

SOLUTION TO CORROSION/ HIGH NSS PROBLEM AT PETROTRIN REFINERY

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PROBLEM – TO IMPROVE RELIABILITY/SAFETY ON THREE HVGO PUMPS AT NO. 4 VDU

- ◆ Chronically high vibration – 0.4 to 1.0 ips pk.
- ◆ Corrosion/erosion/gouging of all wetted parts to depth of $\frac{1}{4}$ inch leading to impeller unbalance and looseness to shaft and looseness of wear rings to the impeller.
- ◆ MTBO – 6 MONTHS.

PROBLEM – TO IMPROVE RELIABILITY/SAFETY ON THREE HVGO PUMPS AT NO. 4 VDU (CONT'D)

- 4 incidents of bearing housing fracture on pump and motor over the period 1990 – 1995. Motor wrecked twice. Small fires.
- Maintenance costs – US\$24,000 per pumpset p.a.(1993)
- Plant downtime of 9.8 days p.a. causing production losses of US\$295,000 p.a.(1993).

Pump Casing (12% Chr) – Gouging by Naphthenic Acid



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INITIAL ANALYSIS & IMPROVEMENT METHODS

- ◆ Trim impeller to suit reduced flow conditions. Reduce turbine speed.
- ◆ Check for pipe strain and temperature growth. Use Essinger bars. Use alignment jack-bolts on pedestals to prevent pump movement.

INITIAL ANALYSIS & IMPROVEMENT METHODS (CONT'D)

- Calculate minimum flow and install a recirculation line.
- Fit up “better” coupling designs (gear and disc type).
- All the above were implemented sequentially over the period 1980 – 1995 with no noticeable improvement.

CONCLUSIONS

- ◆ Successful pumps in similar duties were API code BB2.
- ◆ Estimated suction specific speed NSS was 12,837. which was above the upper limit of 12,000 (HI).

CONCLUSIONS (CONT'D)

- The pumpage (Heavy Vacuum Gas Oil @ 560 F) contained corrodents in the form of H₂S and naphthenic acid (TAN - 4.0 mg KOH/gm, sulfur – 1.8% wt). This acid though very minute in quantity is known to be very corrosive to 12% chrome steel (the metallurgy of the HVGO pumps) at temperatures above 400 F.
- It is doubtful whether the engineers who designed and procured these pumps (circa 1970) had an appreciation of the above factors.

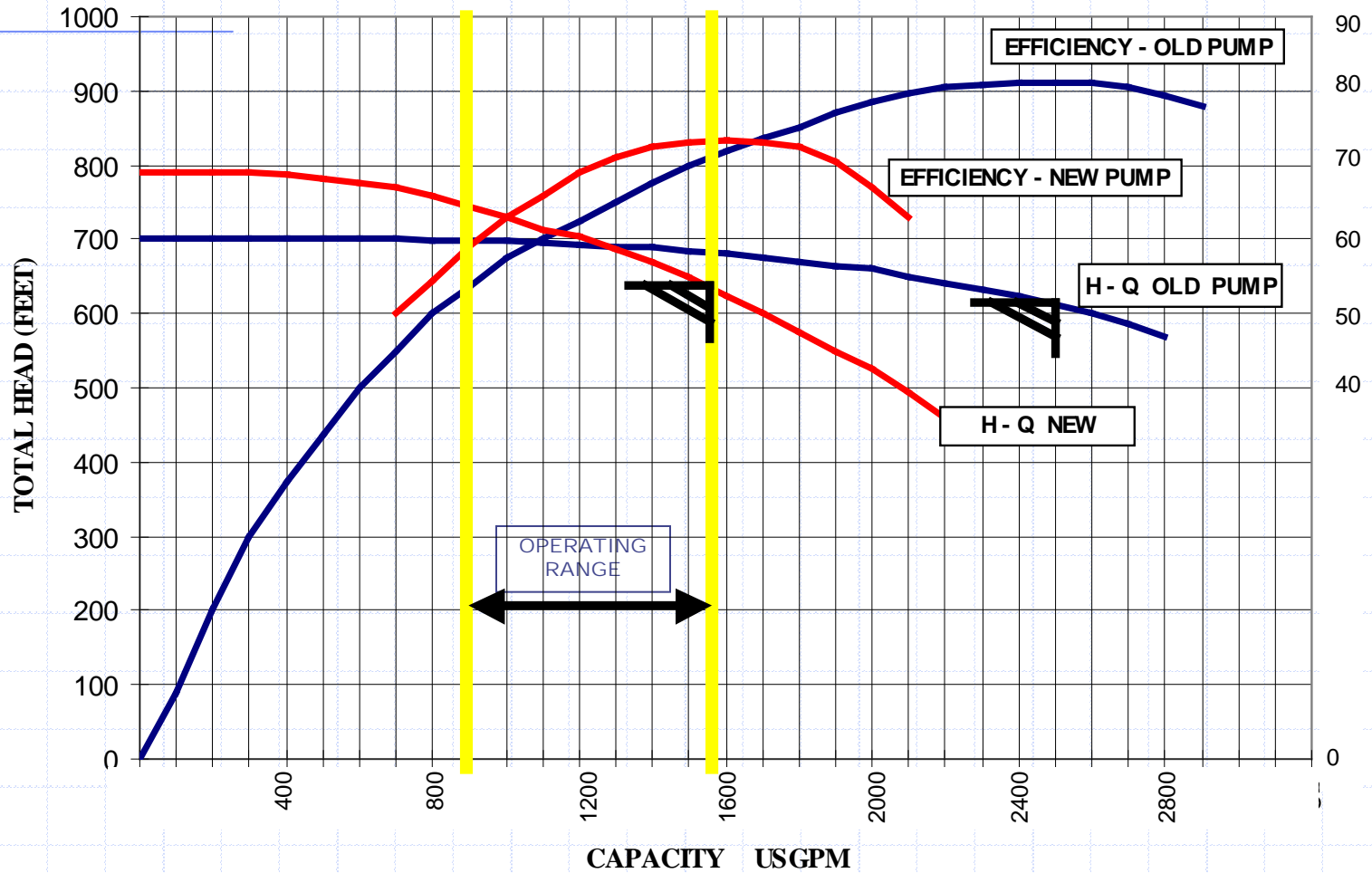
RECOMMENDATIONS

- ◆ Develop a report to justify replacement of the pumps and identify key features of the new design :
- ◆ 316 SS metallurgy to resist the corrosion.
- ◆ API code BB2 construction.
- ◆ Design capacity to be a better hydraulic fit to the process -1600 usgpm instead of 2563 usgpm.

DESIGN COMPARISON

	OLD HVGO PUMPS	NEW HVGO PUMPS
PUMP SIZE	6 X 10 X 13H	6 X 10 X 15A
FLOW RANGE USGPM MCSF - BEP	1081 TO 2563	550 TO 1800
SUCTION SPECIFIC SPEED	12,837	11,200
MOTOR HORSEPOWER	450	300
METALLURGY	12% CHROME STEEL	316 SS
API CODE	OH2 (IMPELLER OVERHUNG)	BB2 (IMPELLER BETWEEN BEARINGS)

PERFORMANCE CURVES - OLD AND NEW PUMPS



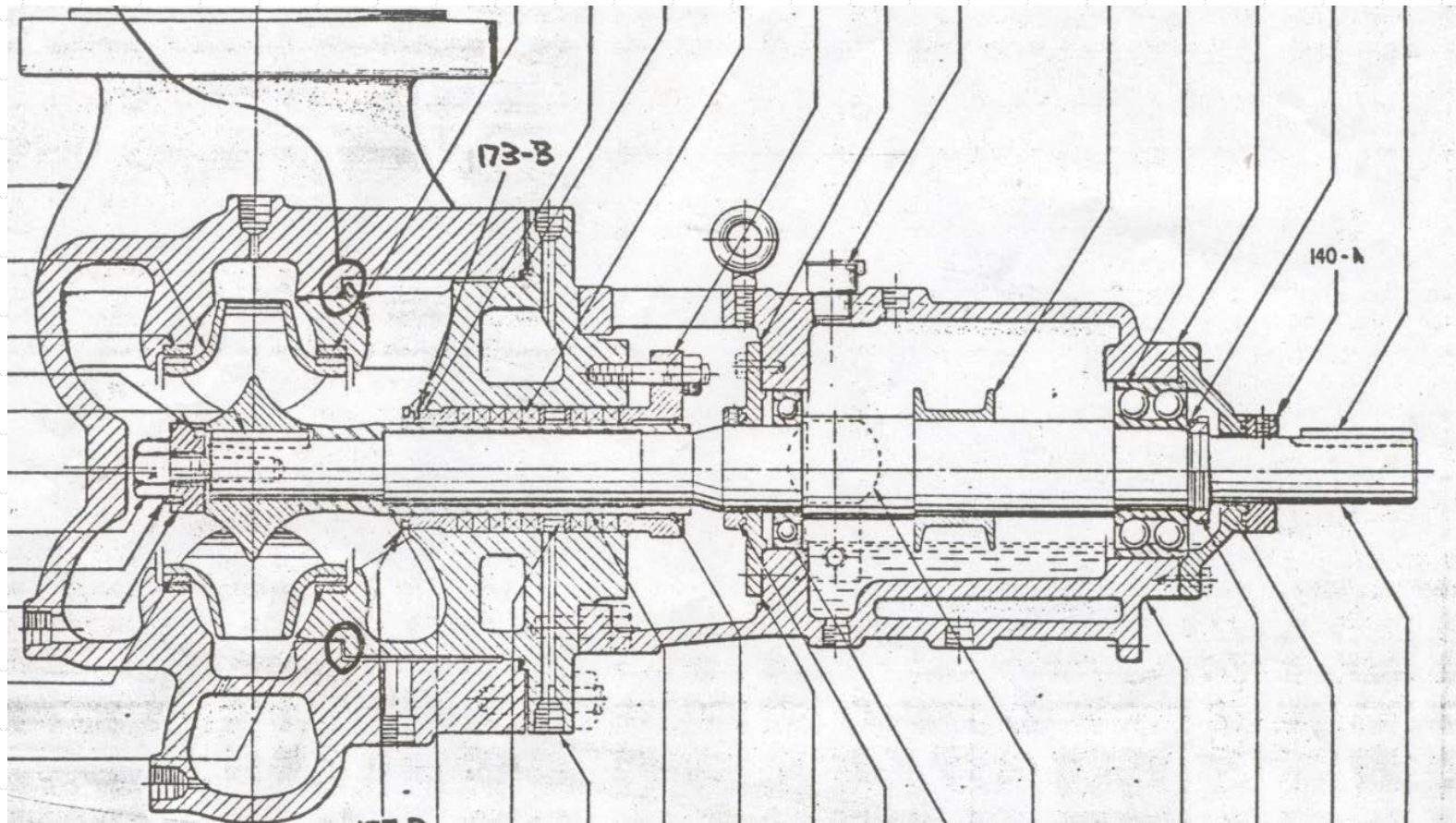
RESULTS REALISED AFTER IMPLEMENTATION IN 1998

	OLD HVGO PUMPS	NEW HVGO PUMPS
PRODUCTION LOSSES US \$ P.A.	\$295,000 P.A. (1990 TO 1995)	NIL
MAINTENANCE COSTS (YEAR 2000 \$) US \$ PER PUMP P.A.	34,000	7,000
MTBO MONTHS	6	28 - MAIN PUMP 55 - STANDBY PUMP
RECIRCULATION TO ENSURE MINIMUM FLOW	REQUIRED	NOT REQUIRED
PROJECT PAYBACK	-	< 2 YEARS

Impeller – 316 S.S (Corrosion Resistant)



OLD HVGO PUMP - API CODE OH2



NEW HVGO PUMP - API CODE BB2

