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 ¼ 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)


• 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

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<thead>
<tr>
<th></th>
<th>OLD HVGO PUMPS</th>
<th>NEW HVGO PUMPS</th>
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<tbody>
<tr>
<td><strong>PUMP SIZE</strong></td>
<td>6 X 10 X 13H</td>
<td>6 X 10 X 15A</td>
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<tr>
<td><strong>FLOW RANGE USGPM</strong></td>
<td>1081 TO 2563</td>
<td>550 TO 1800</td>
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<tr>
<td><strong>SUCTION SPECIFIC SPEED</strong></td>
<td>12,837</td>
<td>11,200</td>
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<tr>
<td><strong>MOTOR HORSEPOWER</strong></td>
<td>450</td>
<td>300</td>
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<tr>
<td><strong>METALLURGY</strong></td>
<td>12% CHROME STEEL</td>
<td>316 SS</td>
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<tr>
<td><strong>API CODE</strong></td>
<td>OH2 (IMPELLER OVERHUNG)</td>
<td>BB2 (IMPELLER BETWEEN BEARINGS)</td>
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RESULTS REALISED AFTER IMPLEMENTATION IN 1998

<table>
<thead>
<tr>
<th></th>
<th>OLD HVGO PUMPS</th>
<th>NEW HVGO PUMPS</th>
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<tbody>
<tr>
<td>MAINTENANCE COSTS (YEAR 2000 $)</td>
<td>34,000</td>
<td>7,000</td>
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<tr>
<td>US $ PER PUMP P.A.</td>
<td></td>
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<tr>
<td>MTBO MONTHS</td>
<td>6</td>
<td>28 - MAIN PUMP</td>
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<tr>
<td></td>
<td></td>
<td>55 - STANDBY PUMP</td>
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<tr>
<td>RECIRCULATION TO ENSURE MINIMUM FLOW</td>
<td>REQUIRED</td>
<td>NOT REQUIRED</td>
</tr>
<tr>
<td>PROJECT PAYBACK</td>
<td>-</td>
<td>&lt; 2 YEARS</td>
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Impeller – 316 S.S (Corrosion Resistant)
OLD HVGO PUMP – API CODE OH2
NEW HVGO PUMP – API CODE BB2