

Ultrasound for Slow Speed

Bearing Monitoring

Part 1: Program Logistics

Presenter: Ron Tangen, CMRP

Dakota Gasification Company





Dakota Gasification Company

A subsidiary of Basin Electric

*Successfully Pioneering
Clean Synfuels from Coal*

About Dakota Gasification Company:

- Plant Capital Cost \$2.1 Billion
- Began Commercial Operation 1984
- 2014 Plant Availability 92%
- Maintenance Expense \$90MM / Year

- Total Employees 725

Products:



- ▶ **Synthetic Natural Gas**
- ▶ **Ammonium Sulfate**-agricultural fertilizer
- ▶ **Anhydrous Ammonia**-agricultural fertilizer
- ▶ **Carbon Dioxide**-enhanced oil recovery
- ▶ **Cresylic Acid**-pesticides, resins
- ▶ **Krypton and Xenon** gas-laser, lighting, windows
- ▶ **Liquid Nitrogen**-food processing refrigeration
- ▶ **Naptha**-gasoline blend stock, solvents
- ▶ **Phenol**-plywood resin
- ▶ Urea / DEF-2017

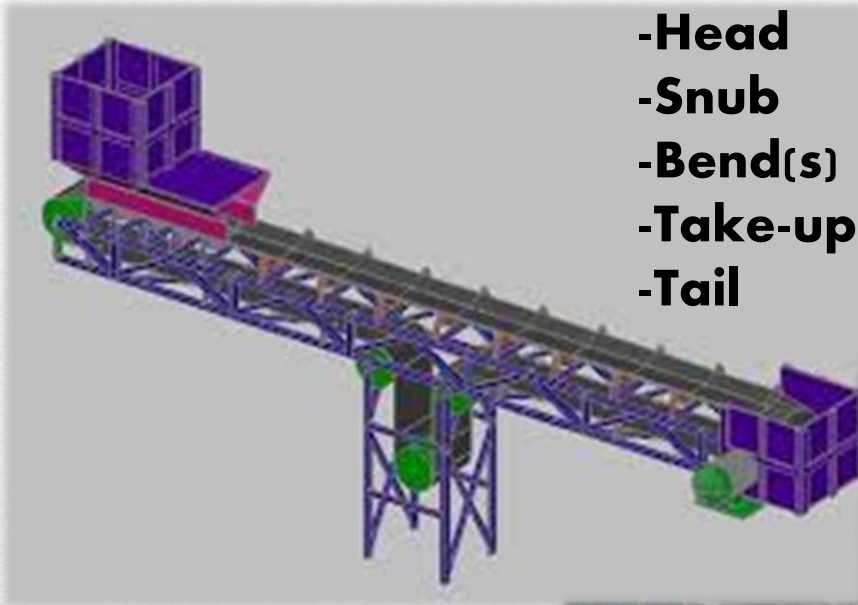
- Ultrasound
 - Leak Detection
 - Slow Speed Bearing Monitoring
 - Electrical Inspections
 - Electric Motor Re-lubrication
- Infrared
 - Thermal IR
 - Gas IR
 - Flare Monitoring
 - Critical Vessel Monitoring
- Vibration Analysis
- Oil Analysis
- Motor Current Analysis / PdMA Testing
- Compressor Performance Monitoring
- Precision Alignment
- RBI (Risk Based Maintenance)

Predictive Maintenance Strategies



ULTRASOUND BEARING MONITORING

Some background information.....



- Head
- Snub
- Bend(s)
- Take-up
- Tail



Typical Coal Belt Conveyor

- **400 Main Pulley Bearings**
- **2 - 4 catastrophic failures / year**
- **Cost of Failure**
 - Bearing
 - Manpower
 - Production Loss
 - Collateral Damage
 - Belt
 - Gearbox
 - Fire
 - Safety
- **Operations: Visual inspection every 7 days, added by an IR spot radiometer.**



Recognized Reliability Issue

- *Reduce the catastrophic bearing failure rate* in Coal Handling in order to:
 - Increase personnel and equipment safety.
 - Increase equipment reliability.
 - Decrease equipment maintenance cost.
 - Decrease production loss.

Improvement Needed

- Operational Reality: All bearings will fail.....
- Mitigation Strategy:
 - Verify bearing reliability
 - Monitor bearing health
 - Optimize operational bearing life
 - Remove bearing prior to catastrophic failure

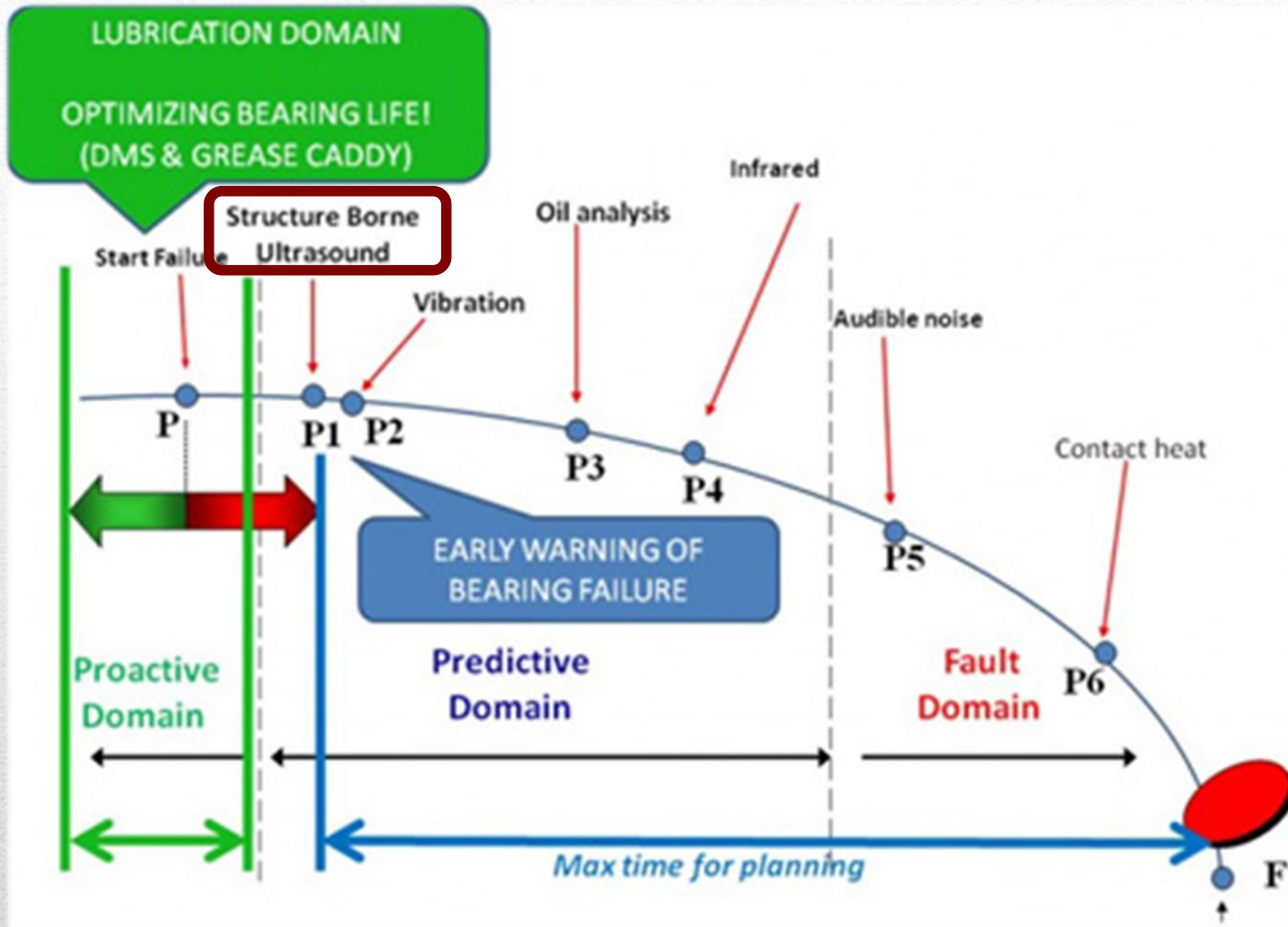
The Goal: Mitigate
***Catastrophic* Failures**



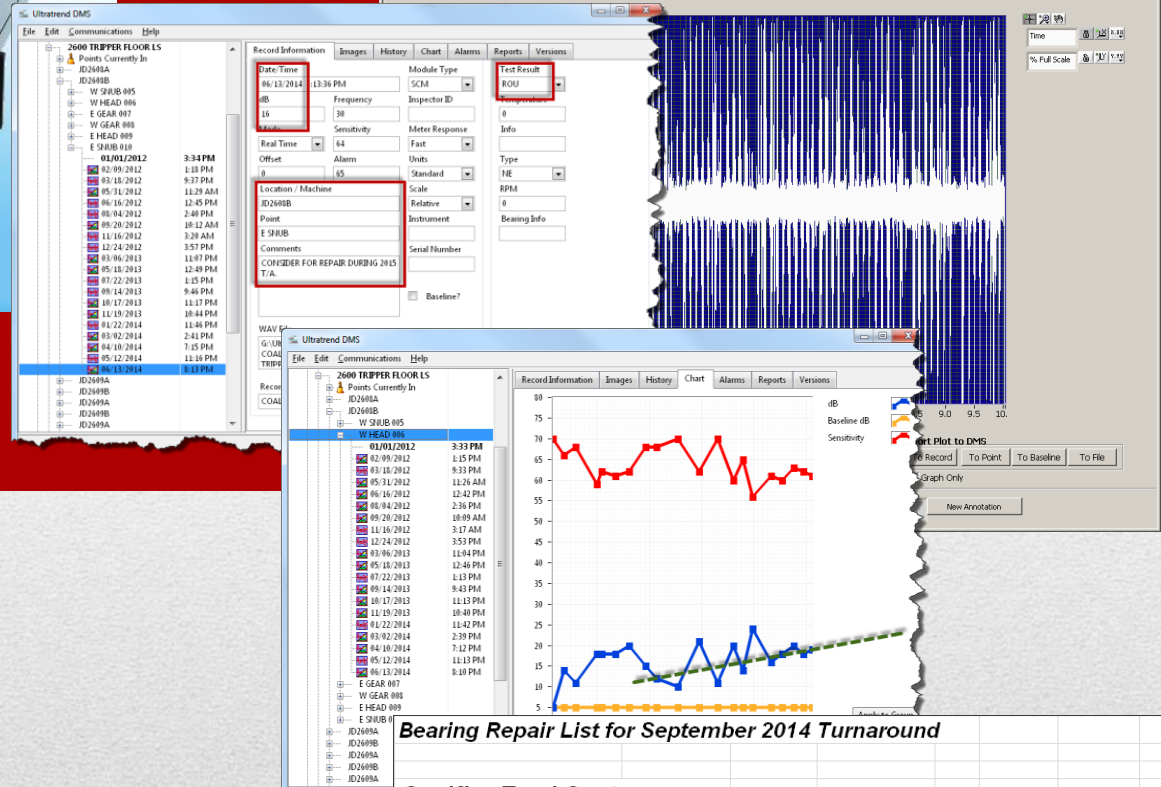
- **Optimizing Bearing Life (Reliability)**
 - Correct Bearing
 - Correct Operation
 - Correct Maintenance
- **Reducing Catastrophic Failure**
 - Correct Pdm Technology(s)
 - Correct Frequency



Moving Forward



Finding the right technology₁₂



Bearing Repair List for September 2014 Turnaround

Gasifier Feed System

Group Name	Location Name	Point Name	Date	dB	Sensitivity	Test Result	Info
2500 FINES SCREENING	JD2501A	E HEAD	05/04/2014	18		IMP-MOD	SPALLING
2500 FINES SCREENING	JD2501A	W TUP	05/04/2014	22		IMP-SIG	SPALLING
2600 SECONDARY SAMPLING	JD2601A	NE BEND	02/26/2013	17		WHN	IMP-MOD
2600 SECONDARY SAMPLING	JD2601A	NW BEND	02/26/2013	26		WHN	IMP-MOD

SSBM

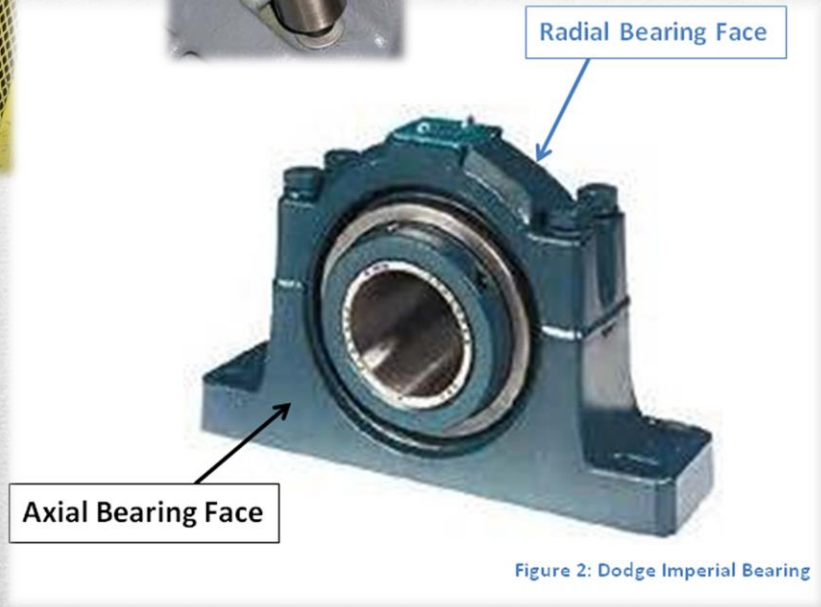
PROGRAM LOGISTICS

- Bearing Mfg / Model:
 - Dodge Imperial Bearings
 - 3 - 5 inch diameter
 - 70 - 80 rpm
- Data collection cycle
 - 400 bearings
 - 7 routes
 - 5 week interval
- Began in 2010
 - Prior: 2 - 4 failures / year
 - 1 failure in 2011
 - No failures in 2012 / 2013
 - 2 failures in 2014
 - No failures in 2015

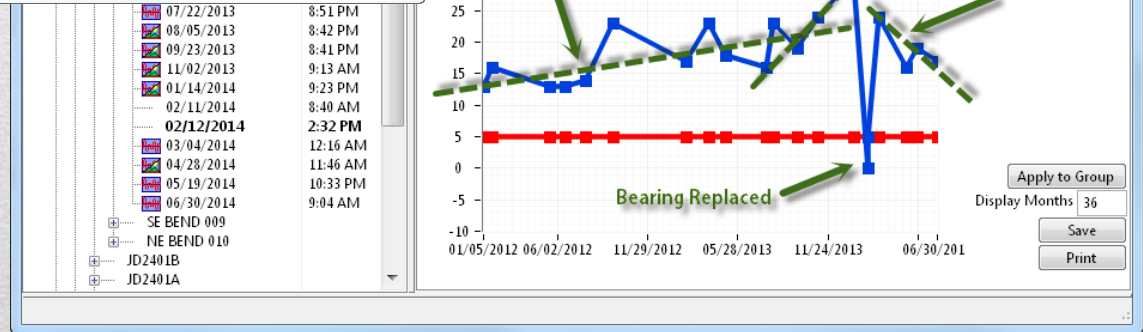
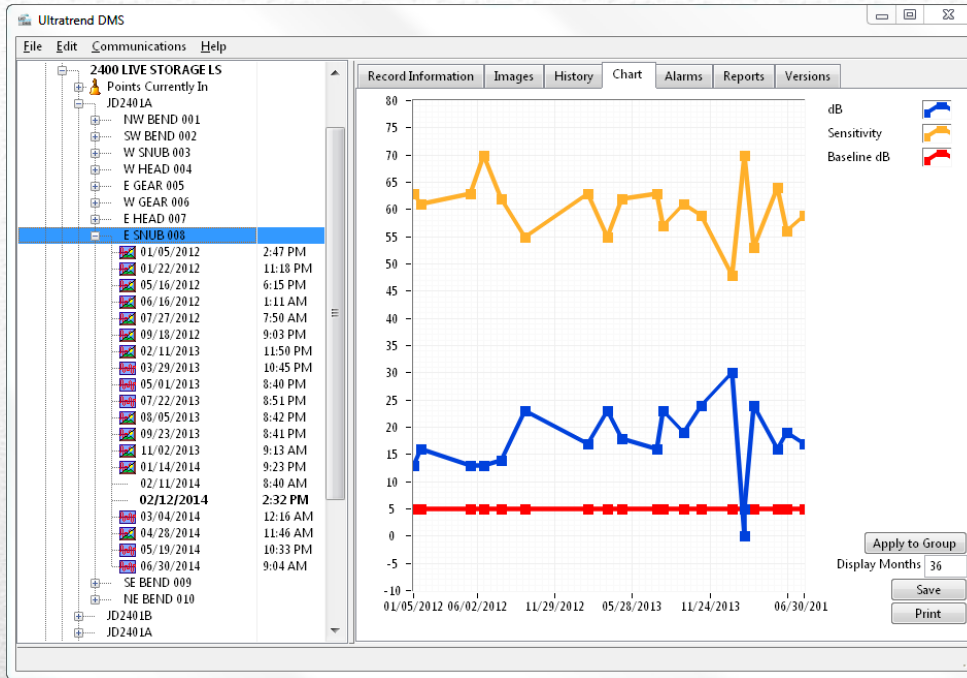


Bearing Monitoring Info

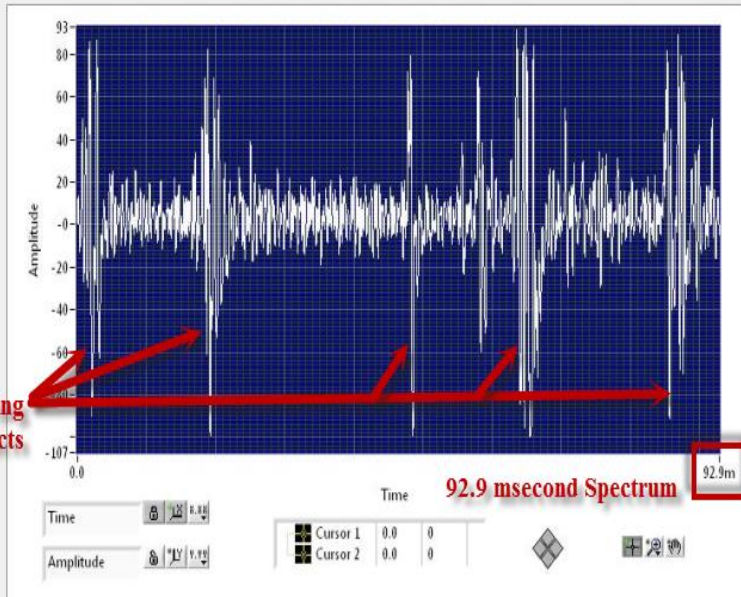
- **Data Collection**
 - Operations personnel
 - UE 10,000 Ultraprobe (RAS sensor)
 - Wavefile and Record Data collection
- **Data Management System (DMS)**
 - Wavefile, Record Data, and Images
 - Storage
 - Trending (Analysis)
 - Reporting
- **Spectralyzer**
 - Wavefile Analysis
- **Reports**
 - E-mail
 - Summary
 - 12 Month Projection



Data Collection

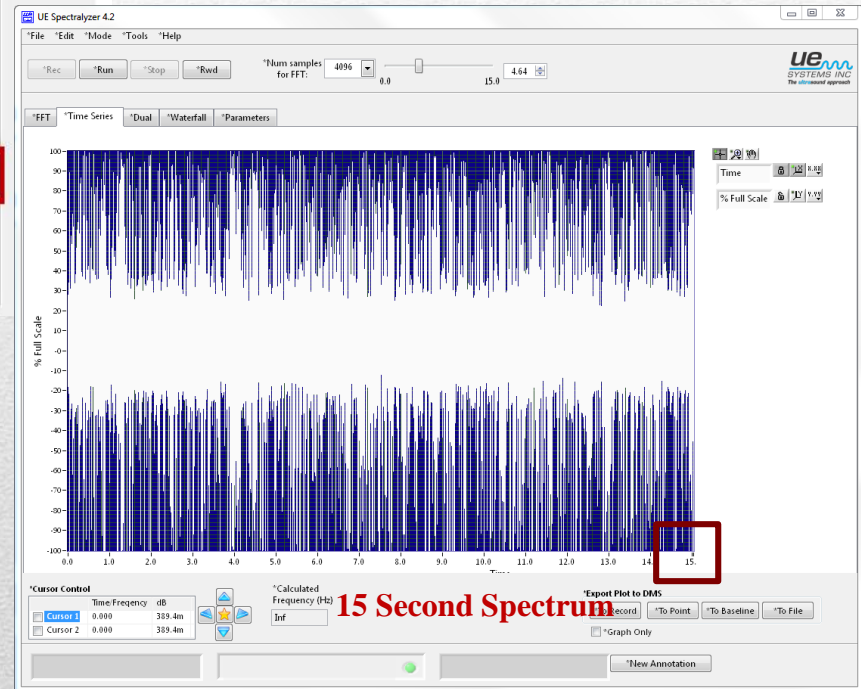


DMS - Trend Analysis



Short Timeframe
100 mseconds

Long Timeframe
10 seconds



Spectralyzer - Sound File Analysis



Acoustical Ultrasound



Slow Speed Bearing Failure Classification Chart

01/31/2014

DB \ Failure	OK / MINOR	MINOR	MINOR / MODERATE	MODERATE	MODERATE / SIGNIFICANT	SIGNIFICANT	SIGNIFICANT / SEVERE	SEVERE
0								
1								
2								
3								
4								
5	Baseline	Setup						
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23							High DB	
24							High DB	
25							High DB	
26							High DB	
27							watch	consider for repair
28							watch	consider for repair
29							watch	consider for repair
30							watch	consider for repair
31							watch	consider for repair
32								recommend for repair
33								recommend for repair
34								recommend for repair
35								recommend for repair
36								recommend for repair

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Failure Classification

Ultratrend DMS

File Edit Communications Help

2400 LIVE STORAGE LS

- Points: Currently In
- JD2401A
 - NW BEND 001
 - SW BEND 002
 - W SNUB 003
 - W HEAD 004
 - E GEAR 005
 - W GEAR 006
 - E HEAD 007
 - E SNUB 008
 - 01/05/2012 2:47 PM
 - 11/18/2012 11:18 PM
 - 01/22/2012 6:15 PM
 - 05/16/2012 11:11 AM
 - 06/16/2012 7:50 AM
 - 09/18/2012 9:03 PM
 - 02/11/2013 11:50 PM
 - 03/29/2013 10:45 PM
 - 05/01/2013 8:40 PM
 - 07/22/2013 8:51 PM
 - 08/05/2013 8:42 PM
 - 09/23/2013 8:41 PM
 - 11/02/2013 9:13 AM
 - 01/14/2014 9:23 PM**
 - 02/11/2014 8:40 AM
 - 02/12/2014 2:32 PM
 - 03/04/2014 12:16 AM
 - 04/28/2014 11:46 AM
 - 05/19/2014 10:33 PM
 - 06/30/2014 9:04 AM
 - SE BEND 009
 - NE BEND 010
 - JD2401B
 - JD2401A

Record Information

Date/Time: 01/14/2014 9:23:21 PM

Module Type: SCM

Test Result: NE

dB: 30

Frequency: 30

Inspector ID: 0

Temperature: 0

Mode: Real Time

Sensitivity: 48

Meter Response: Fast

Info: 0

Offset: 0

Alarm: 65

Units: Standard

Type: NE

Location / Machine: JD2401A

Scale: Relative

RPM: 0

Point: E SNUB

Instrument: 0

Bearing Info: 0

Comments: 0

Serial Number: 0

Baseline?

WAV File: G:\Ultraprobe\COAL ASH FGD SOLIDS\COAL ASH FGD SOLIDS.Bearing.2400 LIVE STORAGE\1.S.WAV.W008.011414212758.wav

Record Path: COAL ASH FGD SOLIDS\Bearing\2400 LIVE STORAGE LS\

ue SYSTEMS INC
The ultrasound approach

Record Information

Date/Time: 01/14/2014 9:23:21 PM

Module Type: SCM

Test Result: **IMP**

dB: 30

Frequency: 30

Inspector ID: 0

Temperature: 0

Mode: Real Time

Sensitivity: 48

Meter Response: Fast

Info: **SEVERE**

Offset: 0

Alarm: 65

Units: Standard

Type: NE

Location / Machine: JD2401A

Scale: Relative

RPM: 0

Point: E SNUB

Instrument: 0

Bearing Info: 0

Comments: **RECOMMEND FOR REPAIR AS SOON AS CONVENIENT. STEEP FAILURE TREND, WATCH, REPAIRED. BEARING CONTAINED SIGNIFICANT DAMAGE. SEE IMAGES**

Serial Number: 0

Baseline?

WAV File: G:\Ultraprobe\COAL ASH FGD SOLIDS\COAL ASH FGD SOLIDS.Bearing.2400 LIVE STORAGE\1.S.WAV.W008.011414212758.wav

Record Path: COAL ASH FGD SOLIDS\Bearing\2400 LIVE STORAGE LS\

ue SYSTEMS INC
The ultrasound approach

- 05/01/2013 8:40 PM
- 07/22/2013 8:51 PM
- 08/05/2013 8:42 PM
- 09/23/2013 8:41 PM
- 11/02/2013 9:13 AM
- 01/14/2014 9:23 PM**
- 02/11/2014 8:40 AM
- 02/12/2014 2:32 PM
- 03/04/2014 12:16 AM
- 04/28/2014 11:46 AM
- 05/19/2014 10:33 PM
- 06/30/2014 9:04 AM
- SE BEND 009
- NE BEND 010
- JD2401B
- JD2401A

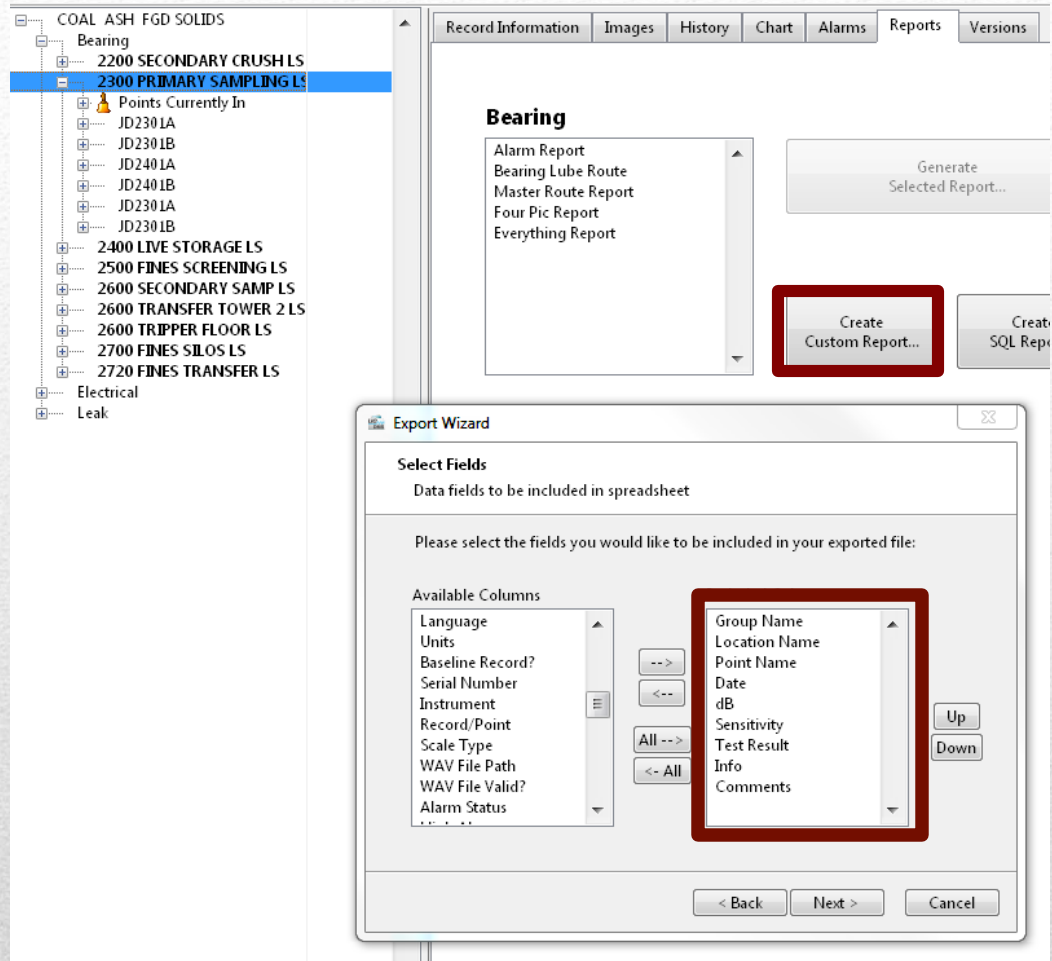
DMS - Documenting Results

- IMP - Impacting – Minor / Moderate / Significant / Severe
- WHN -Whitenoise
- RUB - Rub
- ROU - Rough
- LOS - Loose
- DRY - Dry
- CUS - Competing Ultrasound
- GBOX - Gearbox
- OTH - Other (See Comments)

Test Result / Info (Fields)

- Sensor / Connection problem
- Low Sensitivity / Over Ranged
- Not consistent with history
- Bad Idler
- Classification notes
 - Hi DB
 - Watch
 - Consider / Recommend For Repair
- Work Order Information
- Analysis Results

Comments (Field)



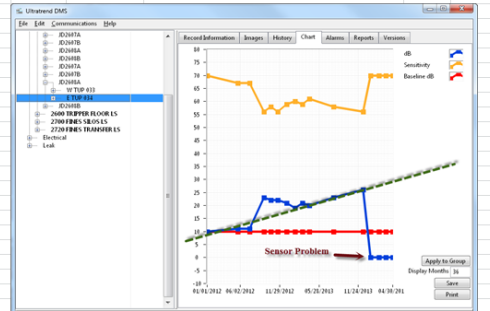
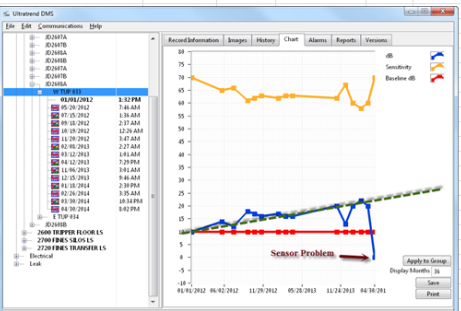
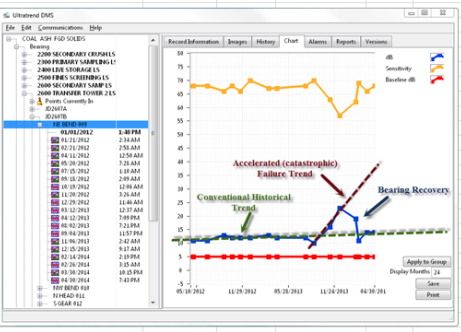
DMS – Report Generation

SUMMARY REPORT_2600 TRANSFER TOWER 2_051514

Group Name	Location Name	Point Name	Date	dB	Sensitivity	Frequency	Test Result	Info	Comments
2600 TRANSFER TOWER 2 LS	JD2607A	NE BEND	04/30/2014 19:37	12	67	30	CHA		
2600 TRANSFER TOWER 2 LS	JD2607A	NW BEND	04/30/2014 19:38	11	69	30	WHN		
2600 TRANSFER TOWER 2 LS	JD2607A	N HEAD	04/30/2014 19:39	17	62	30	WHN	IMP-MOD	
2600 TRANSFER TOWER 2 LS	JD2607A	S GEAR	04/30/2014 19:39	34	46	30	WHN		
2600 TRANSFER TOWER 2 LS	JD2607A	N GEAR	04/30/2014 19:40	35	46	30	WHN		
2600 TRANSFER TOWER 2 LS	JD2607A	S HEAD	04/30/2014 19:40	14	66	30	ROU		
2600 TRANSFER TOWER 2 LS	JD2607A	SW BEND	04/30/2014 19:41	12	68	30	WHN	IMP-MINOR	COMPETING US?
2600 TRANSFER TOWER 2 LS	JD2607A	SE BEND	04/30/2014 19:42	12	68	30	WHN		

2600 TRANSFER TOWER 2 LS	JD2607B	NE BEND	04/30/2014 19:43						
2600 TRANSFER TOWER 2 LS	JD2607B	NW BEND	04/30/2014 19:44						
2600 TRANSFER TOWER 2 LS	JD2607B	N HEAD	04/30/2014 19:44						
2600 TRANSFER TOWER 2 LS	JD2607B	S GEAR	04/30/2014 19:45						
2600 TRANSFER TOWER 2 LS	JD2607B	N GEAR	04/30/2014 19:46						
2600 TRANSFER TOWER 2 LS	JD2607B	S HEAD	04/30/2014 19:46						
2600 TRANSFER TOWER 2 LS	JD2607B	SW BEND	04/30/2014 19:47						
2600 TRANSFER TOWER 2 LS	JD2607B	SE BEND	04/30/2014 19:48						
2600 TRANSFER TOWER 2 LS	JD2608A	SW BEND	04/30/2014 19:49						
2600 TRANSFER TOWER 2 LS	JD2608A	NW BEND	04/30/2014 19:50						
2600 TRANSFER TOWER 2 LS	JD2608A	W TAIL	04/30/2014 19:50						
2600 TRANSFER TOWER 2 LS	JD2608A	ETAIL	04/30/2014 19:51						
2600 TRANSFER TOWER 2 LS	JD2608A	NE BEND	04/30/2014 19:52						
2600 TRANSFER TOWER 2 LS	JD2608A	SE BEND	04/30/2014 19:53						
2600 TRANSFER TOWER 2 LS	JD2608B	SW BEND	04/30/2014 19:54						
2600 TRANSFER TOWER 2 LS	JD2608B	NW BEND	04/30/2014 19:54						
2600 TRANSFER TOWER 2 LS	JD2608B	W TAIL	04/30/2014 19:55						
2600 TRANSFER TOWER 2 LS	JD2608B	ETAIL	04/30/2014 19:56						
2600 TRANSFER TOWER 2 LS	JD2608B	NE BEND	04/30/2014 19:57						
2600 TRANSFER TOWER 2 LS	JD2608B	SE BEND	04/30/2014 19:57						
2600 TRANSFER TOWER 2 LS	JD2607A	N TUP	04/30/2014 19:59						
2600 TRANSFER TOWER 2 LS	JD2607A	S TUP	04/30/2014 20:00						
2600 TRANSFER TOWER 2 LS	JD2607B	N TUP	04/30/2014 20:01						
2600 TRANSFER TOWER 2 LS	JD2607B	S TUP	04/30/2014 20:01						
2600 TRANSFER TOWER 2 LS	JD2608A	W TUP	04/30/2014 20:02						
2600 TRANSFER TOWER 2 LS	JD2608A	ETUP	04/30/2014 20:03						
2600 TRANSFER TOWER 2 LS	JD2608B	W TUP	04/30/2014 20:15						
2600 TRANSFER TOWER 2 LS	JD2608B	ETUP	04/30/2014 20:16						

ANALYSIS RESULTS:
 1- JD2607B NE BEND: BEARING HAS RECOVERED FROM APPARENT FAILURE TREND. (SEE TREND BELOW) REMOVING FROM REPAIR DURING T/A LIST.
 2- JD2608A TUP: RECOMMEND FOR REPAIR DURING T/A. (SEE TREND BELOW)
 3- JD2608B E TUP: RECOMMEND FOR REPAIR DURING T/A. (SEE TREND BELOW)
 4- Some TUP sensors appear to have fallen off. Please confirm and repair as needed.

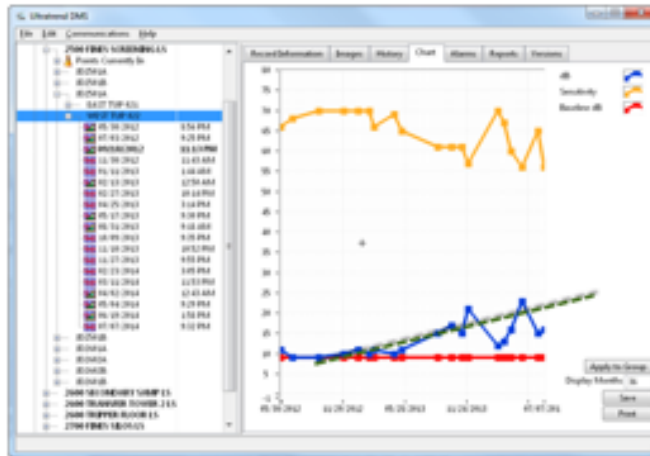


Summary Report

I am OK with this.

FYI.....JD2501A W TUP has a WO in to replace when convenient, so you may get a different signature on it if replaced during T/A.

Ron



From: Fred Wilson
Sent: Wednesday, September 10, 2014 5:25 AM
To: Ron Tangen; Keith DeYoung; Jeff Keller
Subject: acoustic route

Ron,
Right now live storage is down and half of screenings. If routes can wait another week or so we can get them in then. Thanks

Fred wilson

E-Mail Response

Bearing Repair List for September 2014 Turnaround

Gasifier Feed System

Group Name	Location Name	Point Name	Date	dB	Sensitivity	Test Result	Info	Comments	Last Replaced	Last Replaced
2500 FINES SCREENING	JD2501A	E HEAD	05/04/2014	18		IMP-MOD	SPALLING	MONITOR, SLIGHT UPWARD TREND	05/05/2010	
2500 FINES SCREENING	JD2501A	W TUP	05/04/2014	22		IMP-SIG	SPALLING	HI DB, CONSIDER FOR REPAIR DURING T/A, POSS CATASTROPHIC TREND	02/17/2004	
	JD2501B	ETUP						SENSOR OFF		
2600 SECONDARY SAMPLING	JD2601A	NE BEND	02/26/2013	17		WHN	IMP-MOD	SPALLING, SLOW UPWARD TREND	02/17/2004	
2600 SECONDARY SAMPLING	JD2601A	NW BEND	02/26/2013	26		WHN	IMP-MOD	SPALLING, HI DB, UPWARD TREND (WO canceled In 2013)	06/13/2009	01/17/2007
2600 TRANSFER TOWER 2	JD2608A	W TUP	01/18/2014 14:30	20	60	WHN	IMP-MOD	CONSIDER FOR REPAIR DURING T/A (22MAX) SENSOR OFF	04/30/2003	
2600 TRANSFER TOWER 2	JD2608A	E TUP	01/18/2014 14:31	0	70	OTH		CONSIDER FOR REPAIR DURING T/A, (26DB MAX) SENSOR OFF	04/30/2003	
2600 TRANSFER TOWER 2	JD2608B	E TUP	01/18/2014 14:32	27	56	WHN	IMP-MOD	CONSIDER FOR REPAIR, WATCH (29MAX) SENSOR OFF	03/17/2005	
	JD2608B	WTUP						SENSOR OFF		
2600 TRIPPER FLOOR	JD2608A	W HEAD	04/10/2014 0:00	27	58	ROUGH	8DB/2YR	TRENDING UP, CONSIDER FOR REPAIR DURING T/A (27DB MAX) (canceled In 2013)	??	
2600 TRIPPER FLOOR	JD2608A	E HEAD	05/12/2014 0:00	18		ROUGH	7DB/2YR	TRENDING UP, CONSIDER FOR REPAIR DURING T/A (24DB MAX) (canceled In 2013)	??	
2600 TRIPPER FLOOR	JD2608B	W SNUB	01/22/2014 23:42	15	64	ROUGH	8DB/3YR	TRENDING UP, CONSIDER FOR REPAIR DURING T/A, (27DB MAX)	12/22/2007	
2600 TRIPPER FLOOR	JD2608B	W HEAD	01/22/2014 23:42	16	61	IMP	5DB/2YR	TRENDING UP, CONSIDER FOR REPAIR DURING T/A, (24DB MAX)	05/01/2005	
2600 TRIPPER FLOOR	JD2608B	E SNUB	01/22/2014 23:45	15	63	ROUGH	4DB/2YR	TRENDING UP, CONSIDER FOR REPAIR DURING T/A (23DB MAX)	12/22/2007	
2600 TRIPPER FLOOR	JD2608A	N HEAD	05/12/2014	6		WHN	IMP-MIN	MONITOR, POSS FAILURE TREND (PUSH TO 2015)	??	
2600 TRIPPER FLOOR	JD2608A	N TUP	05/12/2014	11		WHN	IMP-MIN	MONITOR (APPEARS TO BE TRENDING DOWN)	??	
2600 TRIPPER FLOOR	JD2608A	STUP	05/12/2014	16		WHN		MONITOR (TREND NOT CLEAR)	??	
2600 TRIPPER FLOOR	JD2608B	N HEAD	05/12/2014	12		WHN	IMP-MIN	MONITOR, POSS FAILURE TREND	05/21/2000	
2600 TRIPPER FLOOR	JD2609C	NW BEND	05/12/2014	13		WHN	IMP-MOD	STEADY BUT CONSISTANT ISSUES, RUB IN PAST	06/07/2004	
2600 TRIPPER FLOOR	JD2609C	N TUP						SENSOR OFF		
Fines Feed System										
2700 FINES SILOS	JD2701B	N TUP	04/06/2014	26		WHN		VERY SLOW DOWNWARD TREND, HI DB, WATCH, SENSOR OFF 5-8-14	05/10/2010	
2700 FINES SILOS	JD2701B	S TUP						SENSOR OFF 5-8-14		
2720 FINES TRANSFER	JD2720A	NW BEND		21		WHN	IMP-MOD	CYCLICAL, SPALLING (SLOW DOWNWARD TREND)	07/17/2012	
2720 FINES TRANSFER	JD2720A	NE BEND		22		WHN	IMP-SIG	SPALLING, HI DB, (SLOW DOWNWARD TREND)	07/17/2012	
2720 FINES TRANSFER	JD2720A	SE BEND	05/10/2014	25		WHN	IMP-MOD	HI DB (VERY SLOW DOWNWARD TREND)	07/17/2012	
2720 FINES TRANSFER	JD2720A	E TUP	03/08/2014 1:24	23	56	WHN	IMP-MINOR	HI DB, CONSIDER FOR REPAIR 2014 T/A	06/17/2004	
2720 FINES TRANSFER	JD2720A	W TUP	04/06/2014					SENSOR NOT READING	06/17/2004	
								RECOMMEND FOR REPAIR		
								CONTINUE TO MONITOR		
								SENSOR OFF		
								PART OF BEARING SET (2)		

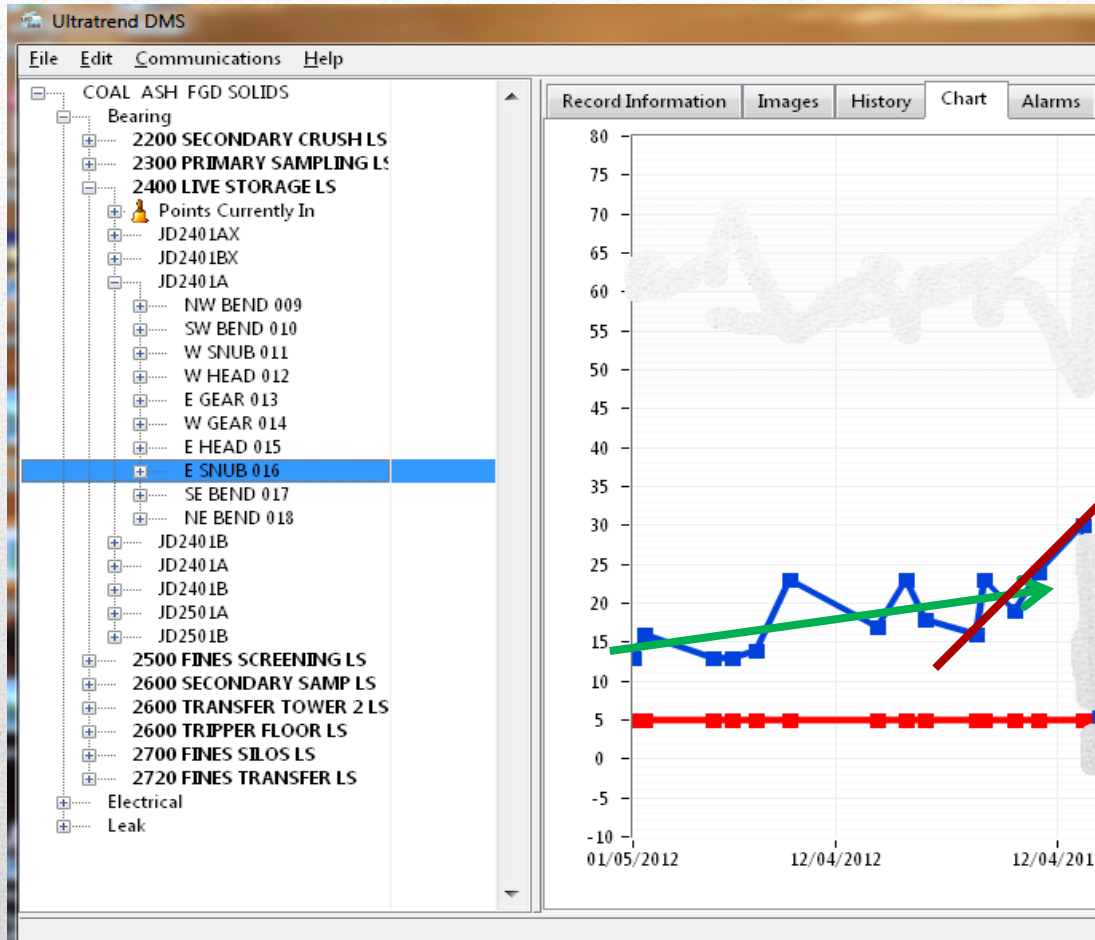
7 PULLEYS / 11 BEARINGS
 9 SENSORS OFF
 11 BEARINGS BEING MONITORED

12 Month Projection

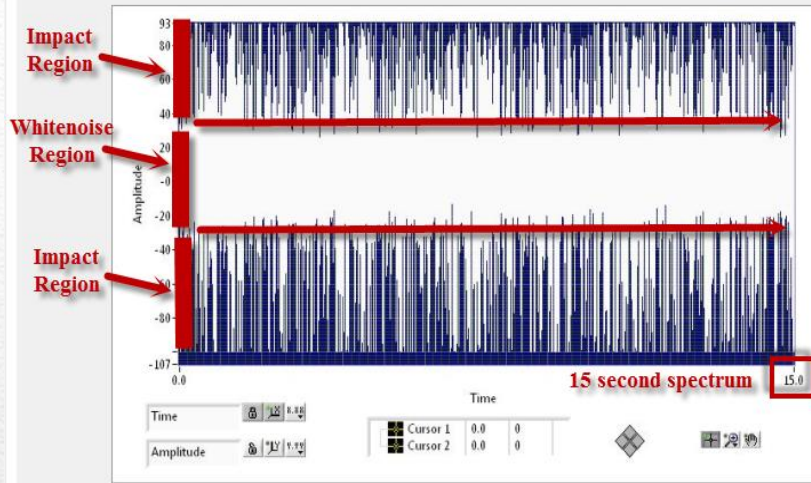


A SUCCESS STORY: PLANNED BEARING REPLACEMENT

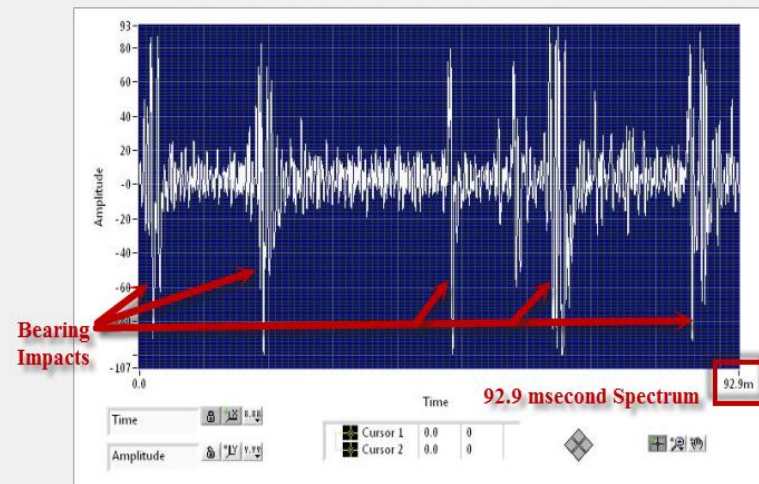
JD2401A East Snub Pulley Bearing



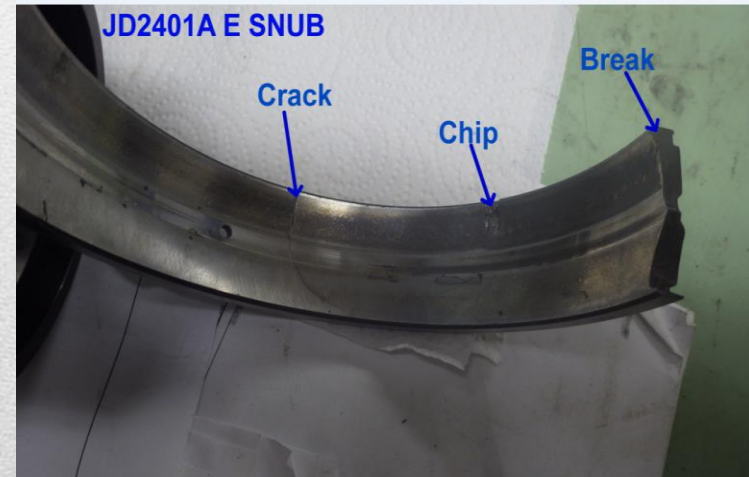
Trend History



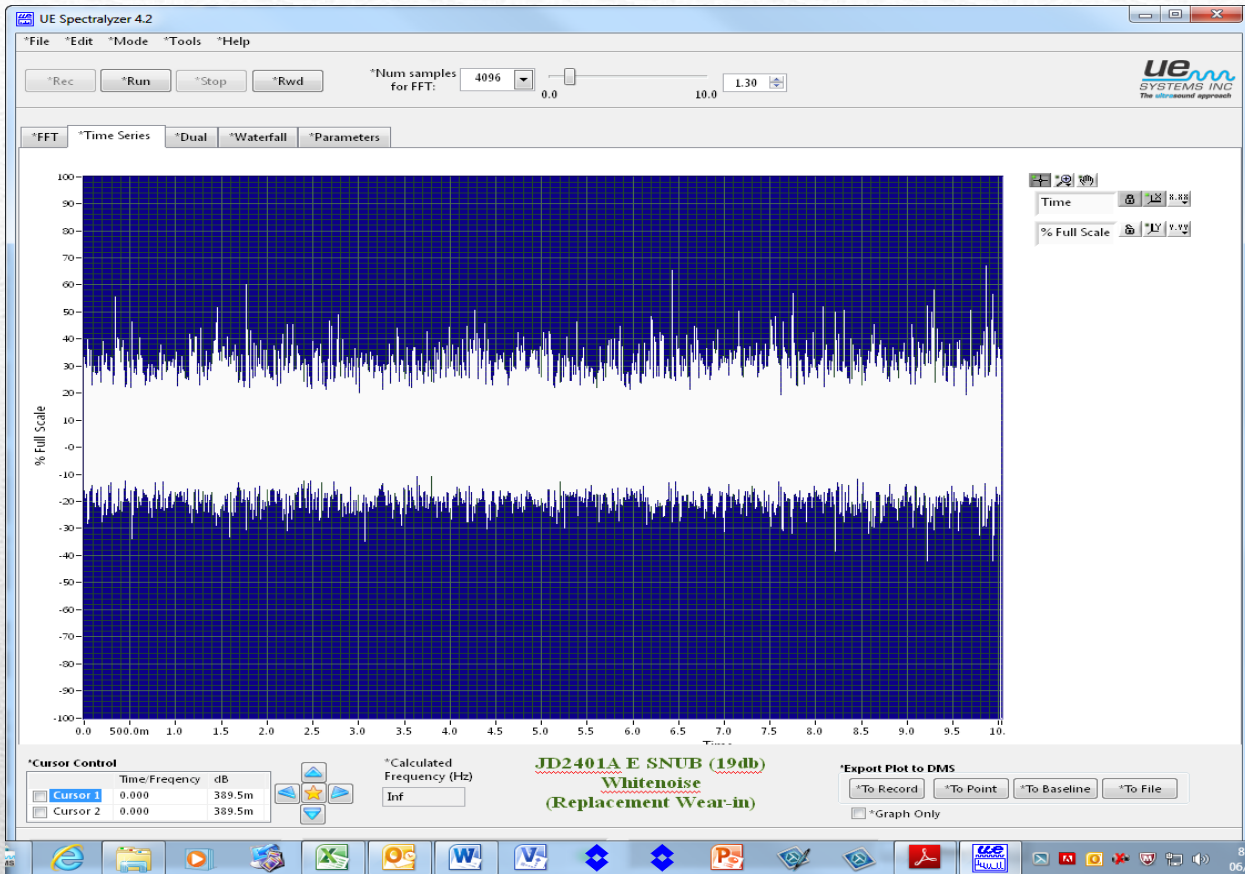
W008_011414212258.wav



Analyzing the data (Time Series Spectrum)



Visual Inspection



W016_092714204433.wav

New Bearing (Spectrum)



IDLER BEARING MONITORING

Using the UE3000

- Available for Operations.
- Tool for early detection of Idler Bearing failure.
- No formal program.

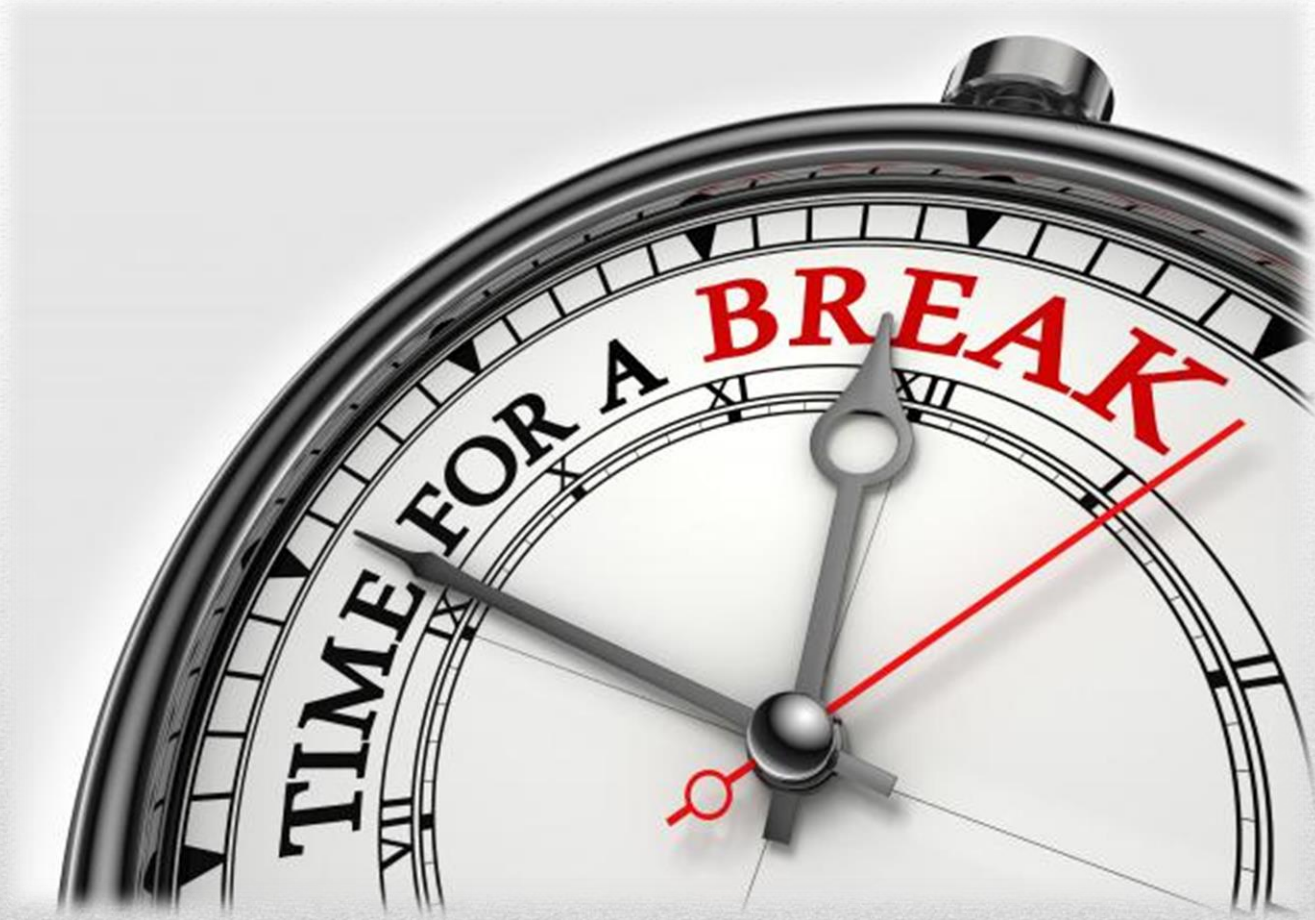
Conditon Monitoring Form for Conveyor Idlers								
Belt No.	Date	25-30 dB	30-35 dB	35-40 dB	40-45 dB	45-50 dB	≥ 50 dB	WR Written
JD2201A								
JD2201B								
JD2301A								
JD2301B								
JD2401A								
JD2401B								
JD2501A								
JD2501B								
JD2601A								
JD2601B								
JD2602A								
JD2602B								
JD2606								
JD2607A								
JD2607B								
JD2608A								
JD2608B								
JD2609A								
JD2609B								
JD2609C								
JD2609D								
JD2701A								
JD2701B								
JD2702								
JD2720A								
JD2720B								
JD2708A								
JD2708B								
JD2708C								
JD2708D								



Idler Bearing Monitoring



Questions.....



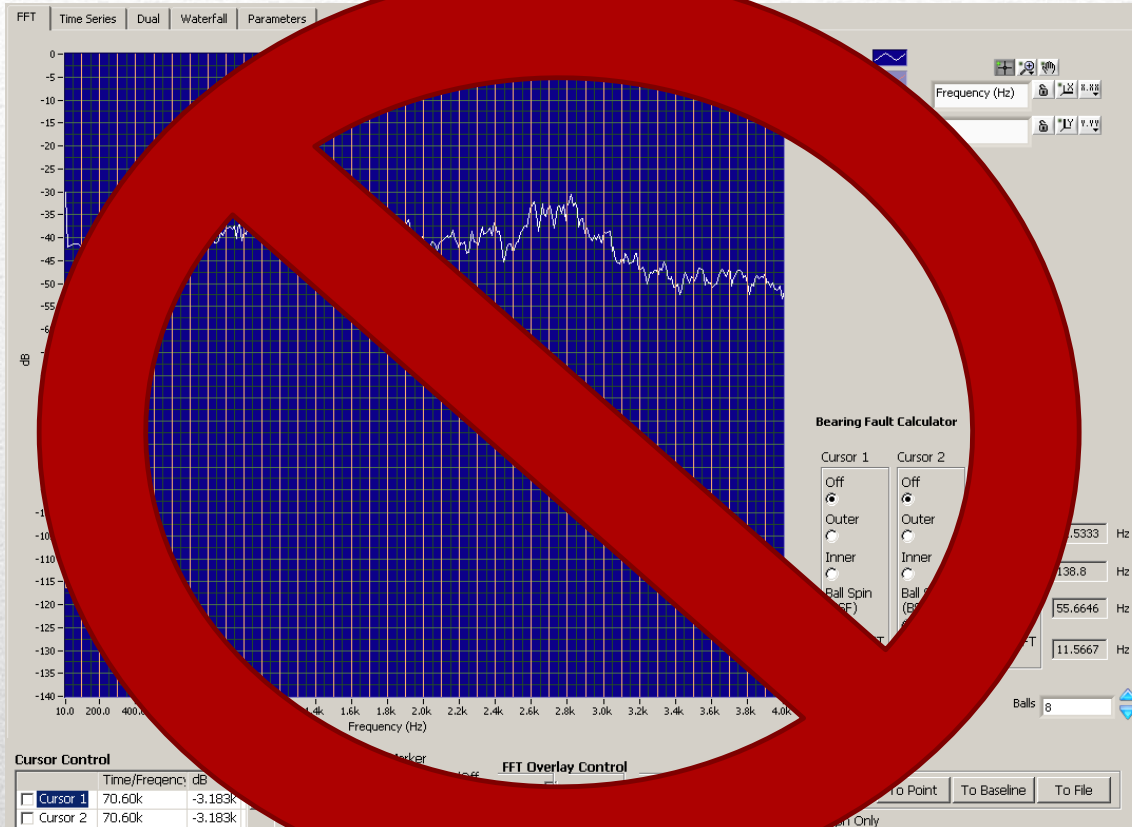
Short Break.....

Ultrasound for Slow Speed

Bearing Monitoring

Part 2: Bearing Analysis

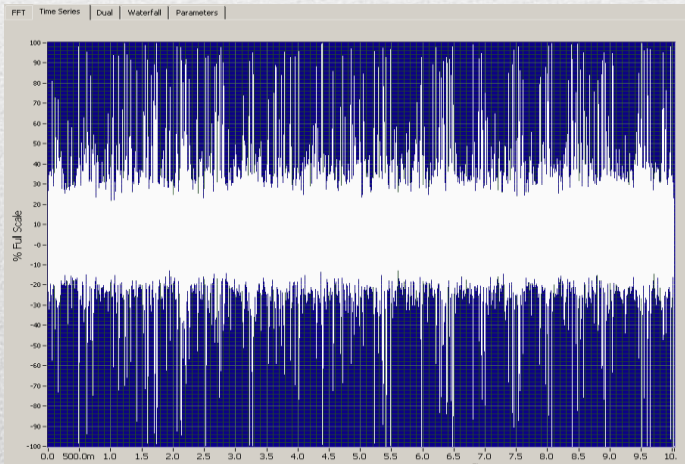




FFT: Doesn't work on SSB's

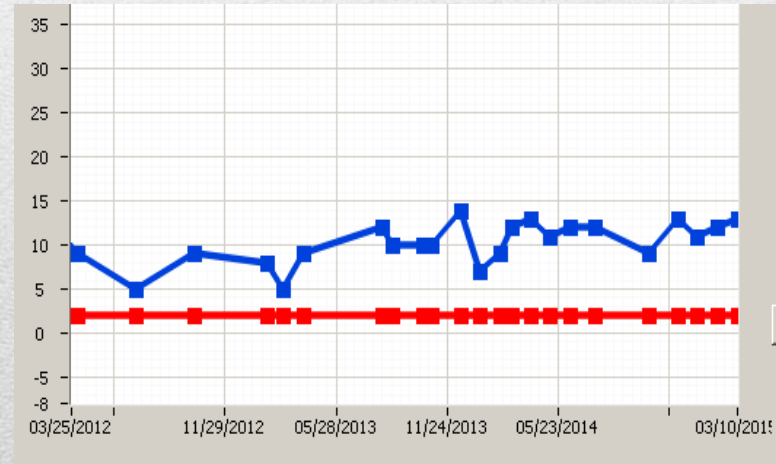
Spectralyzer

- Time Series Chart
- Frictional force over (short) timeframe.
- Health at specific moment.



DMS

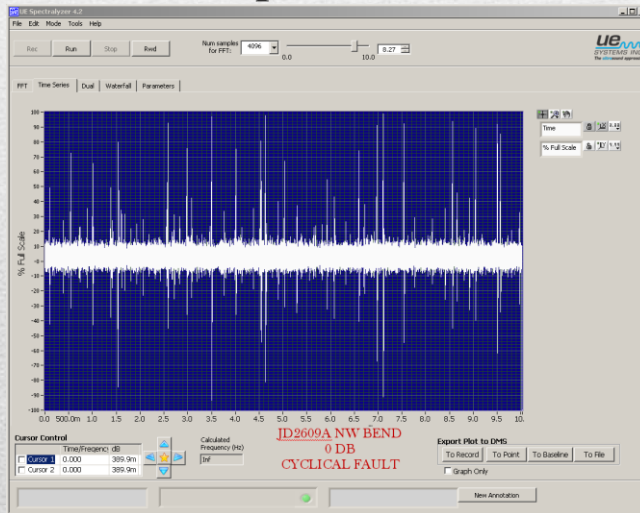
- Trend Chart
- Decibel reading over (long) timeframe.
- Past, Current, *Future* Health.



Analysis Tools

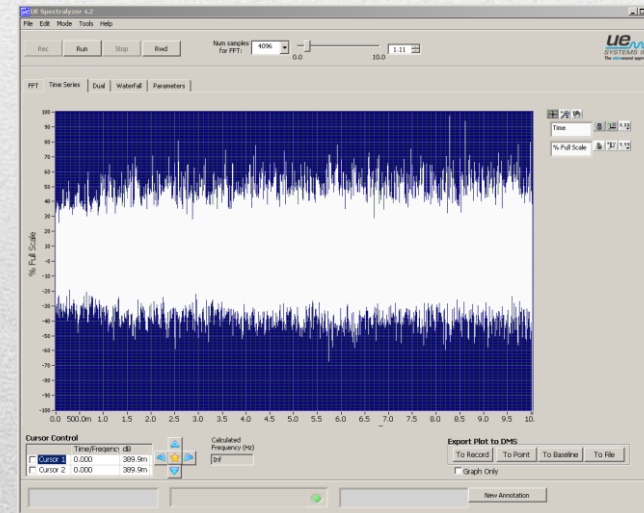
Impacting

- Short duration frictional forces.
 - Contamination
 - Pitting, Spalling, Fretting
 - Broken parts (i.e. cracked race)

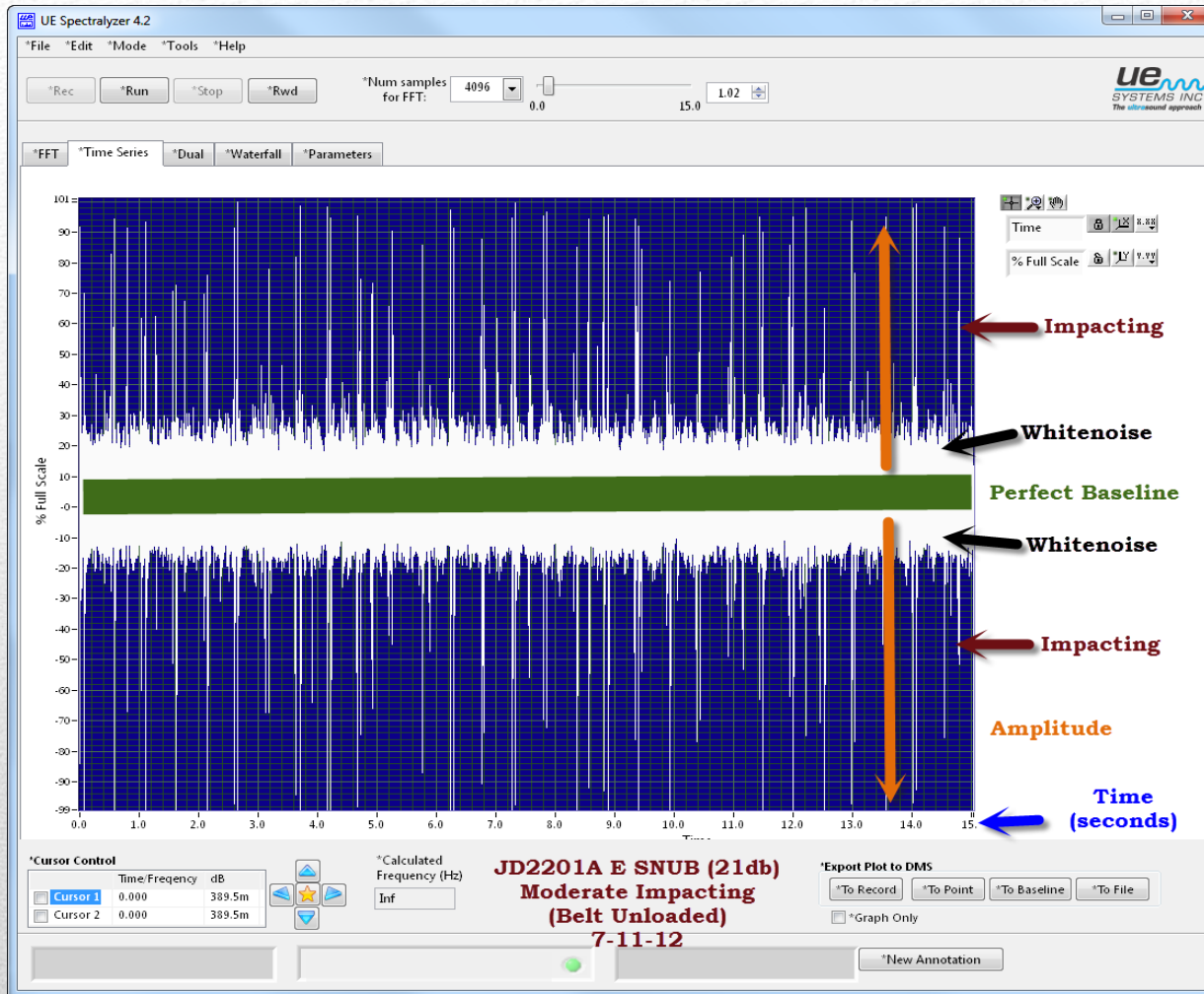


Whitenoise

- Constant frictional forces.
 - Tight (new) bearing
 - Worn (old) bearing
 - High bearing load
 - Low lubrication



Spectralyzer = Frictional Forces

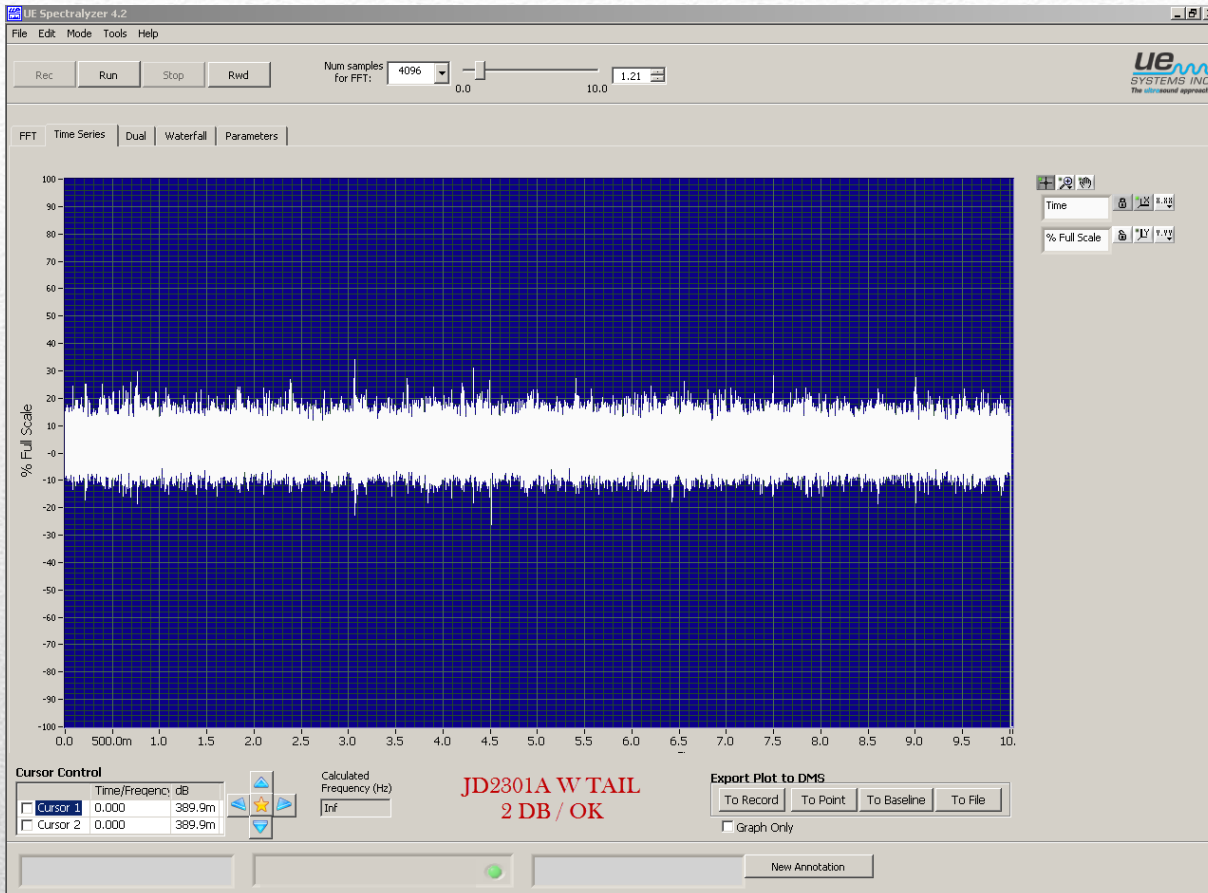


Impacting- Long Timeframe (15sec)



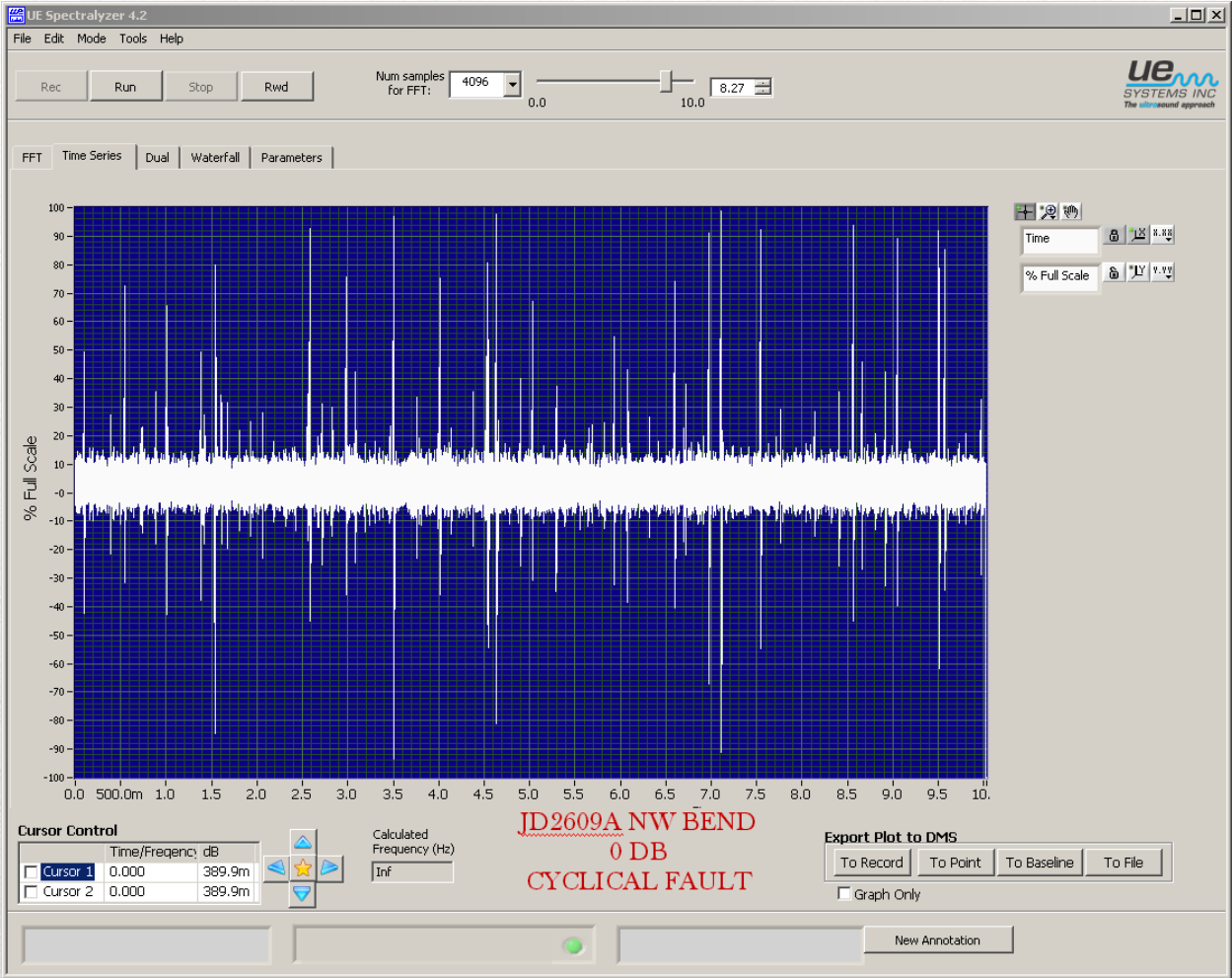
IMPACTING FAILURE CYCLE

Spectrum / Signature



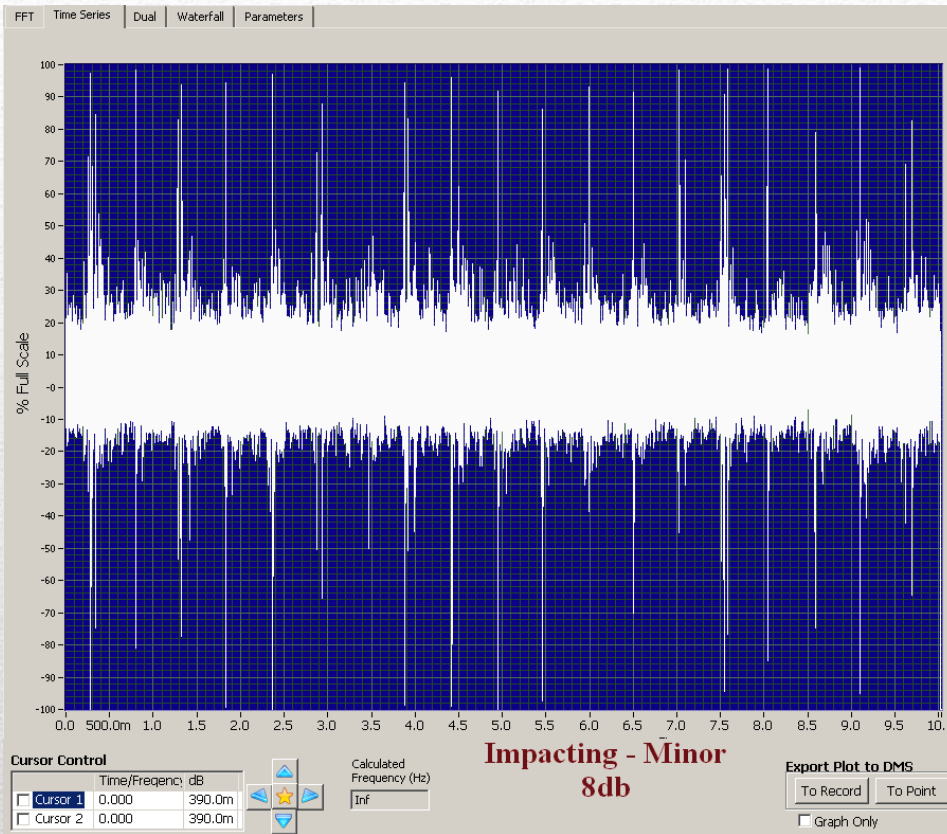
W029_060914231150.wav

OK – NO FAULT

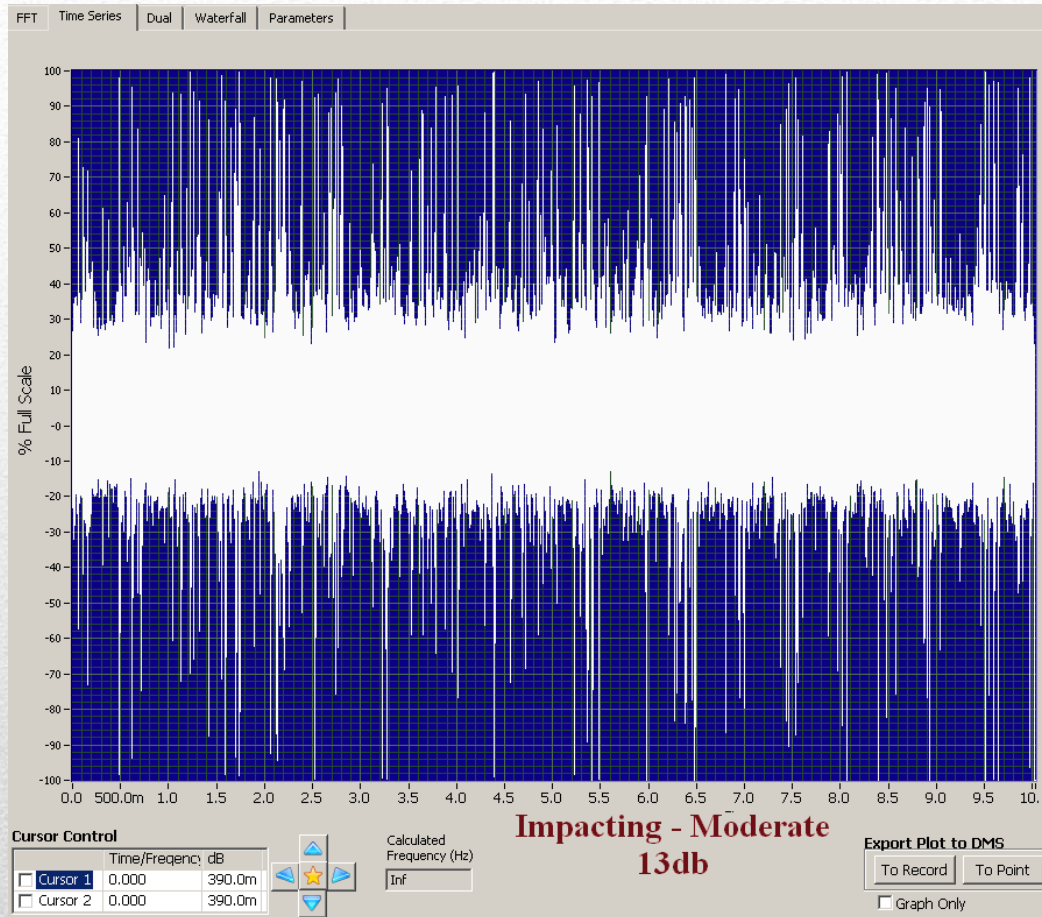


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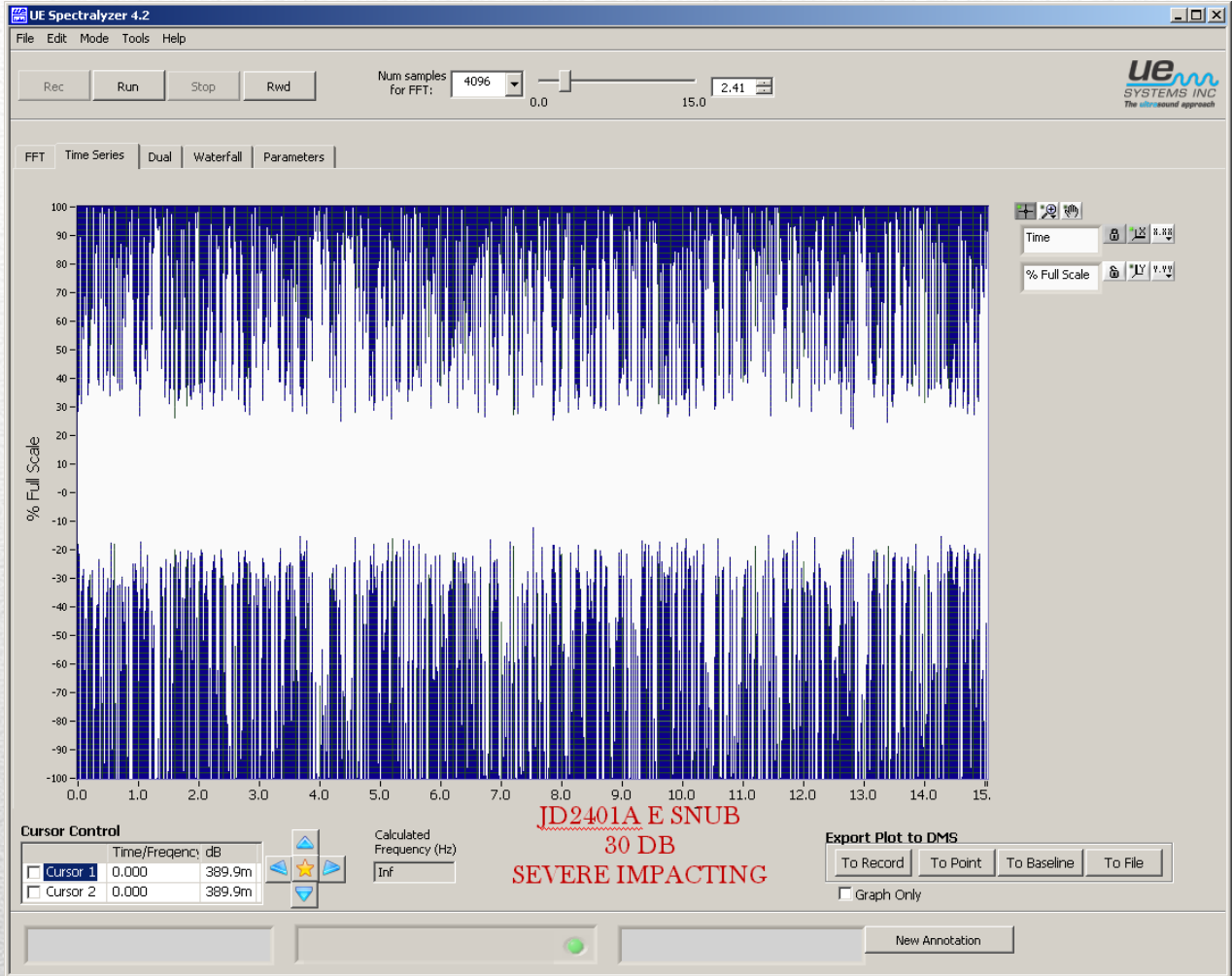
ZERO DB FAULT



Minor Impacting (8db)



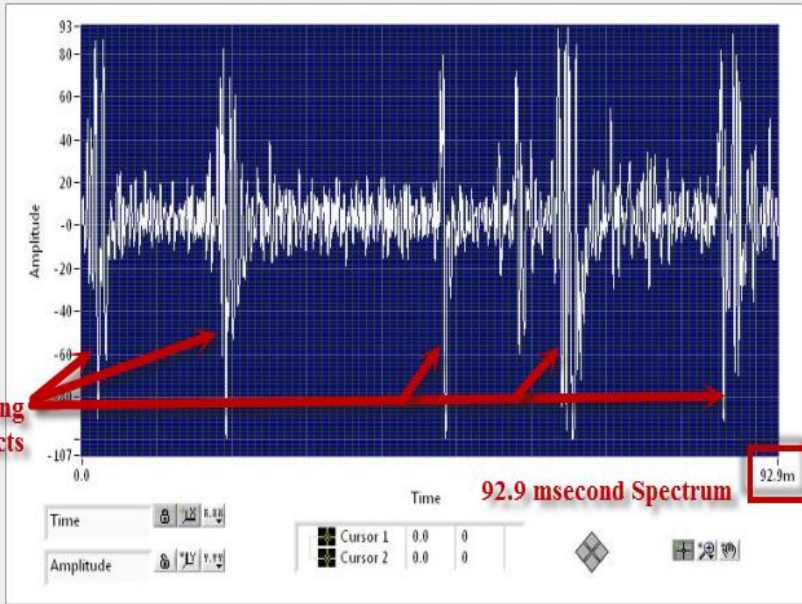
Moderate Impacting 13 db



W008_011414212258.wav

SEVERE IMPACTING

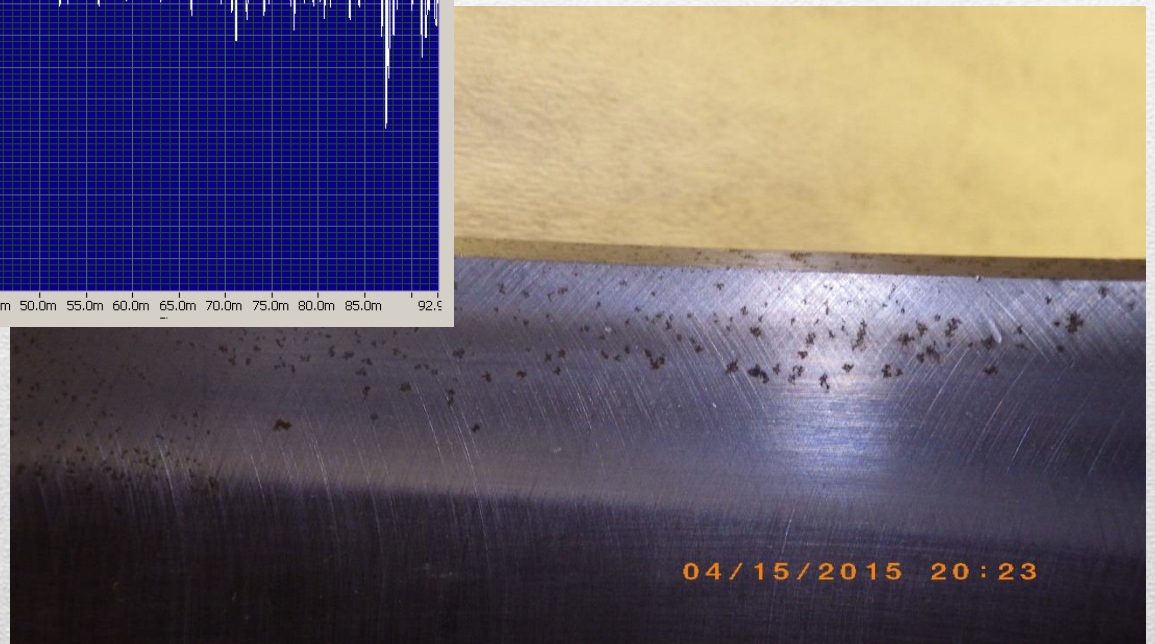
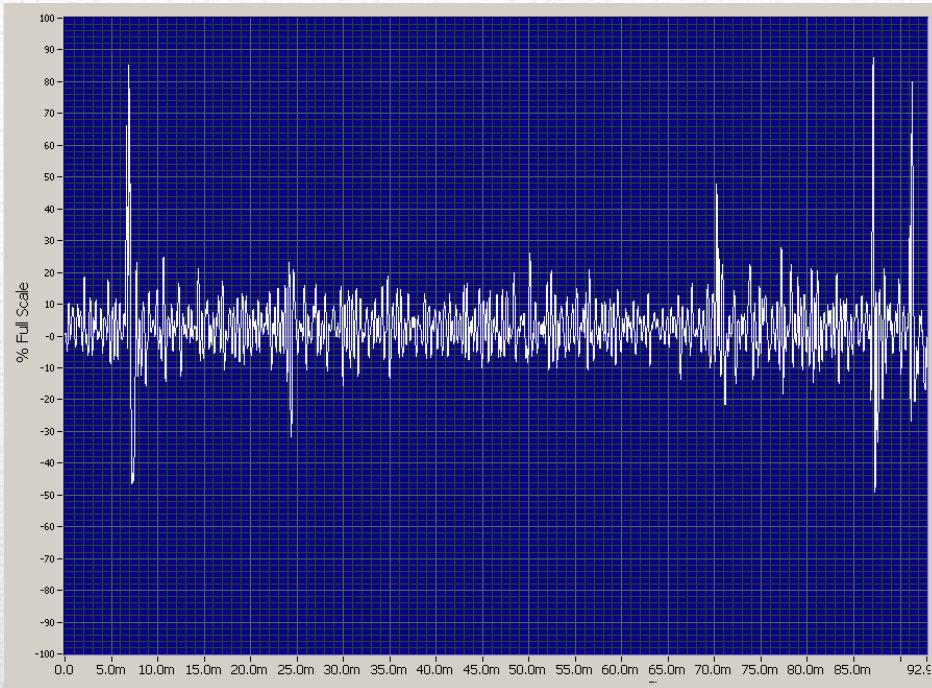
46



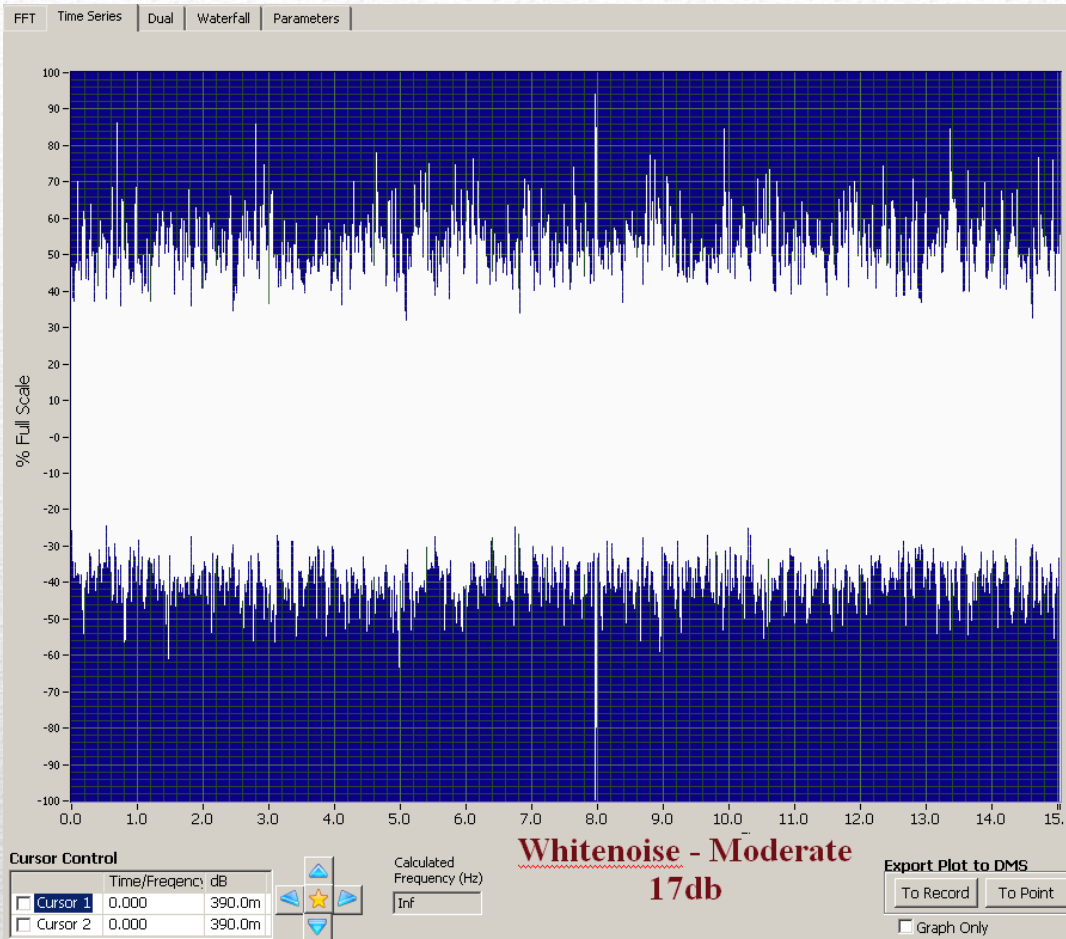
Bearing
Impacts



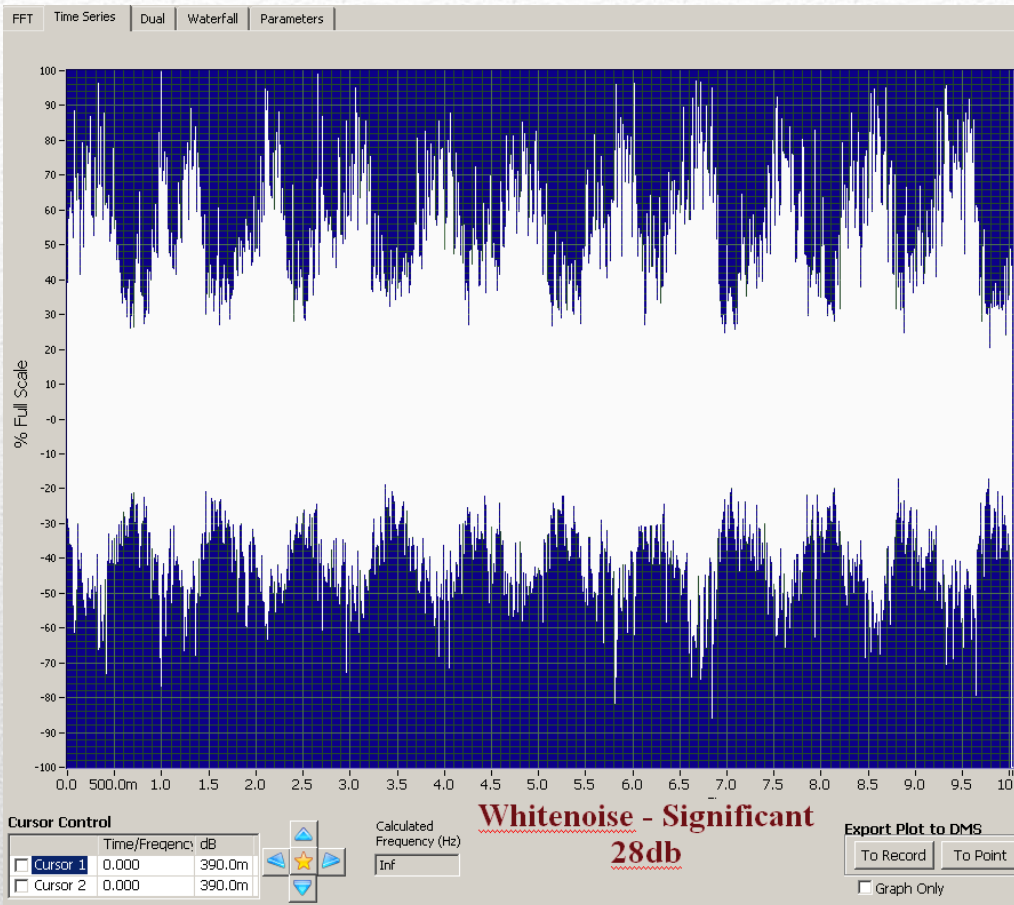
Impact Width: Wide



Impact Width: Narrow



Moderate Whitenoise



Significant Whitenoise



Acoustical
Ultrasound



Bearing Failure Classification Chart

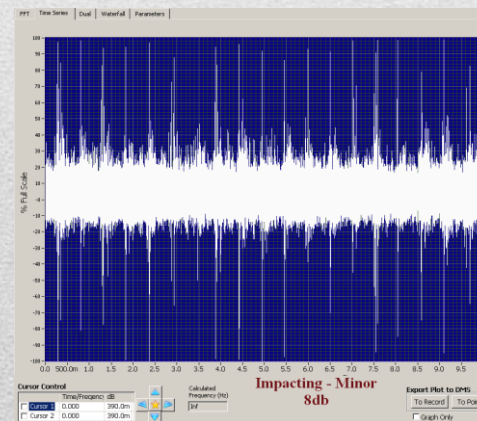
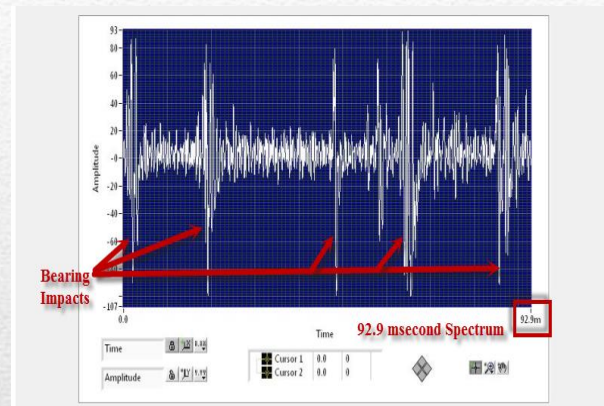
01/31/2014

DB \ Failure	MINOR	MINOR / MODERATE	MODERATE	MODERATE / SIGNIFICANT	SIGNIFICANT	SIGNIFICANT / SEVERE	SEVERE
0							
1							
2							
3							
4							
5	Baseline	Setup					
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22						High DB	
23						High DB	
24						High DB	
25						High DB	
26						High DB	
27						watch	consider for repair
28						watch	consider for repair
29						watch	consider for repair
30						watch	consider for repair
31						watch	consider for repair
32							recommend for repair
33							recommend for repair
34							recommend for repair
35							recommend for repair
36							recommend for repair

Page 1 of 1

Failure Classification Chart

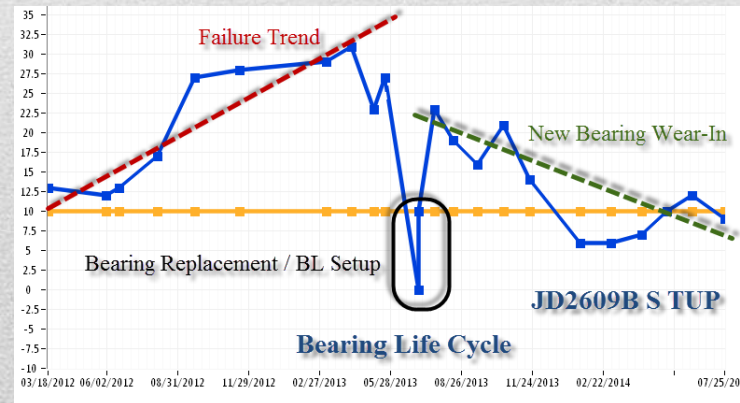
- Impacting
 - DB increases with rate of occurrence, amplitude, width
- Whitenoise
 - DB increases with amplitude
- Short Timeline = 100msec
- Long Timeline = 10sec

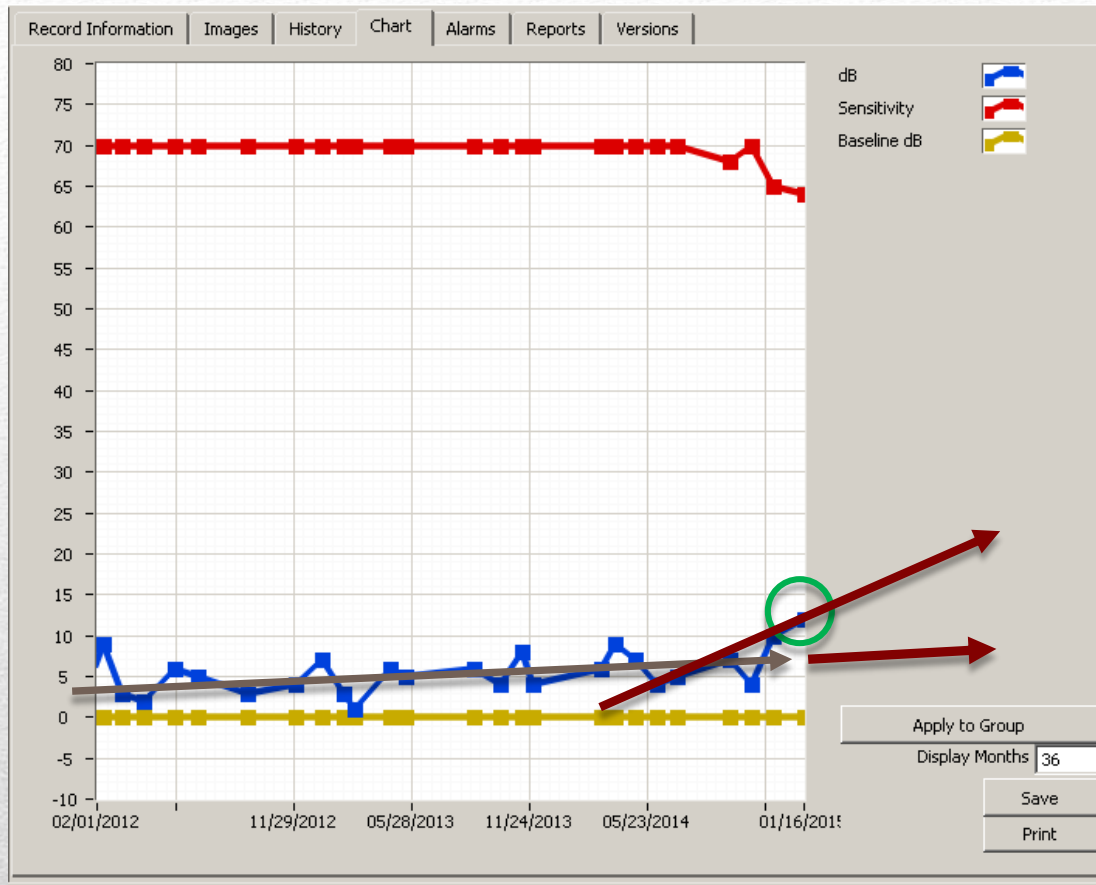


Spectralyzer Guidelines

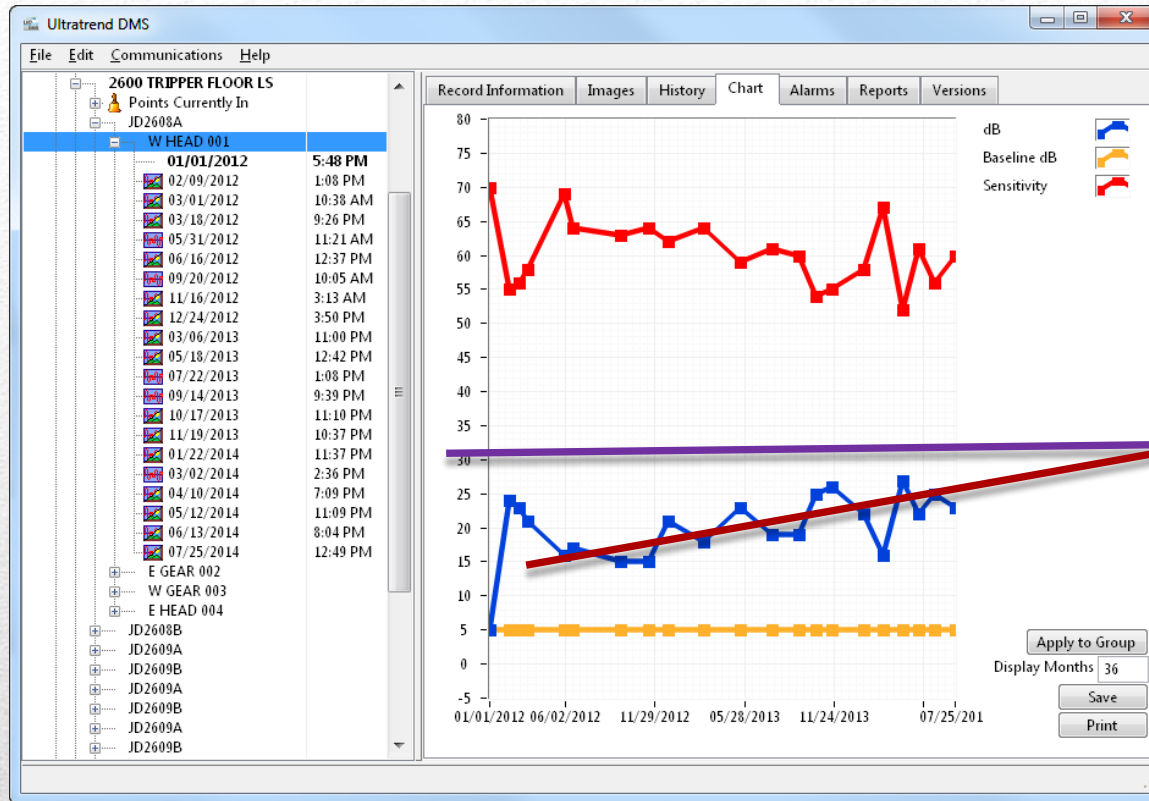
- Current DB Value
 - Current risk of failure
- Historical Trend Values
 - Change in bearing health (*other conditions remaining constant*)
 - Slope is rate of failure
 - *Extended becomes the future / predicted risk of failure*
- Marker for bearing replacements
- Replaced bearings have a wear-in period
- View 24 to 36 months

Trend Chart Guidelines

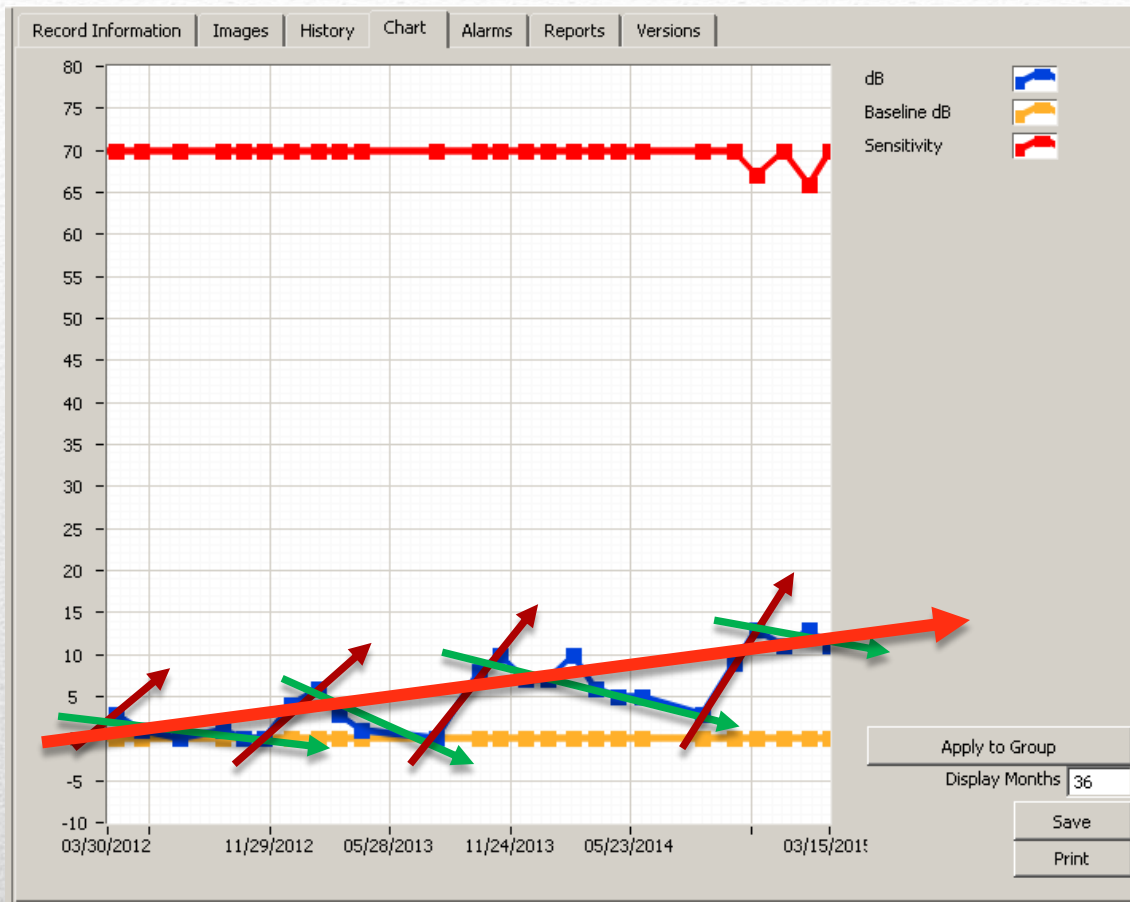




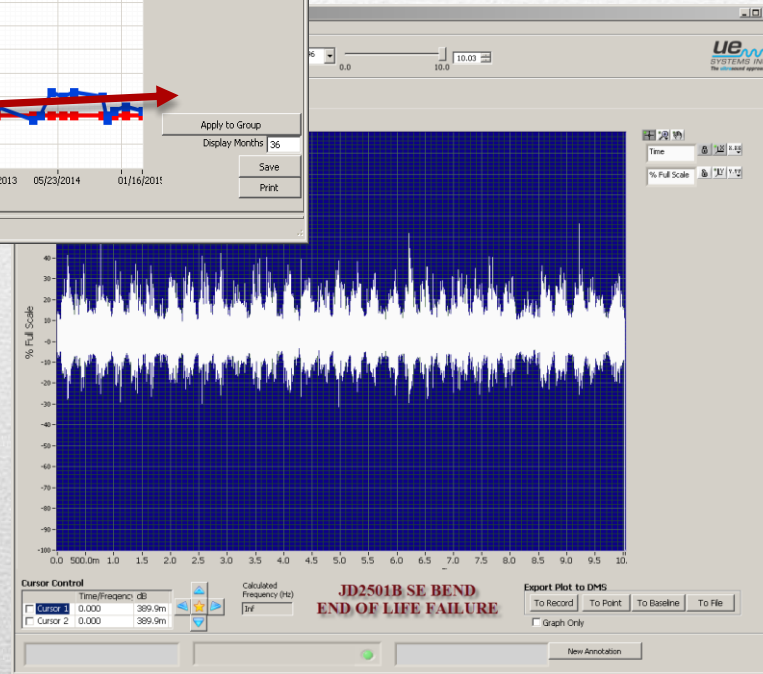
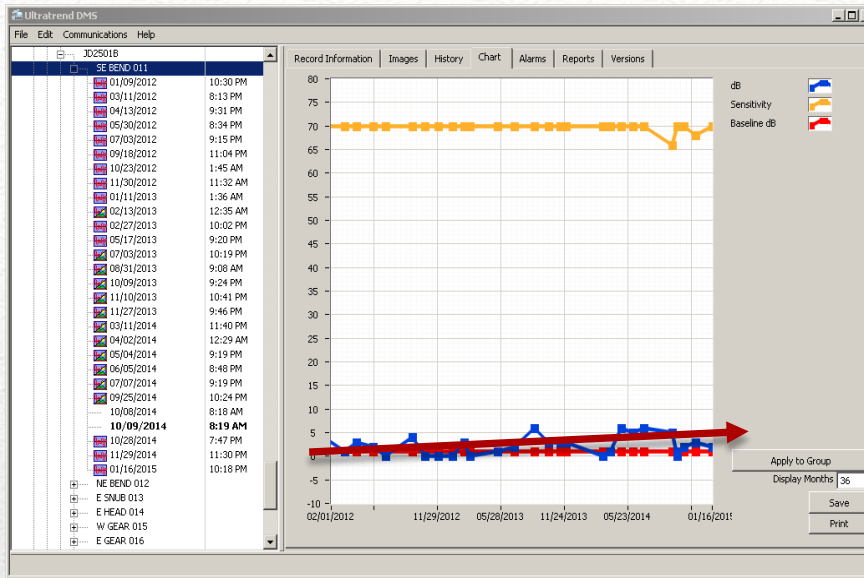
-Past History / Current Health
-Future Predicted Risk



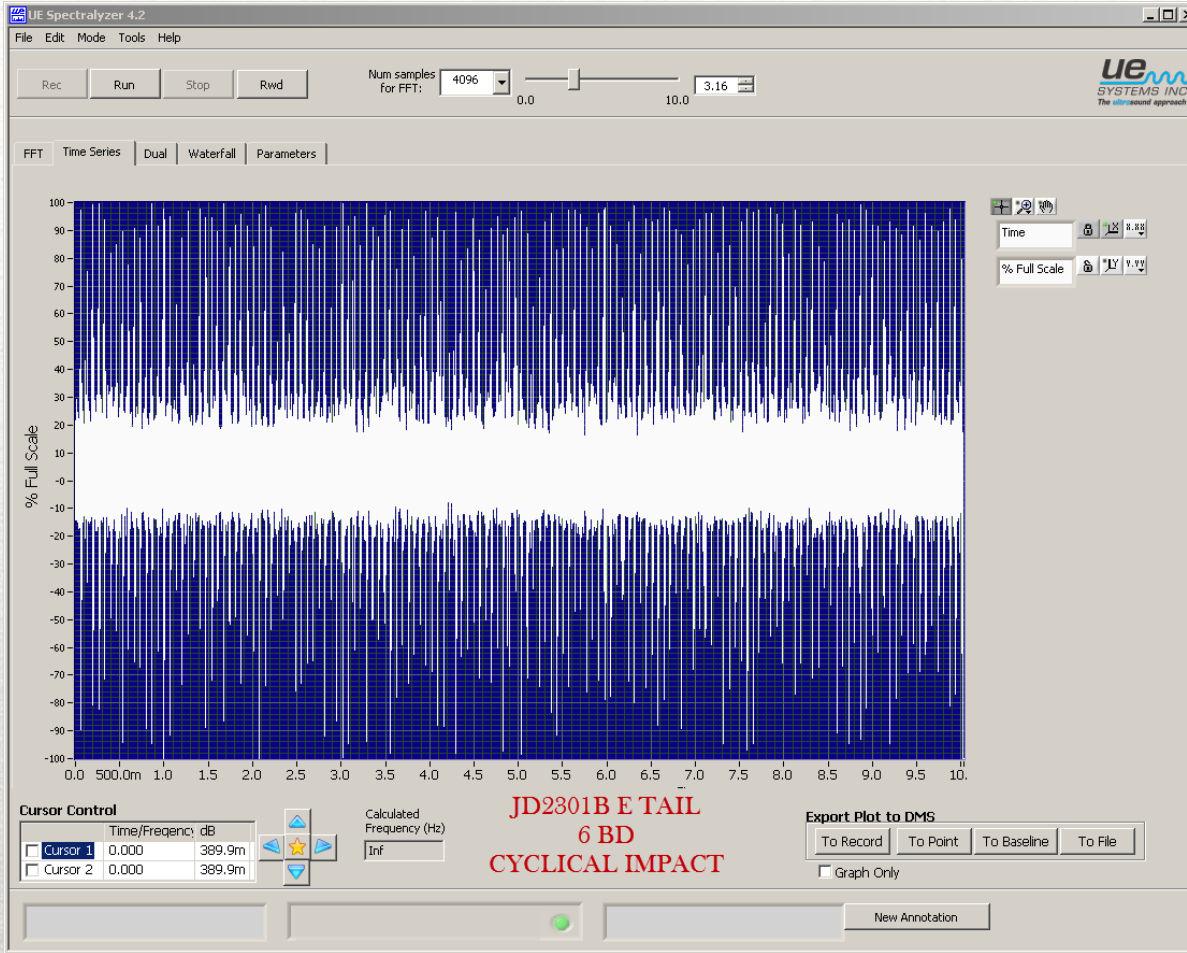
Trend - Predicted Risk / Replacement



SSBs-Ability to Heal



End Of Life Failure



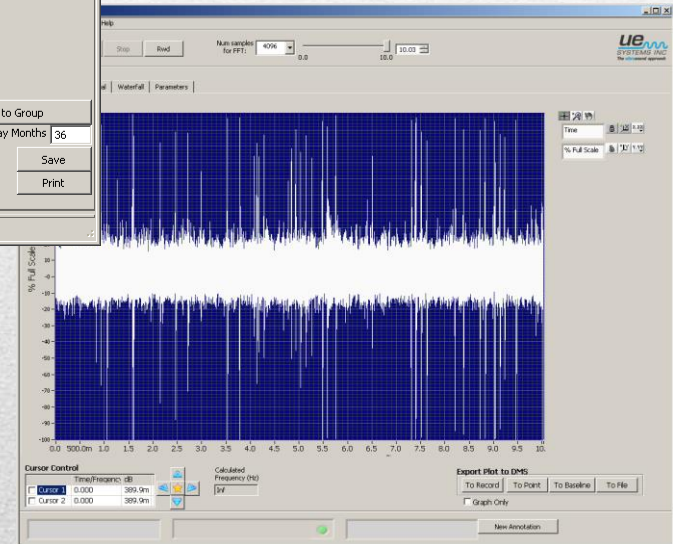
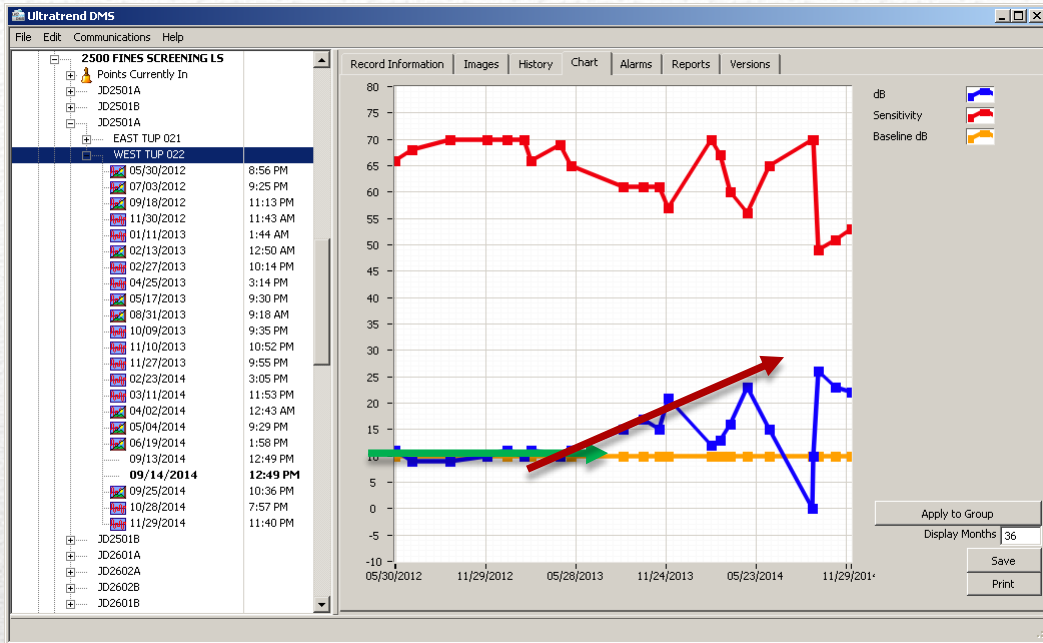
W032_093014031451.wav

Cyclical Impacting



SUCCESS.....

Before / After Replacement

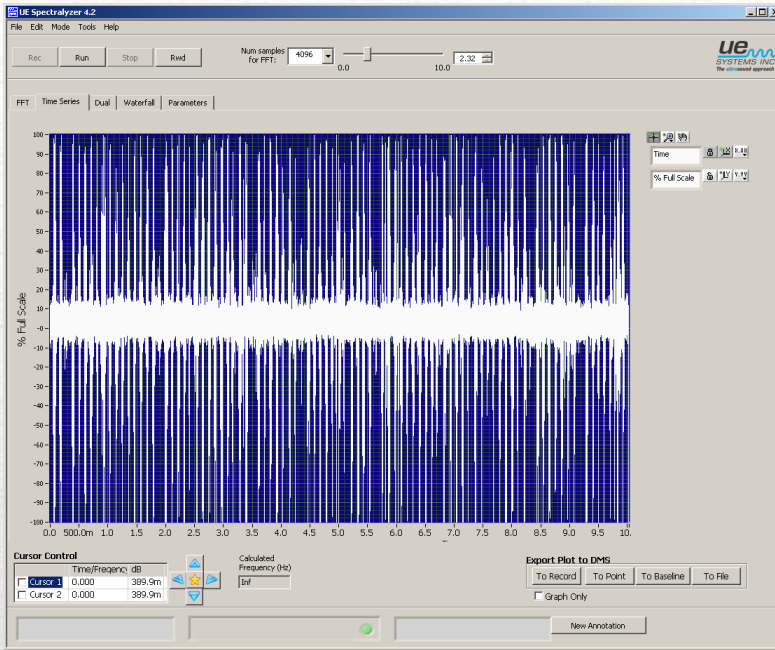


JD2501A W TUP

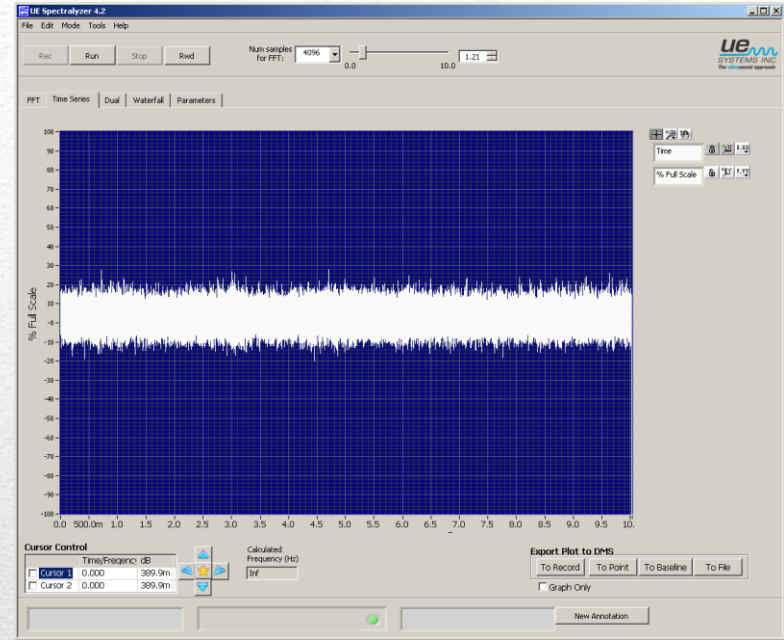


W022_053012205635.wav

60



W022_050414212910.wav



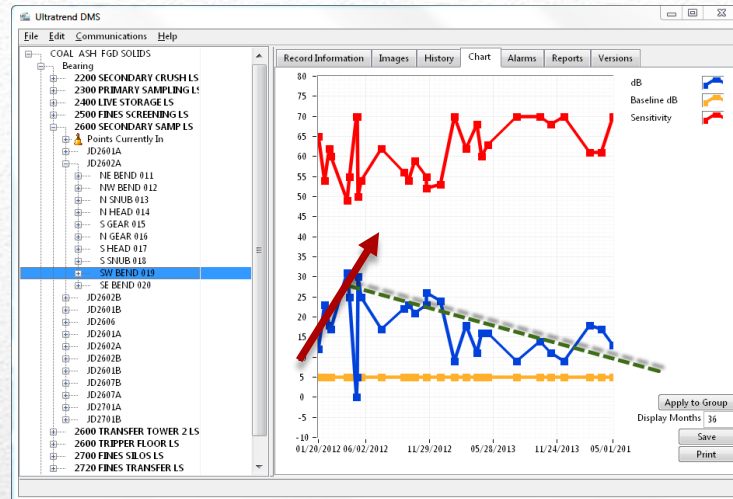
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JD2501A W TUP

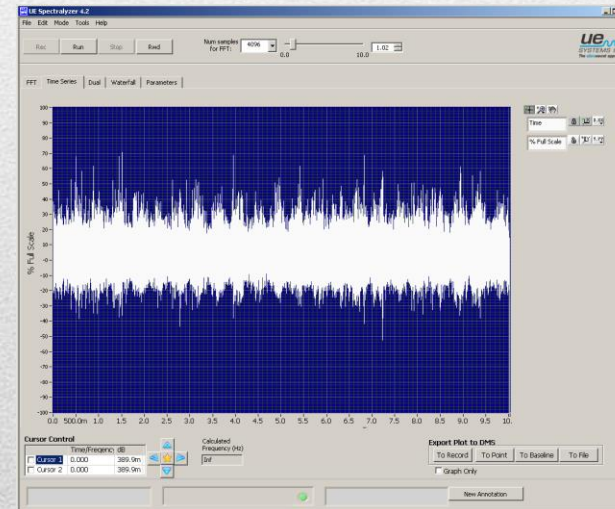
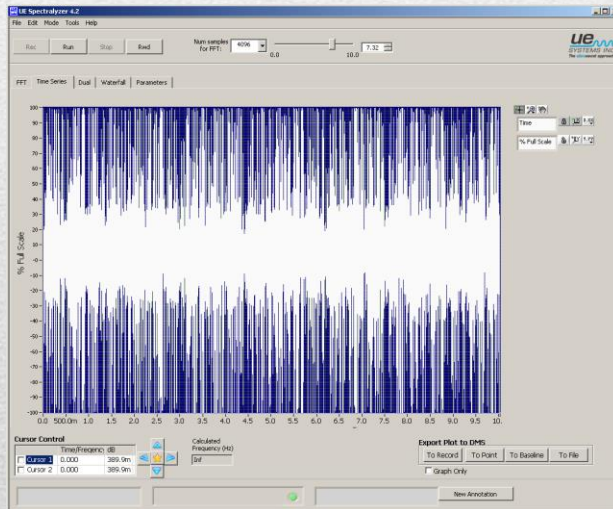
61



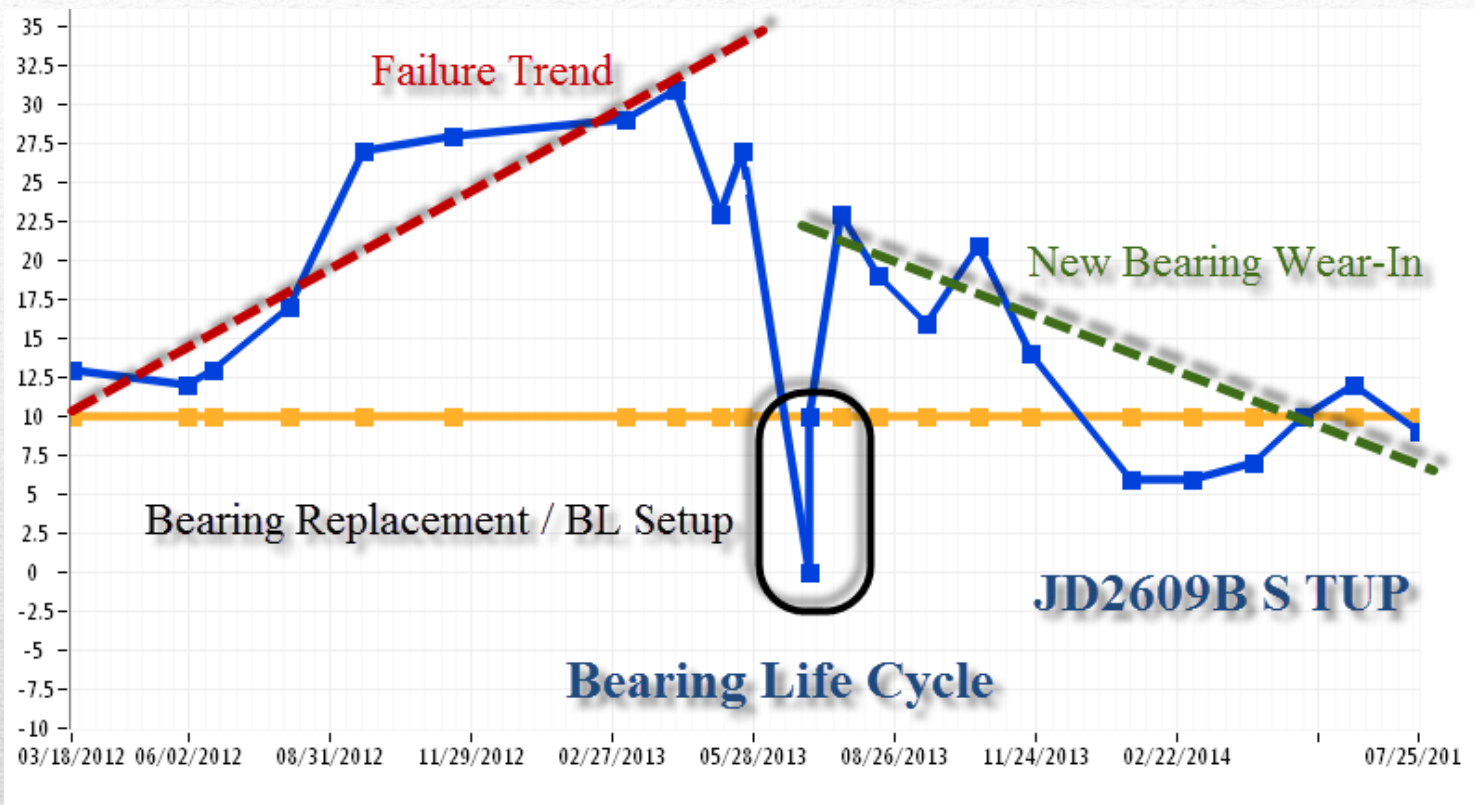
W019_041112022814.wav



W019_090614204928.wav



JD2602A SW BEND



Bearing Life Cycle Trend

- Data Collection
 - Competing Ultrasound
 - Coal (product), Gearboxes, Idlers, Other
 - Hardware Issues
 - Collection Issues
- Analysis
 - Every Bearing / Every Time
 - End Of Life failures (EOL)



Challenges

- Ultrasound is more sensitive than anticipated.
 - Fault is not equal to a Failure
- Bearings can recover from certain levels of failure.
- Bearing failure is a (generally) slow process.
- Thermal failure cycle can be very short.
- Is not a 100% predictive tool.
- For a program to succeed:
 - Need management support
 - Need a committed champion
 - Need to maintain communication with participants
 - Have a continuous improvement cycle in place

Lessons Learned

- *Ultrasound is an effective tool for:*
 - *Monitoring slow speed bearing health.*
 - *Helping reduce catastrophic bearing failures.*
 - *Helping evaluate the future risk of failure.*



Conclusion



Closing Questions.....Finish Line