An Investigation of Main Oil Line Pumps Problems on the Dulang-B Oil Platform, Offshore Kerteh, Terengganu, 1998

Frequent failure of mechanical seals and shafts of the 5 units of Main Oil Line vertical pumps on the Dulang-B Oil Platform, is investigated. The failure / problem have been repeating every 2 – 3 month period since the platform was hand-over. For every failures or unplanned breakdowns, the cost excluding downtime cost about RM60k – RM80k. Hence, the platform was only capable to run only 1 or 2 pumps at a time limiting its production capacity.

Analysis techniques include visual inspection of the stripped problematic pump, machine maintenance history, operation deflection shape analysis, vibration spectrum trending, modal analysis and finite element analysis.

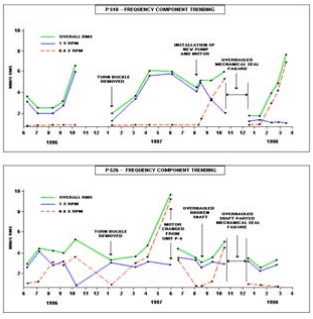
Trending of the 1X and 0.4X frequency components showed the 0.4x component tend to increase rapidly prior to mechanical seal failure while the 1x component dropped. The magnitude of the two frequency components (1x and 0.4x) tend to swap with each other on the approach of shaft failure.

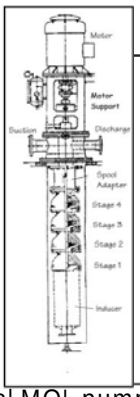
Operating Deflection Shape analysis of the motor support indicated twisting and bending motion. Structural dynamics investigation performed on the MOL pump consisted of Modal Analysis of the pump and the supporting I-Beams, and Finite Element Analysis of the pump. Results from Modal analysis and Finite Element analysis revealed similar twisting mode in the region of 51 Hz – 56 Hz. It was concluded that the mechanics of failure is initiated by the resonance around the pump operating speed, 49.2Hz. As a result, more wear were introduced to the impeller wear rings as well as the bush bearings causing unstable fluid induced vibration (oil whirl) between the bush and the shaft sleeve at 0.4X running speed. The oil whirl symptom registered vibration in the region of 19Hz which would excite the lower natural frequencies of the pump i.e. 12.5 Hz and 15.3 Hz - cantilever mode in the North-South direction and in the East-West direction, respectively. The 0.4XRPM component rapidly increases with respect to increasing wear of the bush bearing and eventually causing mechanical seal failure and low discharge.

Design modification was conducted using Finite Element analysis. It is proposed that the motor support thickness should be increased that would increase the twisting mode to 153.5 Hz and the bending modes to 25.2 Hz and 26.2 Hz, hence shifting the natural frequencies away from both the 49.2Hz (1X) and the 19Hz (0.4X) excitations.

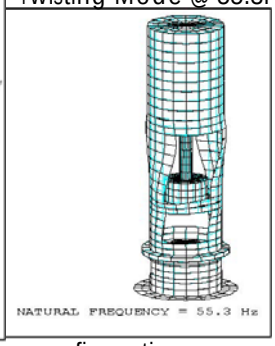
This dynamic design modification was performed on all the 5 units and until now all units has been in operation smoothly for almost 10 years with savings of about RM400,000.00 per annum on the maintenance cost excluding unplanned breakdown cost. (Note: 1 pump transfer about 5k - 6k barrels per day @ USD3.80 in 1998)

Spectral Trending





Twisting Mode @ 55.3Hz



Typical MOL pump configuration

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