

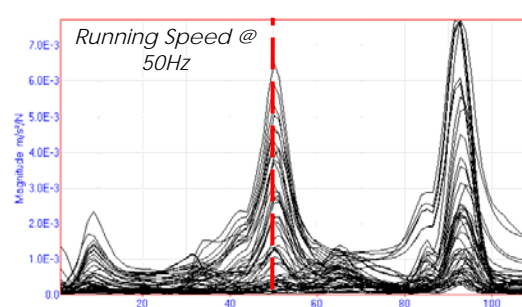
An Investigation of Johnston Vertical Pump Vibration Problem, 2005

The frequent failures of the Johnston vertical pump were investigated. Based on the Modal analysis performed and Finite Element Analysis, it is concluded that the root cause of the Johnston Vertical Pump problem is a structural resonance problem.

During the operating condition, the forces generated by the motor, rotating at 3000 rpm (50 Hz) is transmitted to the thrust pot and discharge head section. These phenomena was clearly shown from ODS analysis animation at the running speed; while the vertical pump is operation this region is suffering from excessive bending movement that caused the mechanical seal, bush etc. to wear.

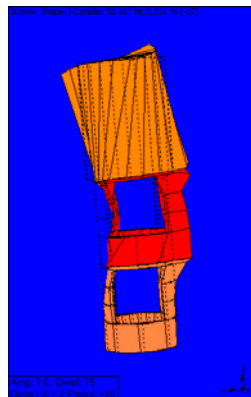
From Modal analysis and FEA, the vertical pump was having its 2nd bending mode at 50.4Hz; 'on-spot' to the running speed of 50 Hz, hence, hitting its structural resonance. The animation clearly showed that the structural movements by this 2nd bending mode was having its anti-node at the thrust pot – discharge head interface assembly that would eventually caused the mechanical seal and other components to wear and leading to the frequent failure of the vertical pump.

Therefore, the modification is aimed to stiffen the thrust pot – discharge head support structure. Structural Dynamic Modification (SDM) performed by adding 8 rectangular and tapered rib stiffener to the existing thrust pot and discharge head. Performing the proposed SDM has shifted the 2nd bending mode of the pump at 50.4Hz up to 81.4Hz; while the twisting mode at 32.7Hz to 38.3Hz.



Mode Shape	Modal FRF (Hz)	Modal FEA (Hz) Original	SDM #2 (Hz) (8 ribs stiffeners)
Twisting mode	32.7	34.9	38.3
2 nd Bending mode	50.4	51.9	81.4

FRF Modal spectrums for Johnston Vertical Pump



Mode shapes @ 50.4Hz



FEA Mode shape @ 51.9Hz