

Extended safe operation of critical machine with PdM technology for Environment & Reliability Targets

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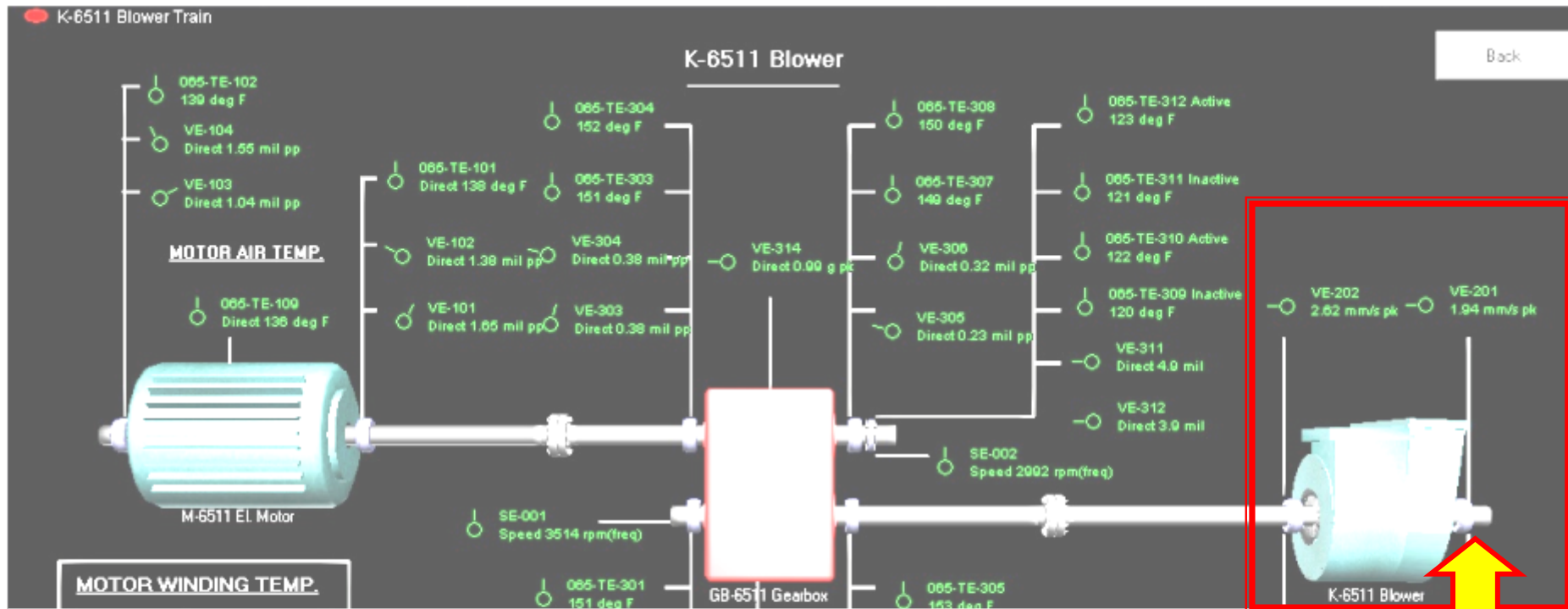
AGENDA

- BAPCO- RGDP PLANT
- RGDP AIR BLOWER INCIDENT
- VIBRATION-OVERLAPPING ANALYSIS
- CREST-BPFO IMPACT ANALYSIS
- TRIBOLOGY- LUBE OIL ANALYSIS
- IMMEDIATE ACTIONS
- SOLUTION-OPTIONS-RECOMMENDATIONS
- BEARING INSPECTION
- RESULTS
- LEARNING POINTS

RGDP AIR BLOWER INCIDENT

- **BAPCO**- The Bahrain Petroleum Company, Bahrain
- **CAPACITY** : 2,60,000 bpd
- **RGDP**- Refinery gas desulphurisation project
 - To reduce H₂S in fuel gas < 150 ppm)
 - To improve air and water qualities
- **INCIDENT**-
 - SUDDEN RISE IN VIBRATION ON BLOWER NDE BEARING TEMPERATURE
- **GOAL**
 - TO EXTEND THE RUN OF THE BLOWER FOR PLANNED STOPPAGE TO REDUCE ENVIRONMENT EFFECT (H₂S) AND ENSURE RELIABLE SAFE OPERATION

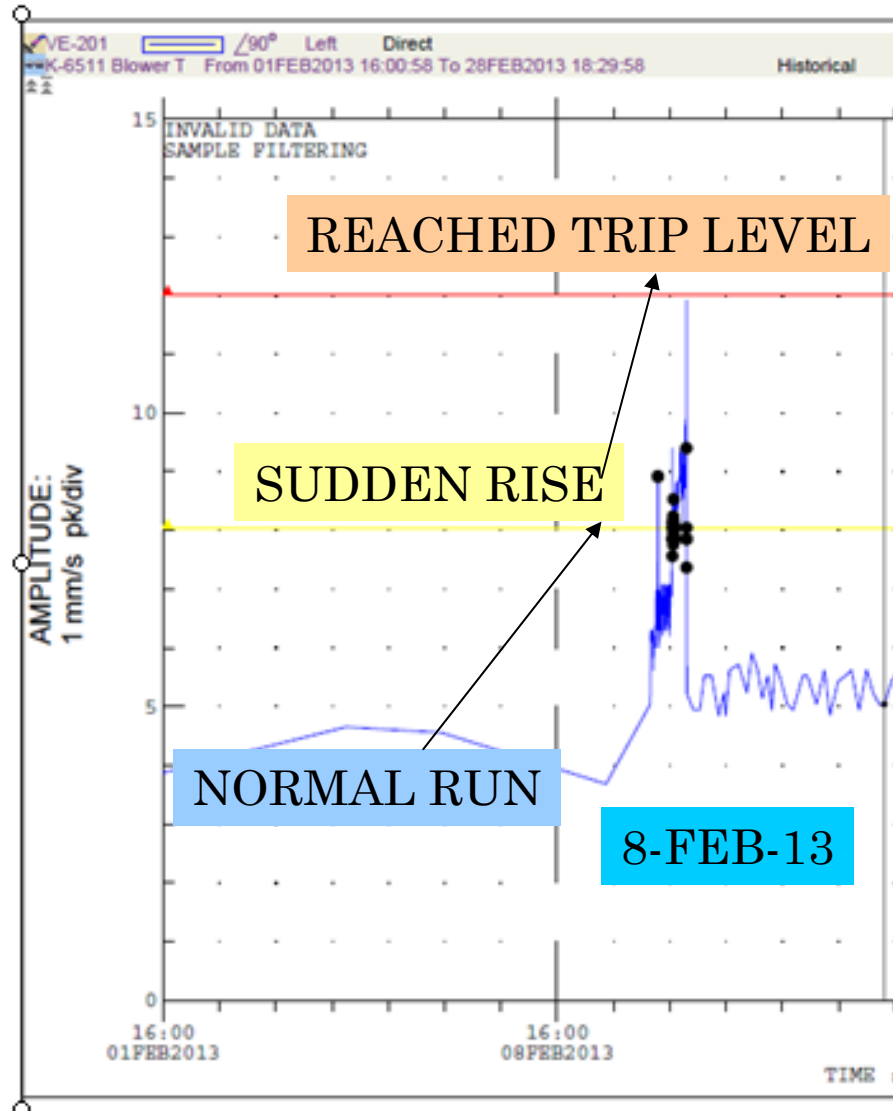
RGDP AIR BLOWER



- RGDP AIR BLOWER-CRITICAL MACHINE
- POWER RATING : 1250 HP / 3515 rpm
- MOTOR DRIVEN WITH STEP UP GEARBOX
- LUBRICATION : PURGE OIL MIST LUBRICATION
- ONLINE MONITORING & MACHINE PROTECTION

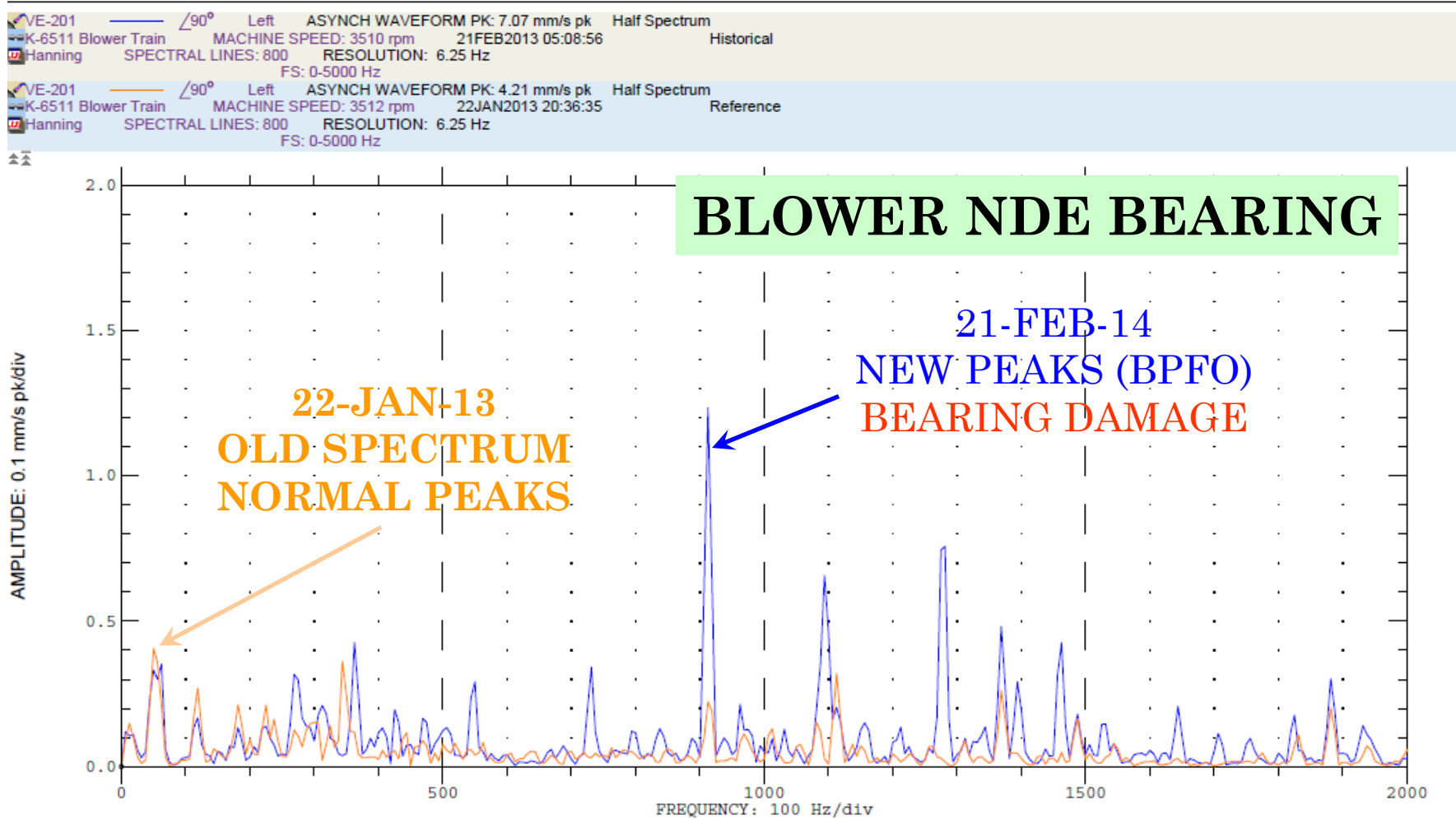
AIR BLOWER INCIDENT : 8 FEB-2013

SUDDEN RISE IN VIBRATION TO TRIP LEVEL

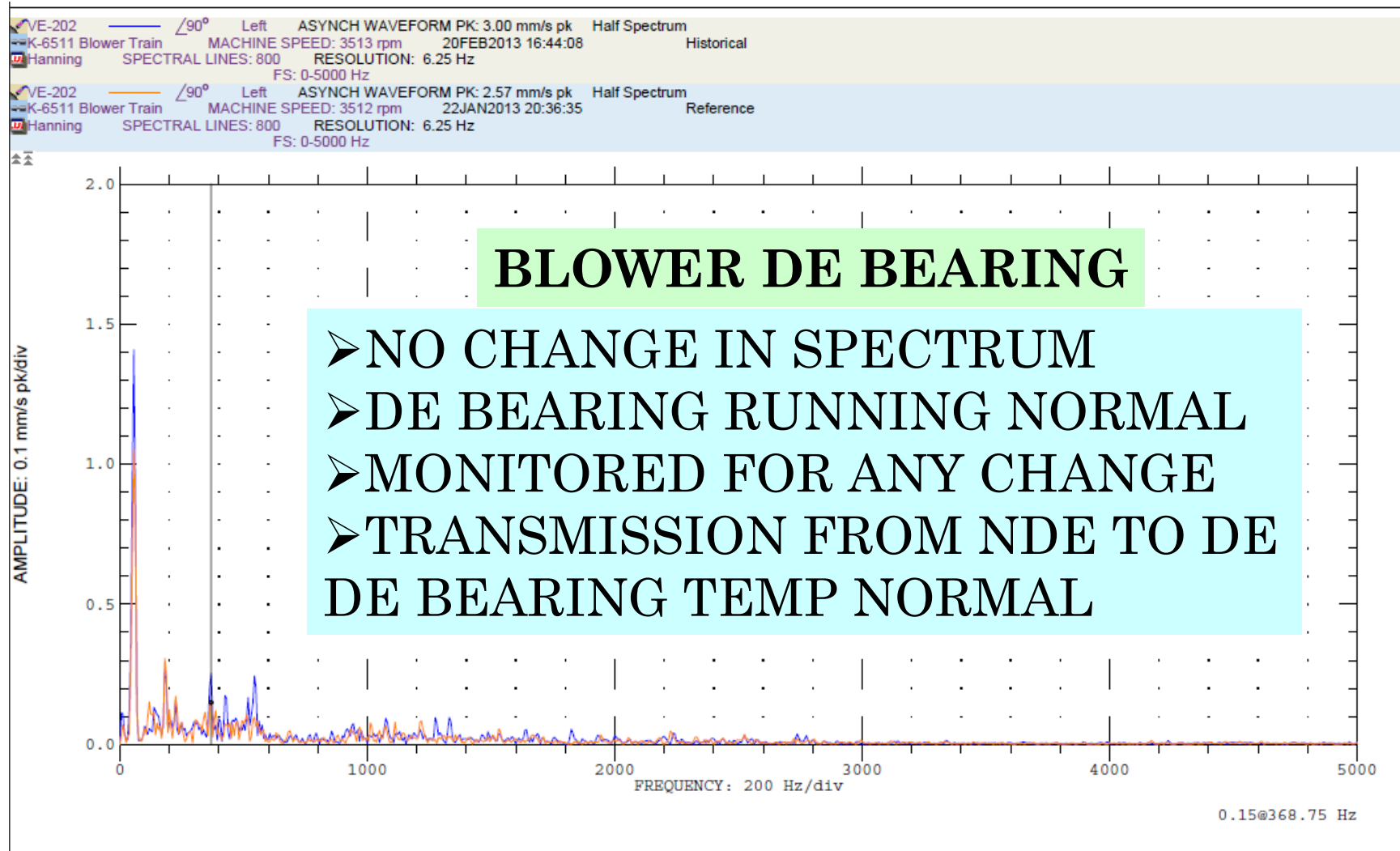


- BLOWER RUNNING WITH NORMAL
- ALARM= 7 mm/s Pk
- TRIP = 10 mm/s Pk
- ON 8-FEB-13 : SUDDEN RISE IN VIBRATION FROM 4 mm/s TO 7 mm/s
- FURTHER RISE UP TO 10 mm/s
- SUDDENLY REDUCED TO 5 mm/s Pk

SPECTRUM ANALYSIS OVERLAPPING TECHNIQUE

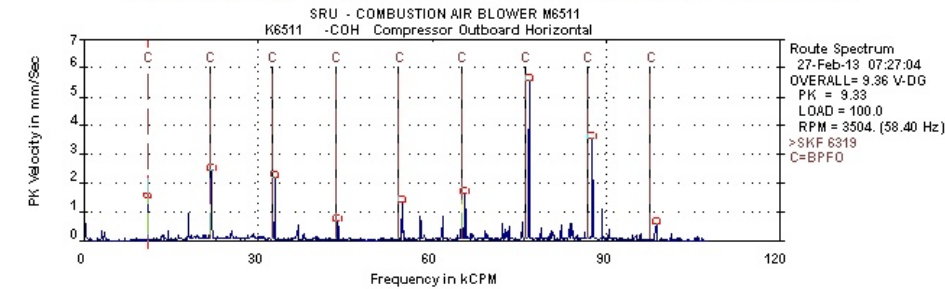


SPECTRUM ANALYSIS OVERLAPPING TECHNIQUE

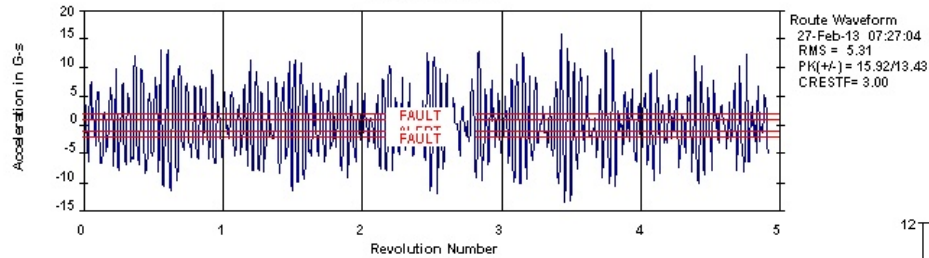


ADVANCE PdM TOOLS-BPCO & CREST TO CONFIRM- NDE BEARING DAMAGE

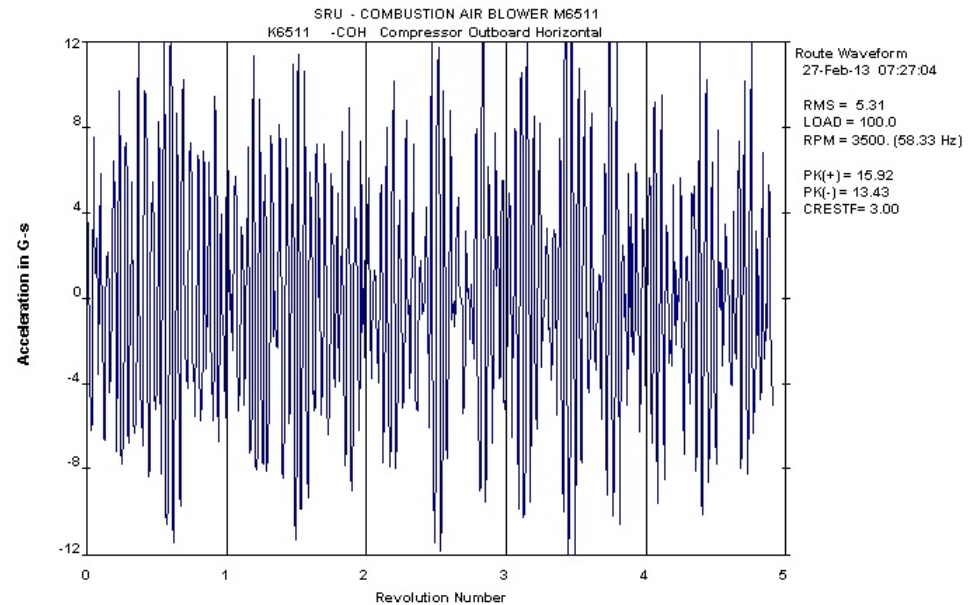
BLOWER NDE BEARING-BPFO FAULT FREQUENCY ANALYSIS



FAULT FREQ ANALYSIS
BPFO- Ball Pass Frequency



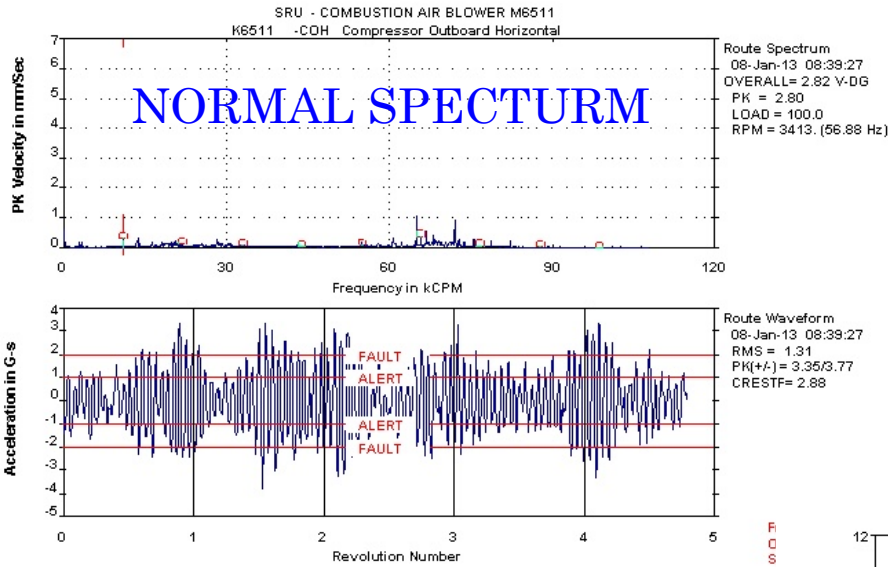
BLOWER NDE BEARING-CREST FACTOR ANALYSIS



IMPACT ANALYSIS
CREST FACTOR IMPACT

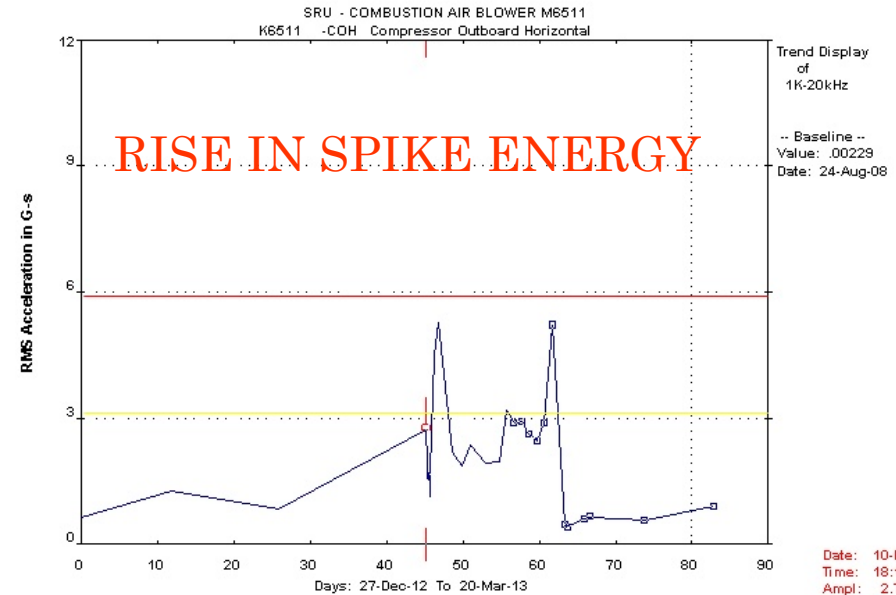
FFT SPECTRUM HISTORY ANALYSIS

BLOWER NDE BEARING-NORMAL SPECTRUM ANALYSIS



FFT DURING NORMAL RUN (08-Jan-13)

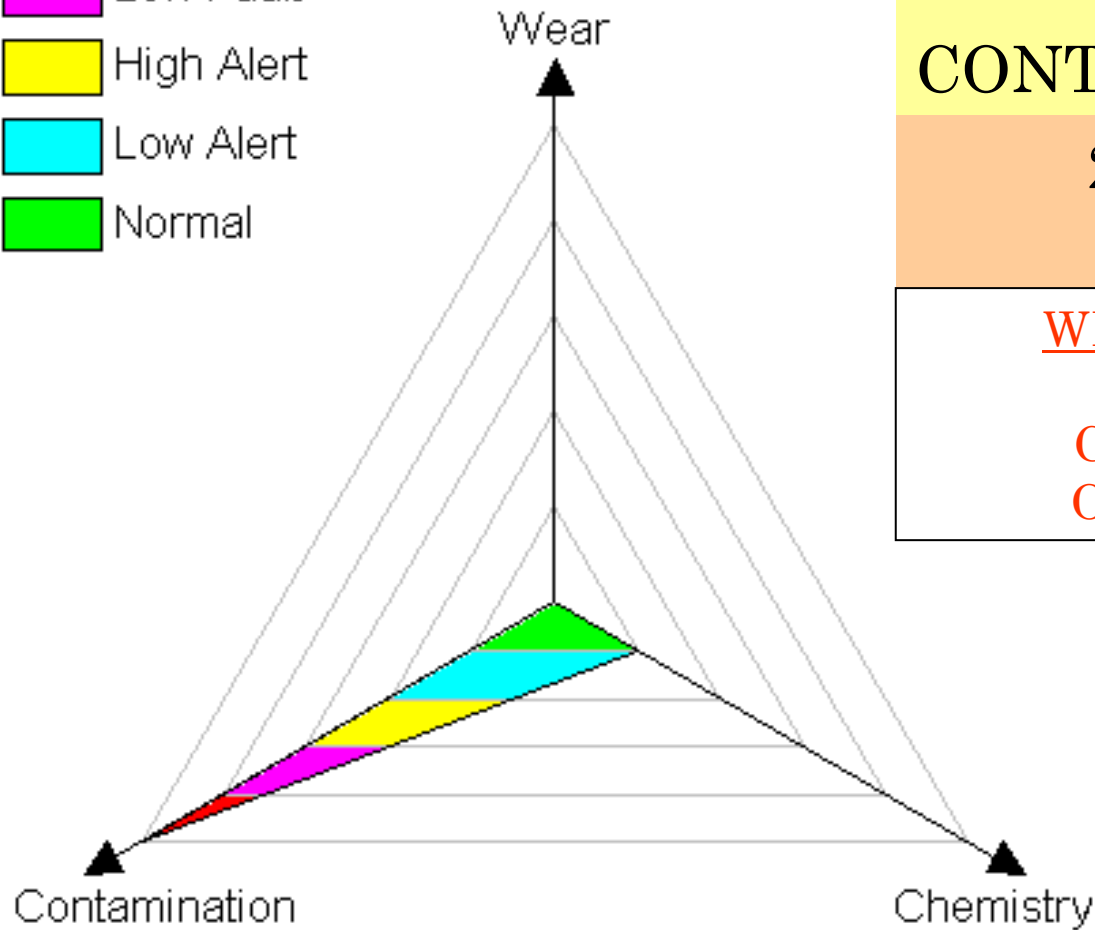
BLOWER NDE BEARING-HFD SPIKE ENERGY ANALYSIS



HFD SPIKE ENERGY RISING TREND

TRIBOLOGY LUBE OIL ANALYSIS

NDE BEARING



1ST OIL SAMPLE
CONTAMINATION-FAULT

2ND OIL SAMPLE
WEAR- FAULT

WEAR DEBRIS ANALYSIS

CONFIRMED BEARING
OUTER RACE DAMAGE

OIL SAMPLE ANALYSIS
DE BEARING-NORMAL

BLOWER NDE BEARING (THRUST) SUDDEN DAMAGE

- SUDDEN RISE IN VIBRATION LEVEL DUE TO SUDDEN DAMAGE OF NDE BEARING.
- **NDE THRUST BEARING OUTER RACE DAMAGE**
 - SPECTRUM ANALYSIS
 - OVERLAPPING TECHNIQUE
 - BEARING DEFECT FREQ ANALYSIS (BPFO)
 - CREST FACTOR ANALYSIS
 - LUBE OIL ANALYSIS
- **DE BEARING RUNNING NORMAL**
 - SPECTRUM ANALYSIS
 - CHECKED FOR TRANSMISSION OF VIBRATION FROM NDE TO DE BEARING

IMMEDIATE ACTIONS TAKEN

- IMMEDIATE ACTION

- NDE BEARING LUBE OIL FLUSHED
- LUBE OIL SAMPLE ANALYSIS DONE
- VIBRATION ANALYSIS USING HAND HELD ANALYSER
- DE BEARING CONDITION CHECKED
- DE BEARING LUBE OIL FLUSHED AS A PREVENTIVE ACTION
- MOTOR & GEARBOX CONDITION CHECKED
- BLOWER OPERATING CONDITIONS CHECKED AND ANALYSED
- FLOW CONDITIONS IMPROVED TO OPERATE AWAY FROM SURGE AREA

SOLUTION-OPTIONS

- **OPTIONS CONSIDERED**

1. **IMMEDIATE SHUTDOWN- TO STOP THE BLOWER IMMEDIATELY FOR INSPECTION AND REPAIR**

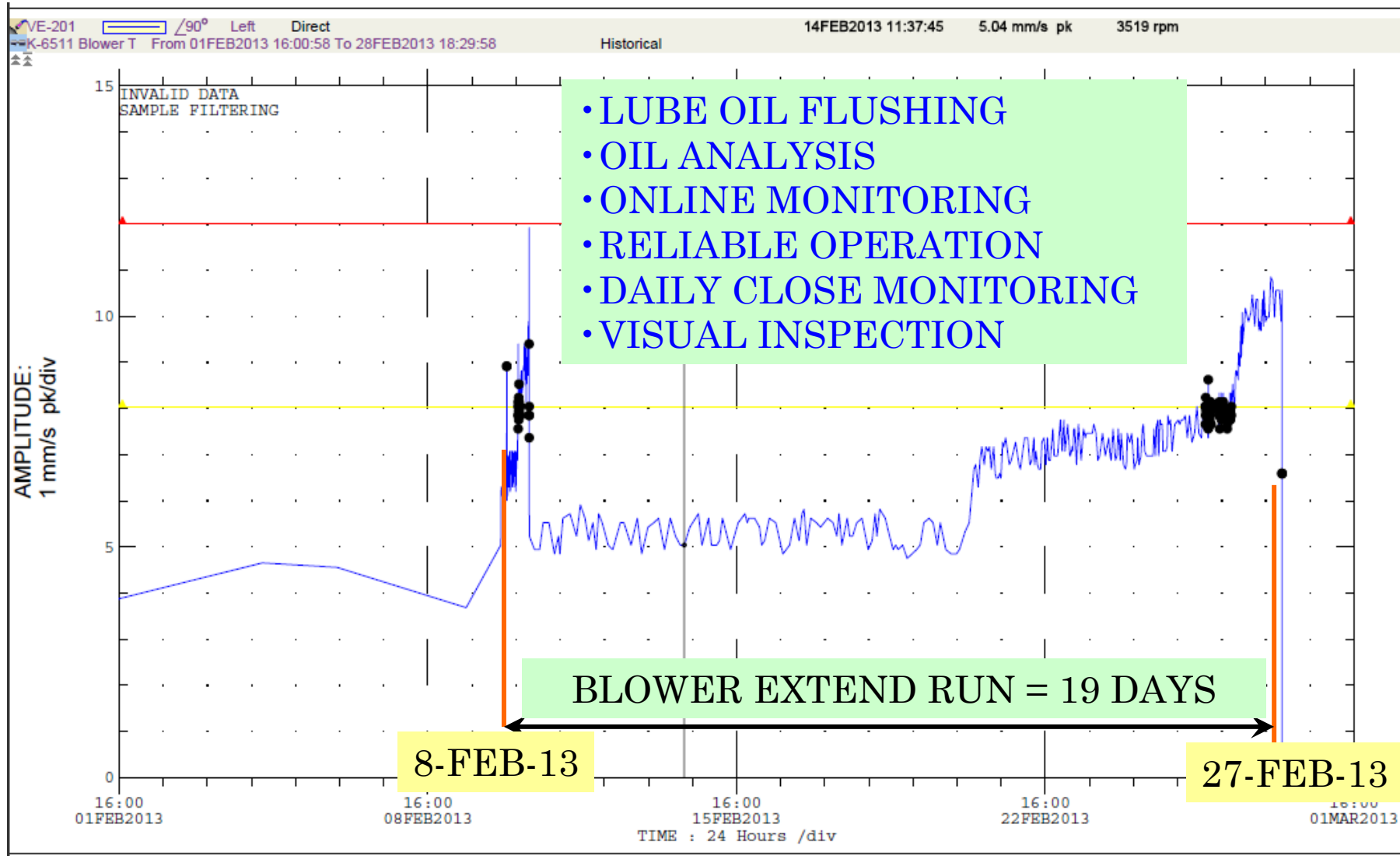
- CAN LEAD TO ENVIRONMENT EFFECT (H₂S)
- CAN LEAD TO FEED REDUCTION OF ANOTHER PLANT (LSFO)
- CAN LEAD TO TOTAL SHUTDOWN OF LSFO
- UNPLANNED SHUTDOWN MAY INCREASE IN MAINTENANCE TIME AND COST

2. **PLANNED SHUTDOWN-TO EXTEND THE BLOWER OPERATION WITH PdM MONITORING**

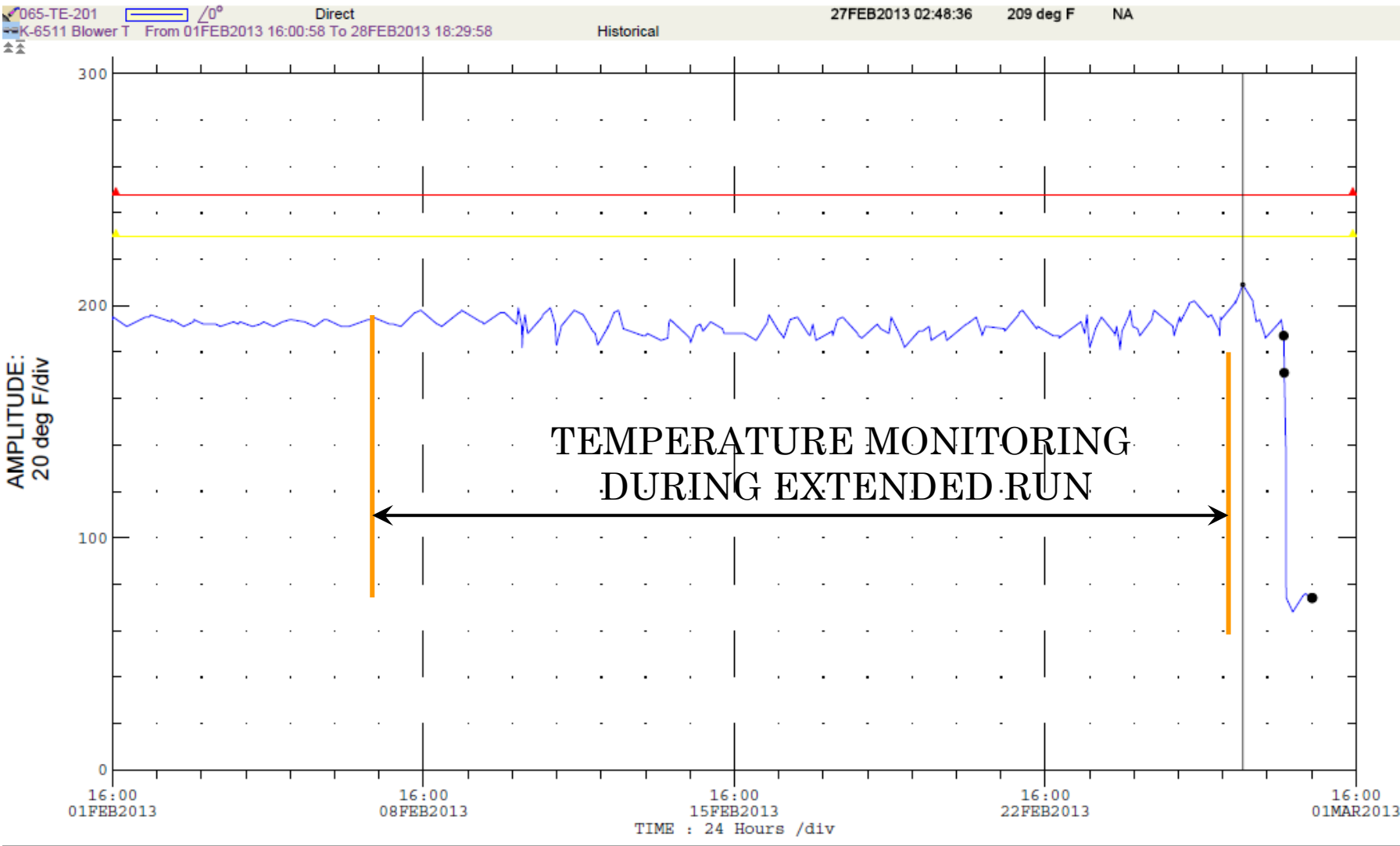
- EVALUATE THE CONDITION OF BLOWER NDE BEARING FOR EXTENDED RUN OF BLOWER
- USE PdM CLOSE MONITORING USING VIBRAITON, LUBE OIL ANALYSIS, ONLINE MONITORING FOR ANY CHANGE IN BLOWER CONDITION
- PREVENTIVE CARE WITH LUBE OIL FLUSHING
- IMPROVE & CHANGE BLOWER OPERATING CONDITIONS (AWAY FROM SURGE CONDITIONS)

SOLUTION-OPTION 2

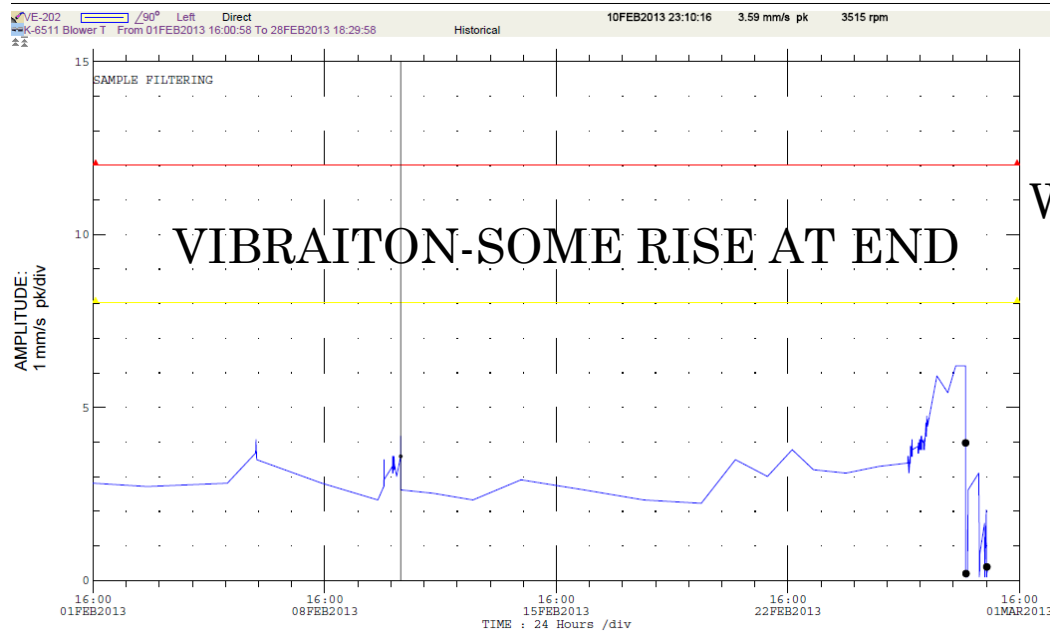
EXTENDED BLOWER OPERATION – 19 DAYS



BLOWER NDE BEARING TEMPERATURE TREND

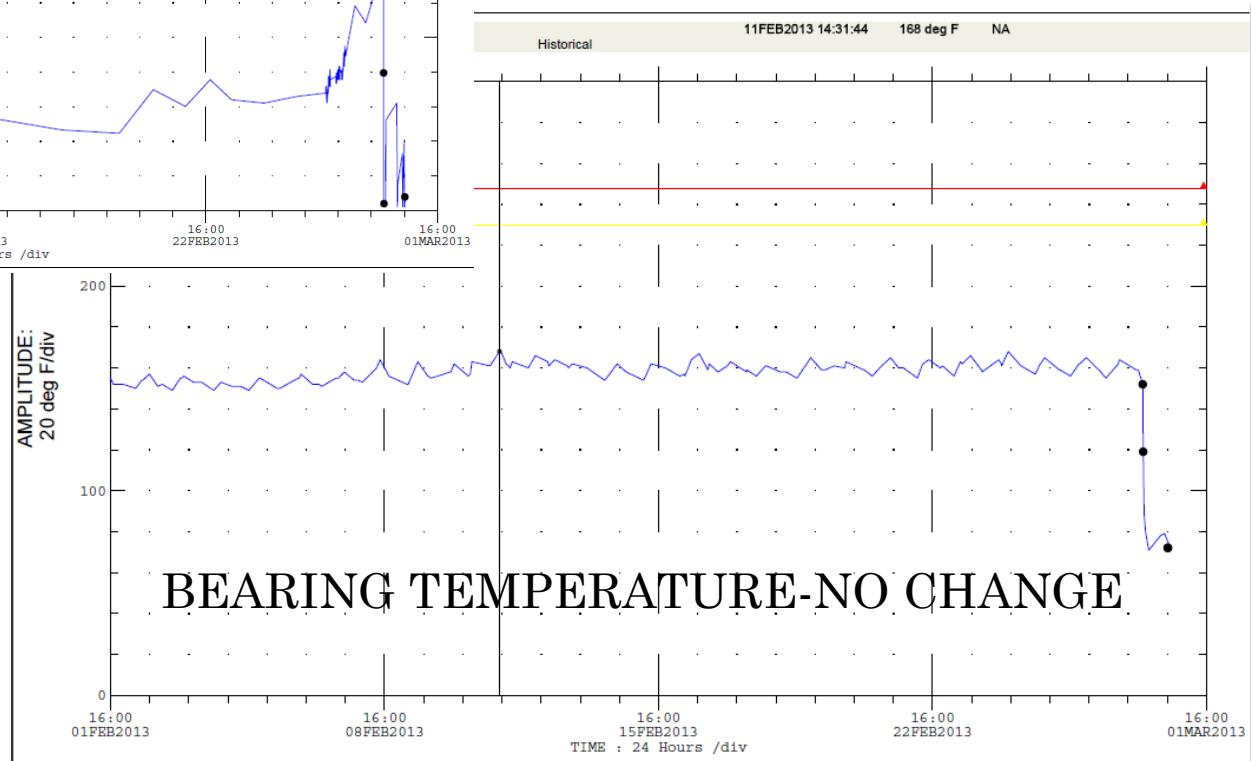


BLOWER DE BEARING MONITORING



DE BEARING MONITORED
WHILE RUNNING BLOWER
WITH DAMAGE ON NDE BEARING

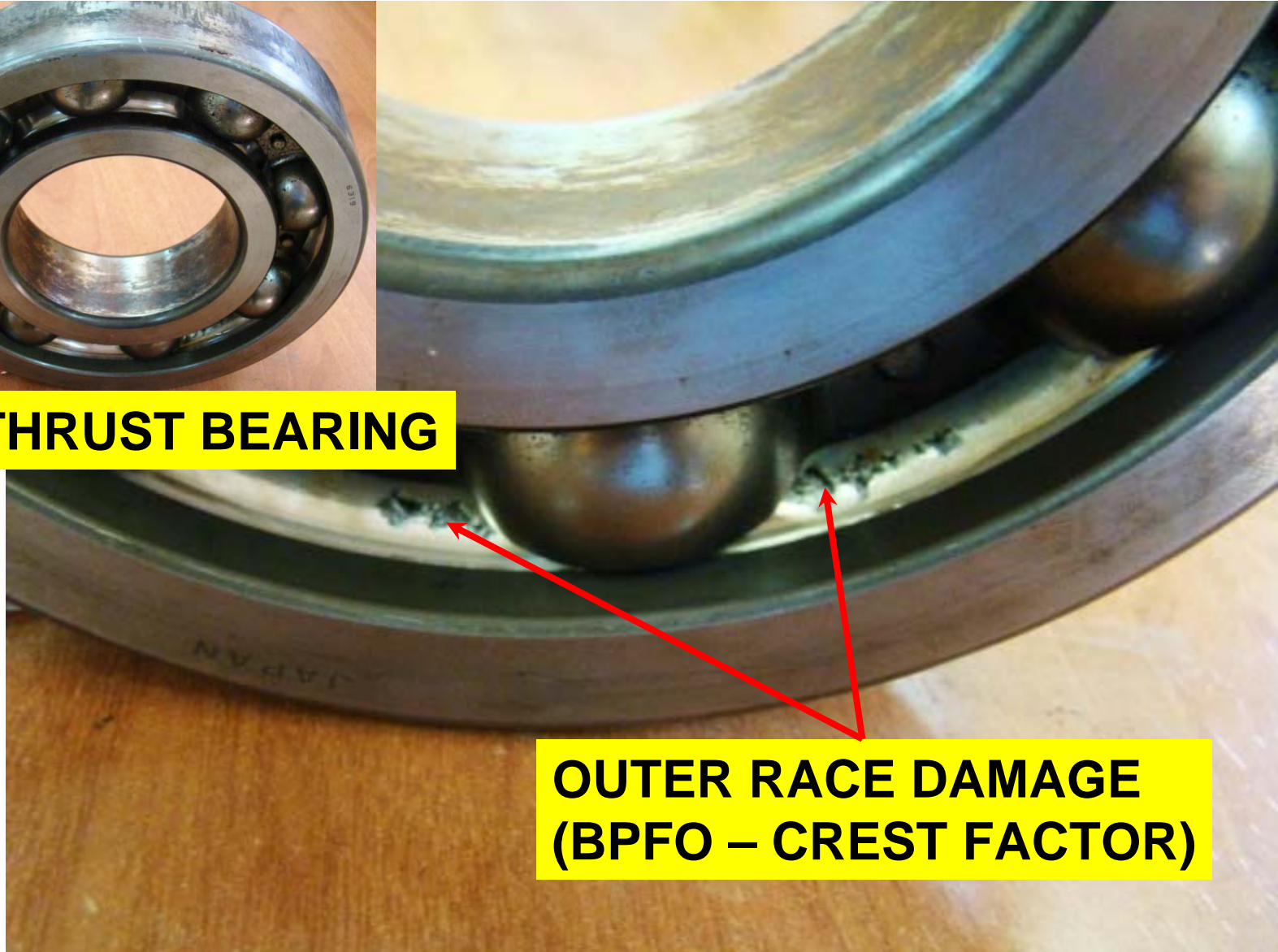
BLOWER DE
BEARING TEMP
MONITORED



BLOWER NDE BEARING INSPECTION



NDE THRUST BEARING



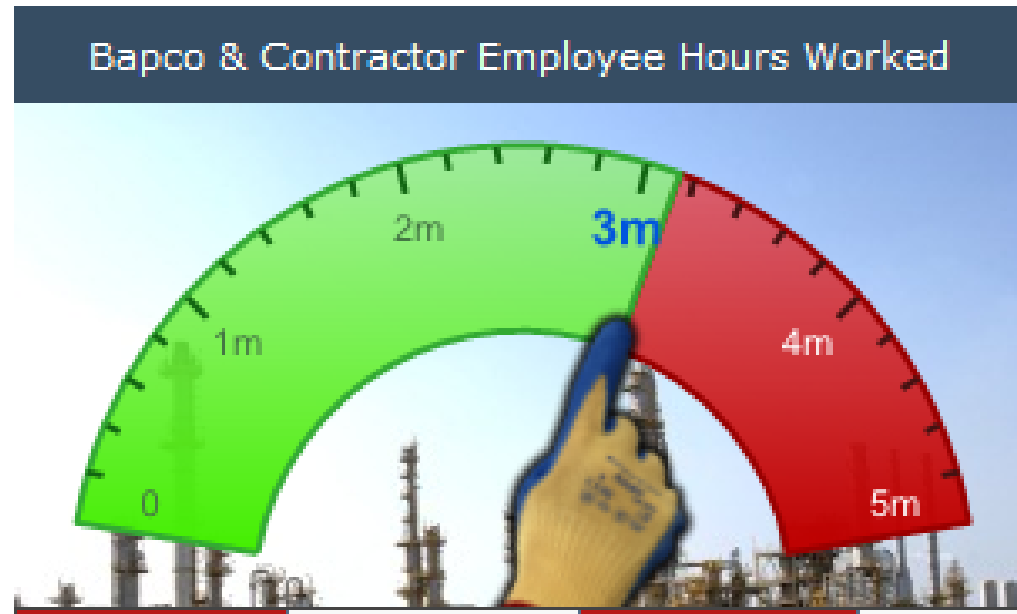
**OUTER RACE DAMAGE
(BPFO – CREST FACTOR)**

RESULTS



- 4. IMPROVED SAFETY & ENVIRONMENT RECORD
- 5. AVOIDED SECONDARY DAMAGE

- 1. AVOIDED UNPLANNED SHUTDOWN OF BLOWER AND RGDP / LSFO PLANT
- 2. SAFE & RELIABLE BLOWER OPERATION FOR EXTENDED RUN – 19 DAYS
- 3. RELIABILITY CLOCK ACHIVED TARGET = 180



LEARNING POINTS

- PdM TECHNOLOGY & TOOLS HELPS IN
 - o Monitoring Of Developing Problems
 - o Early Event Detection
 - o Real-time Condition Status
 - o Reduction Of Maintenance Costs/Risk
 - o Improved Plant Production-avoid unplanned stoppage
 - o Extend the operation of asset with developing problems
 - o Avoid secondary damage with repairs at appropriate time
- PdM TECHNOLOGY HELPS TO DETECT EXACT CAUSE OF FAILURE, SEVERITY OF FAILURE FOR EXTENDED OPERATION OF CRITICAL MACHINE TRAIN & PLAN A SAFE SHUTDOWN.

Questions and Discussion
THANK YOU

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