ID Fan Capability

Optimising induced draft fan performance and reliability

Challenges

Sub-optimal induced draft (ID) fan performance can lead to short- and long-term issues such as:

- premature cracking of fan impellers
- increased power consumption and hence auxiliary load
- damage to fan impellers through erosion.

Solutions

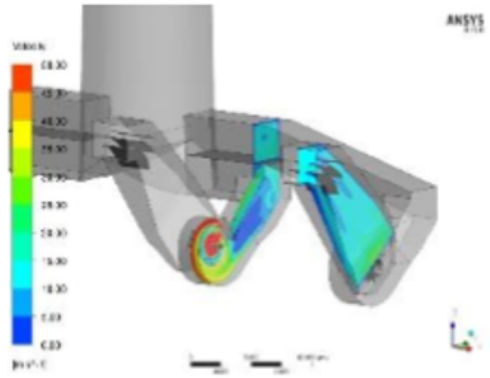
HRL can help plant operators meet these challenges by:

- providing independent ID fan performance/acceptance testing to relevant codes such as ASME PTC 11 - Fans
- auditing fan design using stress and modal analysis (finite element methods), impulse testing, fatigue assessments and strain gauge surveys
- undertaking process modelling and computational fluid dynamics (CFD) modelling of the fans and surrounding ductwork under existing and potential operating conditions.

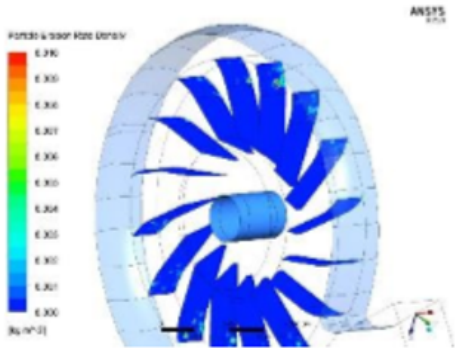
Benefits

HRL services and expertise provide plant operators with numerous benefits, including:

- independent acceptance testing to ensure original equipment suppliers performance guarantees are met
- performance testing and process modelling providing insight into how plant operating conditions are impacting on ID fan performance and efficiency
- auditing fan designs to determine the steady state, static and dynamic stresses experienced during operation; and the mode frequencies and shapes, to help determine the cause and risk of premature cracking
- auditing that can also determine expected fan life and assist in developing weld-repair procedures
- using computational fluid dynamics modelling to reveal the underlying flow structures within the fan and surrounding ductwork to diagnose performance issues such as vibration caused by the fan or its interaction with surrounding ductwork
- using CFD modelling to predict erosion patterns caused by particle-laden flows to help plan maintenance and compare scenarios to minimise such erosion.



CFD modelled flow for a unit with 2 ID fans and the surrounding ductwork



Predicted erosion on a radially bladed fan

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Case Study

Investigating premature cracking in an ID fan

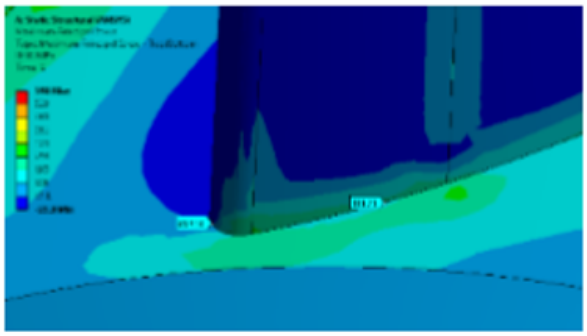
An Australian power station found significant cracking within the impeller on one of their induced draft fans. The impeller had been replaced three years earlier and had been subjected to several design changes, such that the replacement impeller could be considered as a different structure to the original. HRL was engaged by the power station operators to investigate the root cause of premature cracking in the new impeller.

HRL investigated the cracking by:

- installing (wireless) strain gauges onto the new impeller to survey strain during start-up and normal operation
- undertaking a finite element analysis (FEA) of the fan to determine the resonant frequency of the impeller and mode shape of the natural frequencies
- undertaking steady-state analysis to compare the operating mean stress of the new impeller to the original
- performing a stiffened modal analysis to determine the system's natural frequencies and modal shapes
- performing an unstiffened modal analysis to determine static natural frequencies for validation against impact testing results
- performance testing of the fan during operation to determine its efficiency under different operating conditions.

HRL established the most probable cause of the cracking to be vibration, possibly linked to the changed impeller design. HRL provided the power station operators with options to prevent further cracking of their ID fans. HRL recommended:

- the fan manufacturer review the fan flow-design characteristics based on the performance test data HRL collected under plant operating conditions – near stall at low load
- to mitigate the flow-induced vibration, the station to consider a smaller fan, or installing a variable speed fan or bypass duct system
- installing flue-gas flow measurement devices on both fans to eliminate bias to one fan
- specific operating instructions to avoid running the fan at near-stall condition.



Maximum principal stress on an ID fan impeller due to steady-state operation

Strain gauging on an ID fan impeller to survey strain during operation

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The company's NATA Accredited Laboratories number is 561.

HRL Technology Group's ISO 9001 Quality Management is certified by BSI under certificate FS605116

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