ACIDS 2

DU PONT

Reliability Maintenance Team

COGA Unit
Flue Gas Recycle Fan
5031-7035

Online Vibration Case Study

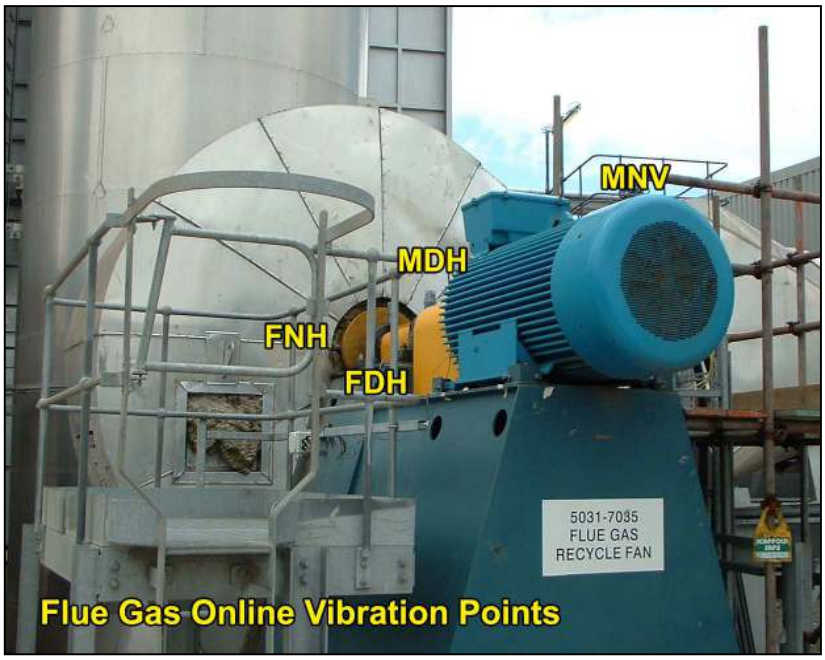
Report Prepared by: John Stubbs
Geoff Copeland
Stuart Walker
Chris Bennet
Dean Whittle
Dave Shevels

RMS

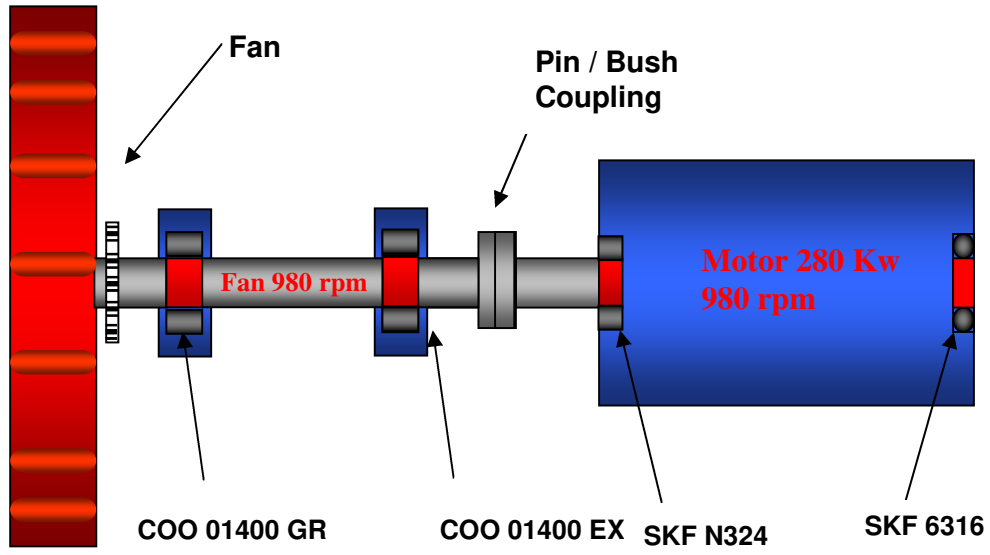
Reliability Maintenance Solutions Ltd

5031-7035 Flue Gas Recycle Fan (Online Case Study)

The Flue gas fan is part of the COGA unit. The fan increases the efficiency of the coga unit by recycling a proportion of the incinerated gases from the coga stack. The fan is critical in sustaining high rates of operation on the plant, catastrophic failure of this fan would result in a coga unit shut down. This would increase the emissions to the atmosphere and heavy fines could be imposed by the Environment Agency.



The above Photo illustrates the position of the fixed online vibration sensors that are fitted to the fan and motor (i.e. MNV = Motor Non Drive End Bearing Vertical).



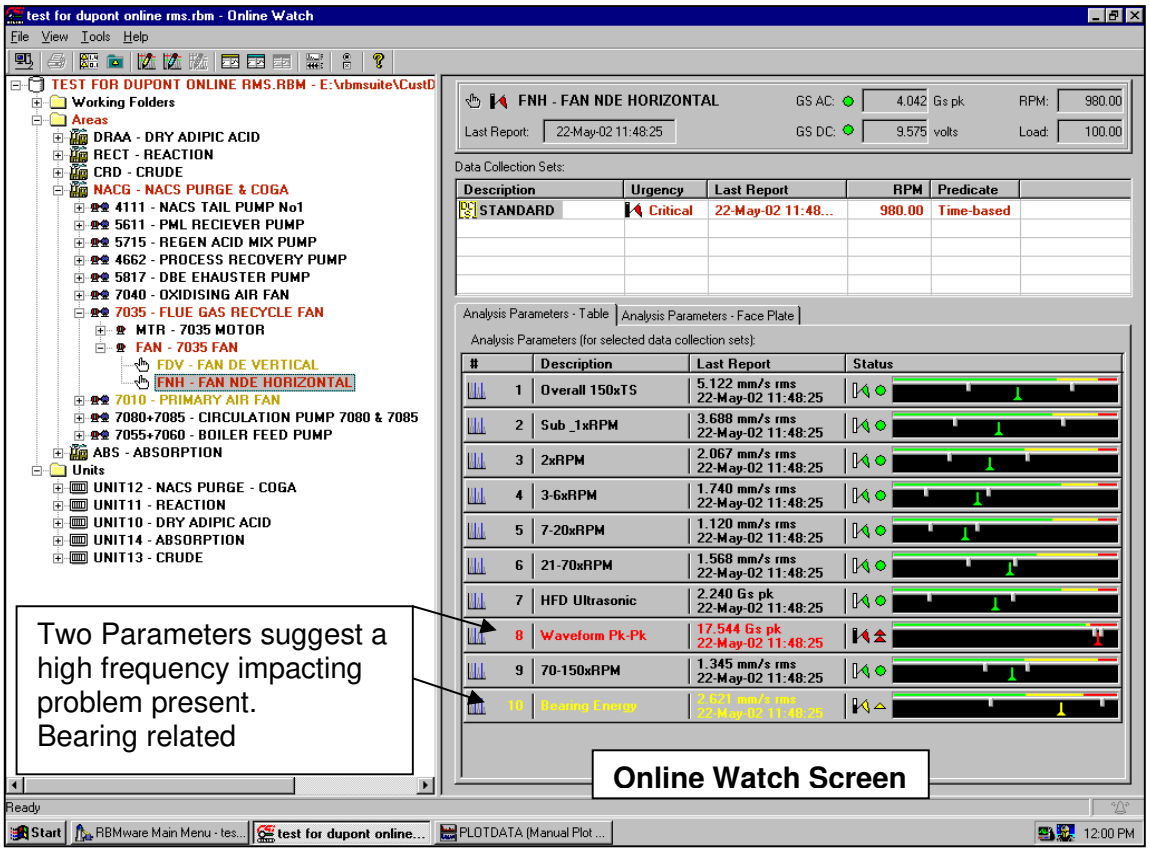
Flue Gas Fan - Vibration Frequencies

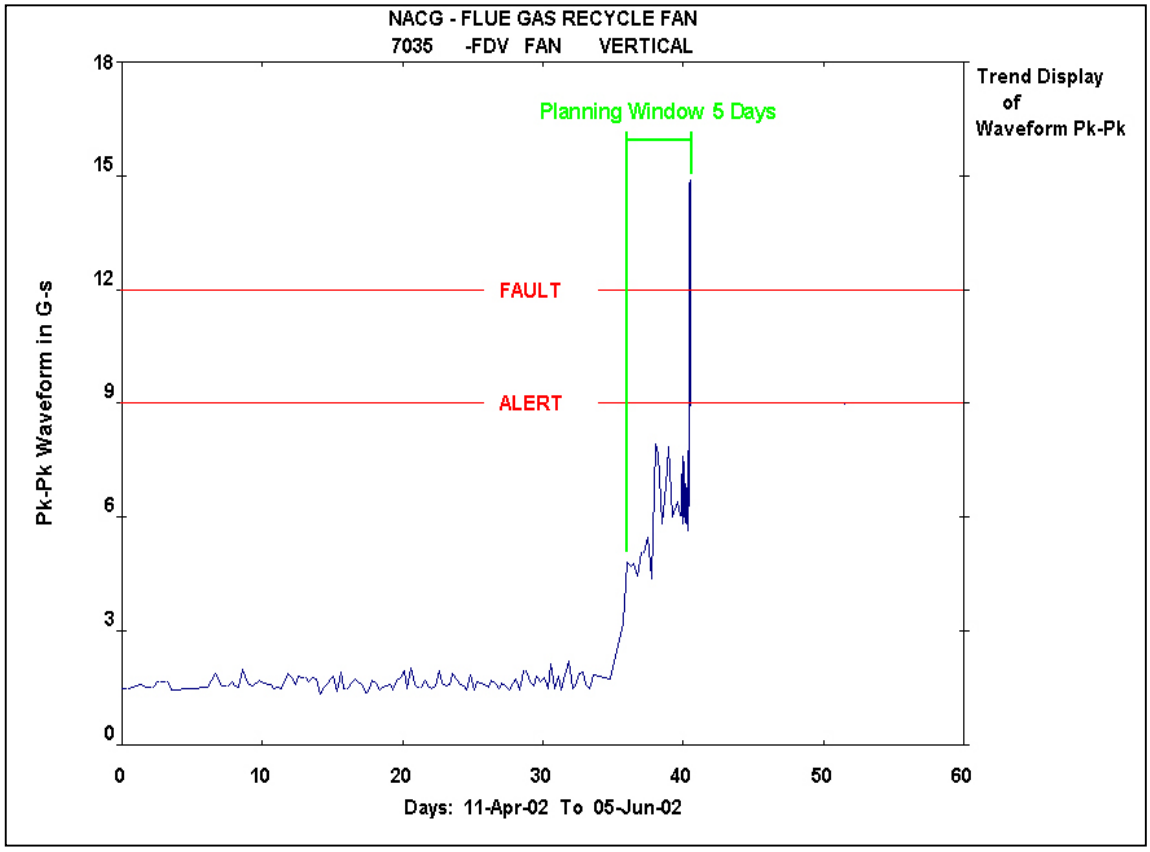
Fan Frequency = 980 CPM (**1 Order**)

Bearing Defect Freqs In Orders (1Order = 980 CPM)
Motor Brg SKF 6316 Cage **0.36** / Ball Defect **2.07** / Outer Race **3.09** / Inner Race **4.91**
Motor Brg SKF N324 Cage **0.40** / Ball Defect **2.55** / Outer Race **4.86** / Inner Race **7.14**
Fan Brg Coo 01 400 Cage **0.42** / Ball Defect **3.35** / Outer Race **5.98** / Inner Race **8.02**

The above diagram shows the configuration of the flue gas fan. The above configurations, speeds, bearing details etc have being entered into the online system to assist in fault diagnostics.

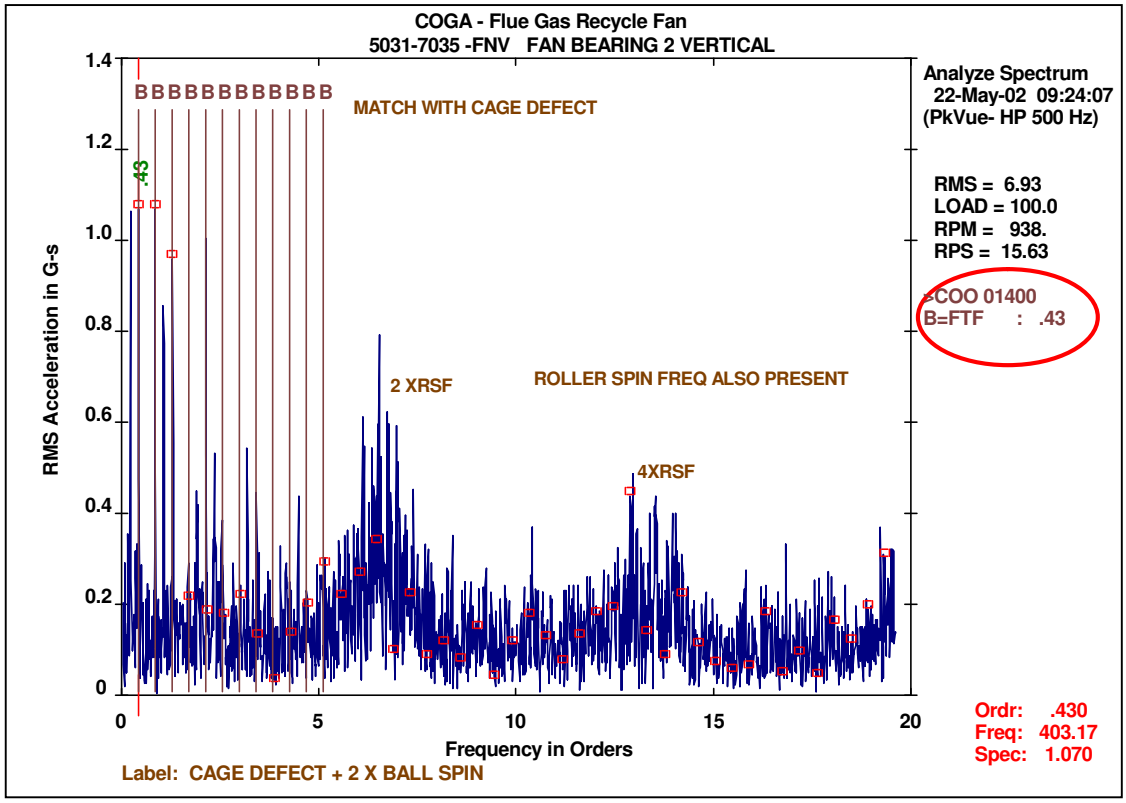
In Mid May 2002 the Flue gas fan sensor (**Fan Non Drive End Fan Horizl)** entered into an alarm condition, the system automatically started rapid data collection. Two parameters were initially in alarm PK-PK Waveform, (Peak to Peak Value of time waveform measured in G's) and a Bearing energy band also measured in G's. Below is the **Online watch screen** showing the status of monitored plant.



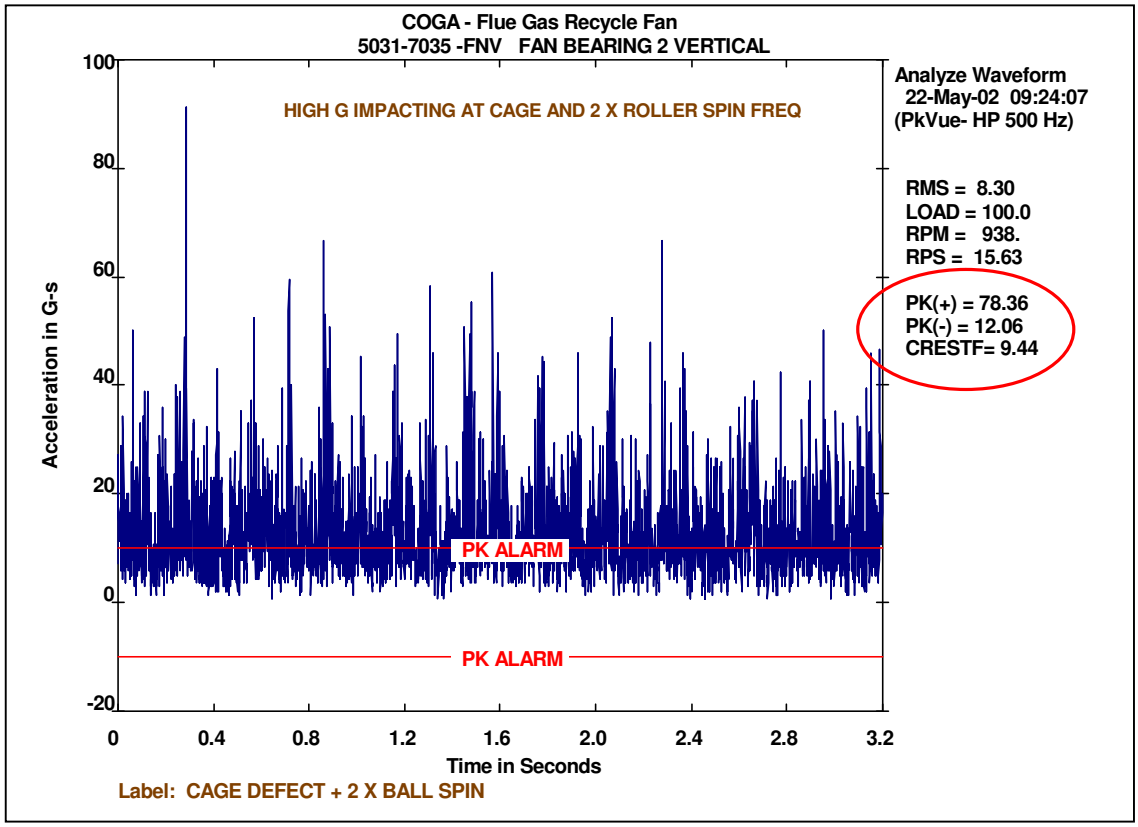


The above online trend is taken off the Fan Non Drive End Sensor; note how quick the fault is deteriorating. Planning windows are rare on the coga unit due to the environmental consequences if the plant is shut down.

The next step is to analyse the data to pinpoint why the vibration levels were increasing. Spectrum and Time Waveform analysis was used for this. Below is a spectrum taken from the online system. (Fan Non Drive end horizontal Bearing.)

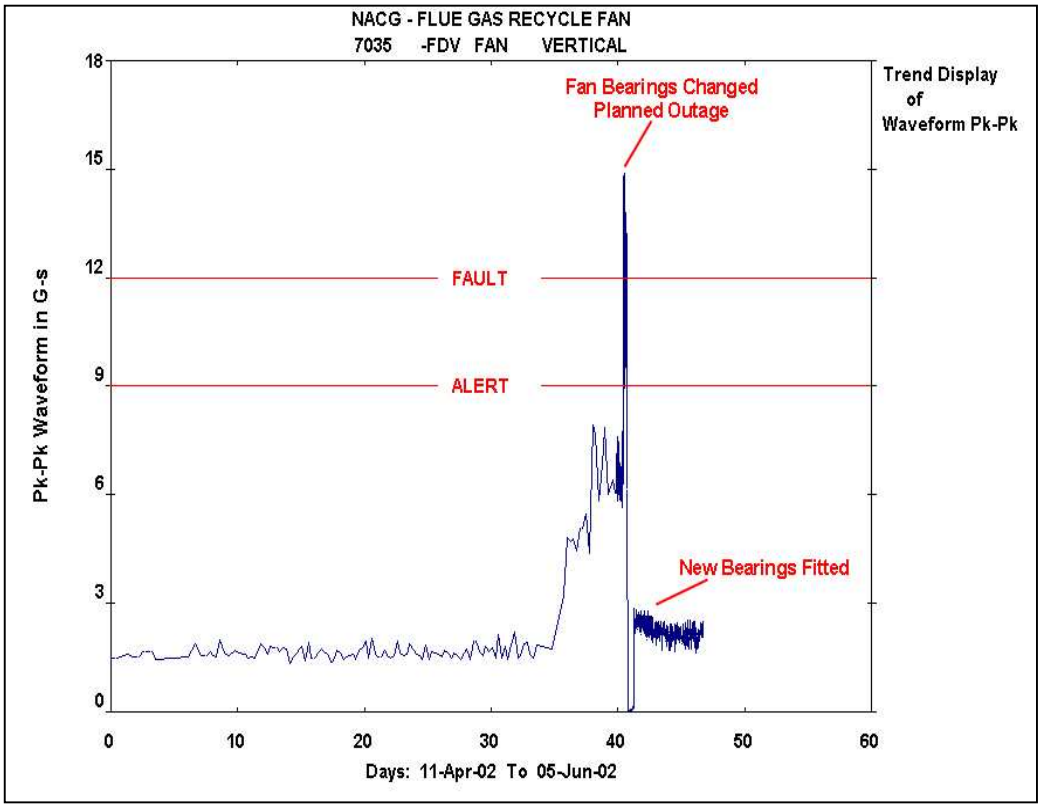


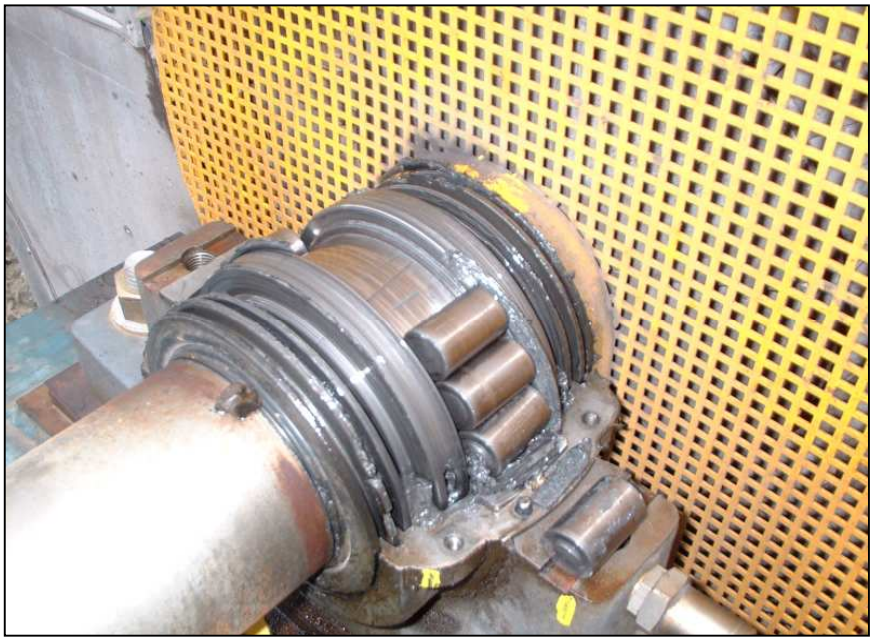
The filtered spectrum above indicates a problem with the cage and rollers on the NDE fan bearing, a clear match is made with the cage (0.4 orders). 2X Roller spin freq is also present due to defects on the rollers impacting the inner and outer races as they rotate. Cage defects are well known to deteriorate quickly.



The time waveform shows impacting to 78 G's, severe bearing damage.

After discussions with production and maintenance, the reliability team decided to plan for the fan bearings to be changed at the earliest opportunity. New bearings were ordered and a scaffold erected ready for a quick bearing change. The opportunity came on the 21st May when the Dryer Plant shut down on an overload issue. The coga was still running at this point, so a plan was formulated to shut the flue gas fan down in controlled manner so that the coga unit could still be run, but at reduced rates, this was only possible because of the Dryer plant shutting down.





Upon inspection of the bearing it was found that the cage had disintegrated and the bearing had entered the final failure mode. The fan would have failed catastrophically later that day, this would have caused major shaft and fan damage. The bearings were replaced and the fan was running within 6 Hours.

The cleaned up NDE cooper fan bearing showing remains of the cage and the damaged rollers.

Estimated Cost Savings

(Using DuPont Best Practice)

Actual Costs (Action Taken)

Parts : New Bearings Coo 01400 x 2
= £ 500

Labour : 2 men , 6 hours @ £ 30/ hour
= £ 360

Production Losses: None, job planned in with Boil Out

Total Cost = £ 860

Costs (No Action Taken)

40% of ERV (Estimated replacement value)
0.40 x £ 55000 (Cost of New Fan)
= £ 22,000

Labour : 2 men, 48 hours @ £30 /hour
= £3500

Environmental Effect (Fines)
3 Days to remove/repair/replace flue gas fan
If no credits/ Fines Potential £ 2 Million a /day
Production Loss / running on lower rates.
3 Days on lower rates £ 26012

Total Cost = £ 47978

Estimated Avoided Cost = £ 51512

Final Note

This case study highlights the fact that cage defects can rapidly deteriorate; in this case it only took 5 Days. This type of fault is often missed using conviently walk round programs; continuous monitoring is sometimes the only way to pick these faults up.