LIFE CYCLE INSTITUTE

# Bearing Failure Investigation Case Notes

Kelly was hired as a Reliability Engineer at Alpha Site. After six months in the position, Kelly was informed that one of the six key pneumatic conveyor fans was down, and "it was probably the inboard thrust bearing…again."

Replacing the inboard thrust bearing is not a small job. The bearing replacement requires four millwrights and takes an average of 16 hours. During downtime, 50% of production capacity is lost.

The Maintenance Manager asked Kelly to perform a root cause analysis on the problem. Kelly proceeded to conduct an investigation and determine the level of analysis needed.

Kelly's first action is was to interview the Maintenance Manager to get background on the problem. The interview yielded the following information:

- There are six identical pneumatic conveyor fans used to extract airborne product from a production application
- In 13 years of service, these fans have had a chronic history of thrust bearing failures
- The following information was confirmed during the interview: Thrust bearing replacement requires four millwrights
- The average downtime to replace each bearing is 16 hours
- 50% of production capacity is lost during downtime
- Failure frequency is every 6 months (2 failures per year per fan)

Kelly deduced that the problem was equipment related (versus process, etc.).

Next, Kelly calculated the cost of the failures so a cost/benefit analysis could be conducted after a solution is implemented. The cost of the failure is listed in the table below.

| Item | Amount | Per year | Annual Loss |
|---|---|---|---|
| Maintenance labor | $87 | 128 hours | $11,136 |
| Materials (bearing) | $500 per unit | 2 units | $1,000 |
| Fixed operating cost<br>(burdened cost production area) | $1164 per unit | 32 hours per unit | $37,248 |
| Production losses:<br>Area produces 1,000 tons/hour<br>1 ton = $500 | 500 tons<br>(50% reduction) | 32 hours per fan<br>(6 fans) | 96,000 tons<br>$48,000,000 |

Before pulling together an RCA team and beginning the RCA process, Kelly initiated a Design and Application review. To perform the review, Kelly gathered data to evaluate the design of the fans and conveyor system.

The fans were designed to operate as follows:

- In a positive system
- 4 hour intermittent operation
- Maximum air (inlet) temperature $300^0$ F
- Maximum particulate load 40% by weight

Kelly then compared the design parameters to how the fans were actually being operated. A table of findings is below:

| Design | Application |
|---|---|
| Positive system | Installed in negative system |
| 4 hr intermittent operation | 24 hours/day, 7 day continuous operation |
| Maximum air (inlet) temperature $300^0$ F | Inlet temperature $500^0$ F |
| Maximum particulate load 40% by weight | Particulate load greater than 50% by weight |

Kelly also obtained predictive maintenance data history. The PdM data indicated:

  – Elevated bearing temperature ($270^0$ F)
  – Outer race bearing frequency always present
  – No axial vibration
  – No other indication of abnormal behavior

- The predictive analysts had not been able to resolve the chronic bearing problem

After completing the design/application and PdM-history review, Kelly concluded that although the initial data was not sufficient to confirm the root cause, the data suggested that the problem was caused by abnormal suction conditions. What drove Kelly to make this conclusion?

- All six fans have identical failure history
- Application was the exact opposite of the fan’s design
- The vibration profiles showed an outer race defect, which may be indicative of abnormal suction load

To prove the theory, Kelly installed manometers in the suction and discharge ports of the fan to measure load. The findings were:

- Suction-side 55 inches/water
- Discharge well below design pressure
- Estimated thrust load, based on manometer reading 36,000 pounds
- Thrust bearings in use were rated at 8,800 pounds

Discussion questions:

1. **What conclusions can you draw from the given information?**
2. **Was there an RCA trigger process in the example?**
3. **What does this tell you about root cause analysis tools and process?**