

An Investigation of Johnston Vertical Pump Vibration Problem, 2005

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

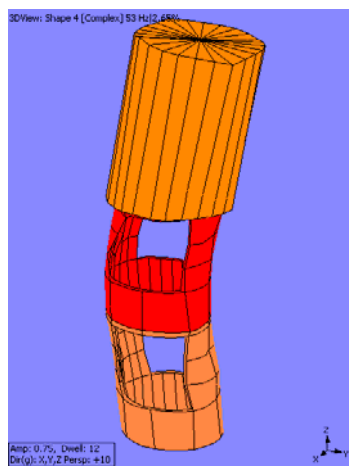
During the operating condition, the forces generated by the motor, rotating at 3000 rpm (50 Hz) is transmitted to the thrust pot and discharge head section. These phenomena was clearly shown from ODS analysis animation at the running speed; while the vertical pump is operation this region is experience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

From Modal analysis and FEA, the vertical pump was having its 2nd bending mode at 46.4Hz and 53.0Hz; 'very close' to the running speed of 50 Hz. The animation correlates and clearly showed that the structural movements during operation dominated 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.

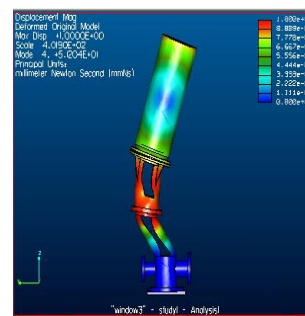
A dynamic design criterion was established that would shift both the 2nd bending mode of the Vertical Pump at 46.4Hz and 53Hz, away from the running speed up while ensuring that the 33.9Hz twisting mode will not enter into the Pump operating region

Some modifications were performed on the Vertical Pump thrust pot - discharge head assembly to accommodate interchangeability have shifted the resonance frequency 46.4Hz away from the running speed of 50Hz to 76.2Hz and the twisting mode at 33.9Hz to 36.7Hz.

Mode Shape	Modal FRF (Hz)	Modal FEA (Hz) Original	SDM (Hz) (8 ribs stiffeners)
Twisting mode	33.9	34	36.7
2 nd Bending mode	46.4 & 53	51.2	76.2



Mode shapes @ 46.4, 53.0Hz



FEA Mode shape@ 51.2Hz