



Vibration Monitoring of Shovels and Draglines

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Vibration Monitoring of Shovels and Draglines

- ★ Proof of concept that reliable online data collection is possible
- ★ Refine data analysis and collection process
- ★ Sensor application and options
- ★ Weather extremes
- ★ Operational challenges
- ★ Extreme duty cycle



Vibration Monitoring of Shovels and Draglines



- ☀ 100 ton shovel
- ☀ Located in Canada
- ☀ In service for 2 years
- ☀ Unique application
- ☀ Analyzed failure modes
- ☀ Secured detailed drawings
- ☀ Designed base system

Vibration Monitoring of Shovels and Draglines

- ★ Two onboard systems
- ★ Crowd system
- ★ Hoist system
- ★ No swings or propel - yet
- ★ Provides continuous surveillance of critical points
- ★ Stores data on cards
- ★ Speed data from encoders on motors



Vibration Monitoring of Shovels and Draglines



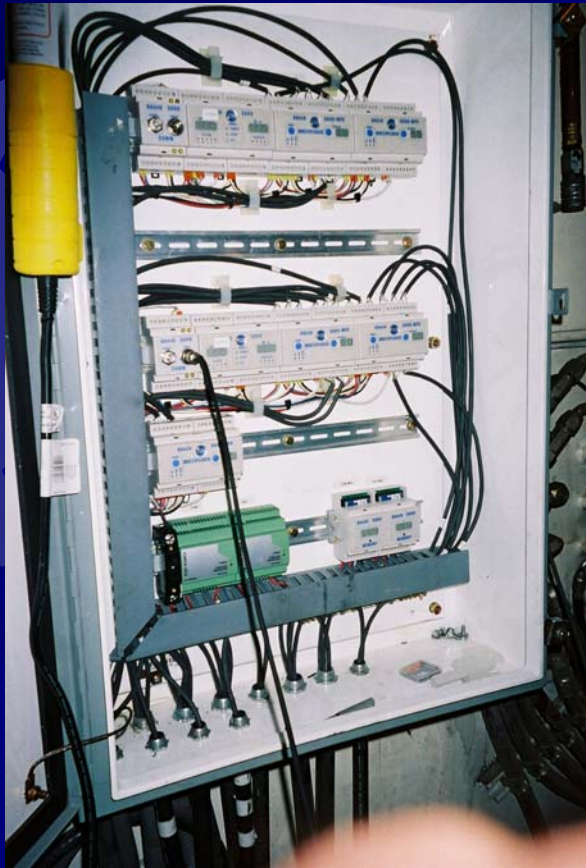
- ☀ Hoist gearbox ass'y
- ☀ Monitoring main gears, pinion gears, motor
- ☀ Hoist drum, drive motor
- ☀ 18 sensors total
- ☀ 100 mv/g on gearcase
- ☀ 500 mv/g on hoist drum
- ☀ All data is speed stamped
- ☀ Data on hoist only
- ☀ Reference data taken for motion

Vibration Monitoring of Shovels and Draglines

- ✱ Only need 2 sensors per bearing
- ✱ Radial and axial give us bearing, gearmesh and thrusting
- ✱ Xtra-flex mining cable protected by liquidtite conduit
- ✱ Mounted to SS pads welded to housings
- ✱ Great linear response from sensors



Vibration Monitoring of Shovels and Draglines



- ✦ Crowd system has 11 sensors
- ✦ All 100 mv/g
- ✦ Same type wiring considerations
- ✦ One setback due to broken cable
- ✦ Continuous data
- ✦ Modular components
- ✦ Configurable
- ✦ 3 options for data collection and storage-time, trigger, condition

Vibration Monitoring of Shovels and Draglines

- ★ Data transmission options for phase 2
 - ★ Memory cards
 - ★ GSM module
 - ★ Tie into advanced control and communications scheme
 - ★ Running reports remotely
 - ★ Looking at data every 2 weeks presently
 - ★ May add hard drive and/or satellite link
 - ★ Wireless network running on locomotives and overhead industrial cranes
 - ★ Almost any Microsoft or compatible options

Vibration Monitoring of Shovels and Draglines

- ☀ Draglines are very similar
- ☀ Less motion to extract
- ☀ MG sets are straightforward
- ☀ Drive, sheave and pinion monitoring
- ☀ Lower speeds
- ☀ Longer time to get samples
- ☀ $F=1/T$ is limitation
- ☀ No overlap, one sample

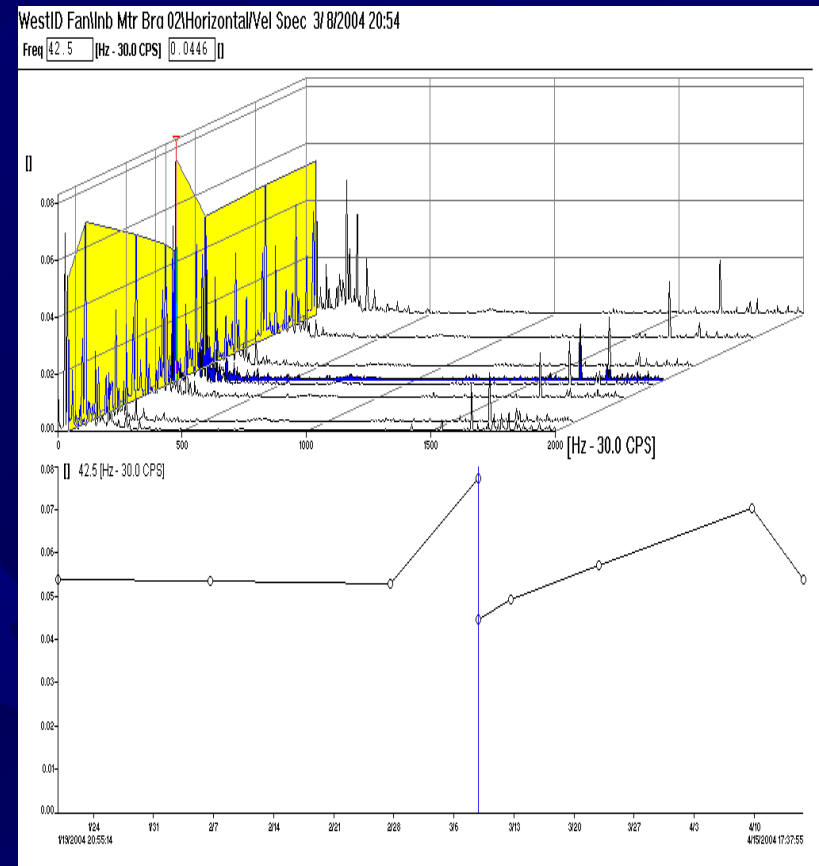


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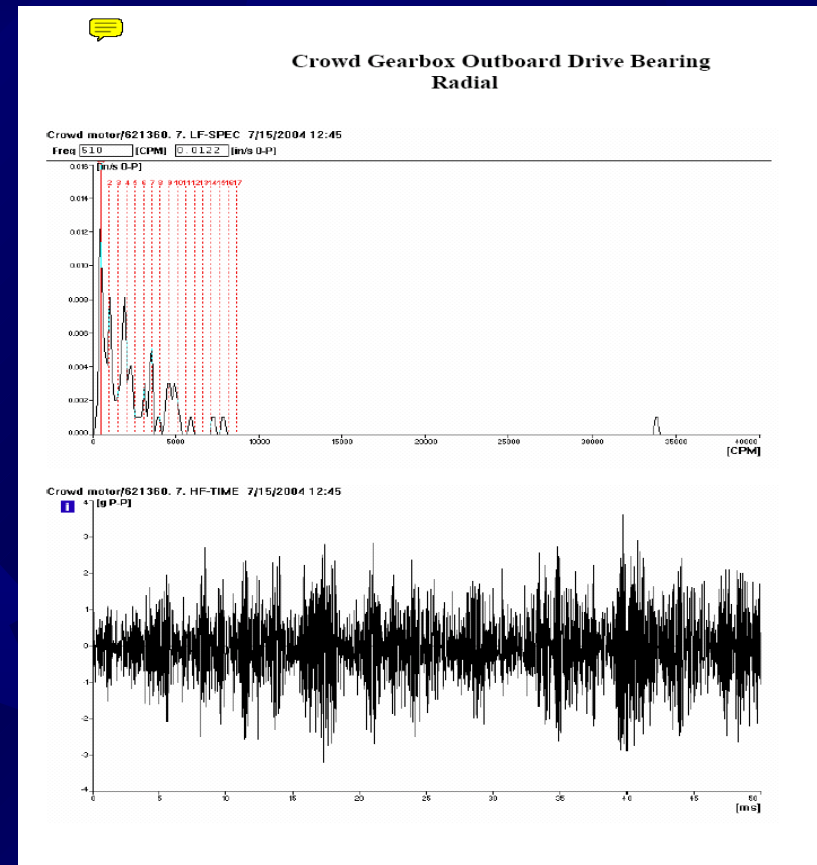
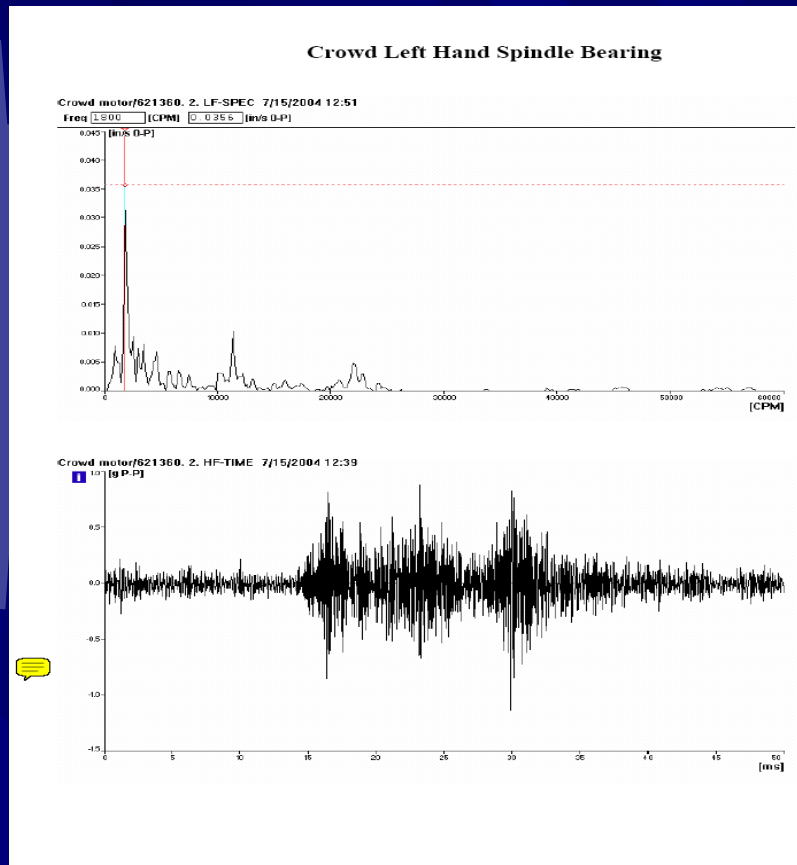


Vibration Monitoring of Shovels and Draglines

- ☀ Differentiate data from motion
- ☀ Motion is non-synchronous
- ☀ Need fast data capture, but not too rapid
- ☀ Storing Time Waveforms, integrating in the software
- ☀ Trends can be extracted
- ☀ No more than 3 samples
- ☀ No overlap averaging



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Vibration Monitoring of Shovels and Draglines

★ Planned developments

- ★ Online editing and simplified remote setup
- ★ Automated alarming
- ★ Swing and propel monitoring
- ★ Control system interface
- ★ Distributed sensor systems
- ★ Web access via mine communications
- ★ Larger data storage capability (Jan 05)
- ★ Wireless sensors

Vibration Monitoring of Shovels and Draglines

★ Conclusions

- ★ Online vibration analysis is possible
- ★ Special considerations
- ★ Systems have to be modified
- ★ Sensors are no longer limiting
- ★ Data transmission options are the key
- ★ Can be affordable, fast and reliable