.0
- **Threshold Type**: Auto
- **Events Per Rev**: 1
- **Orientation Degrees**: 0
- **Upper RPM Limit**: 99,999
- **RPM Clamp Value**: 0

I/O Module:
- Internal

www.arfanali.webs.com
Relay Configuration

Available Monitor Channels/Alarms:
- S05C##A1 (Slot 5 Any Active Alert)
- S05C##A2 (Slot 5 Any Active Danger)
- S05C01A1 (Slot 5 Channel 1 Alert)
- S05C01A2 (Slot 5 Channel 1 Danger)
- S05C02A1 (Slot 5 Channel 2 Alert)
- S05C02A2 (Slot 5 Channel 2 Danger)
- S05C03A1 (Slot 5 Channel 3 Alert)
- S05C03A2 (Slot 5 Channel 3 Danger)
- S05C04A1 (Slot 5 Channel 4 Alert)
- S05C04A2 (Slot 5 Channel 4 Danger)

Simpex Relay Channel Association:
- Channel 1
- Channel 2
- Channel 3
- Channel 4

Alarm Drive Logic:
S04C01A1 \* S05C02A2

Relay NE\NDE Switch Status: N/A
Not OK

- Channel not ok status results from any of the following conditions:
  - Probe is open
  - Connection looseness

- Note: If time defeat is ON
  - 30 sec are required to move from not OK state OK state
  - When any channel go into Not okay state it will go into bypass state
By Pass

- A software switch is bypassing any channel alarming function
- A transducer is not okay and the channel is configured for “Timed ok Channel Defeat”
- The Keyphasor associated with the channel has gone invalid
- The monitor has detected a serious internal fault
Internal Fault

- Internal faults are rectified by checking the code (event number) from the system event list and checking the corresponding value in the system manual.
Key Phasor
Shape of proximity probe
Negative Supply of Proximititor

I am glad you benefited from my article. To answer your question is that the first reliable transistors that were commonly available for use were NPN, which required a negative supply.

Mark Snyder, Bently Nevada