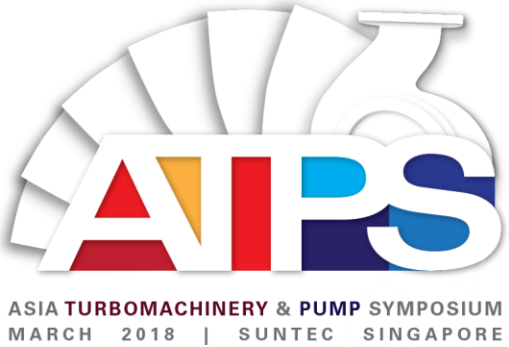

Base plate corrosion and Premature Bearing failure in RO Pump

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Introduction

- On 19th Aug 2017, abnormal noise noticed from **RO (Reverse osmosis) Membrane Feed pump** coupling area. Checked the vibration for pump & motor and found very high vibration at Pump Drive end. The vibration level at Pump DE Vertical recorded as 4.5 mm/sec (Allowable: 3 mm/sec Max.)
- Pump was stopped to identify the reason for the high vibration and abnormal noise. Checked the alignment and found the vertical offset at motor end coupling is 0.8 mm higher than the pump end.
- Customer has tried to perform the alignment with their own maintenance team and found there is no shim at motor foot to do the necessary correction.
- Customer has approached OEM Service team.

Background

- **Osmosis** is the tendency of a fluid, usually water, to pass through a semipermeable membrane into a solution where the solvent concentration is higher, thus equalizing the concentrations of materials on either side of the membrane
- In reverse osmosis (RO), an applied pressure is used to overcome osmotic pressure, a colligative property, that is driven by chemical potential differences of the solvent, a thermodynamic parameter.
- Reverse osmosis can remove many types of dissolved and suspended species from water, including bacteria, and is used in both industrial processes and the production of potable water.

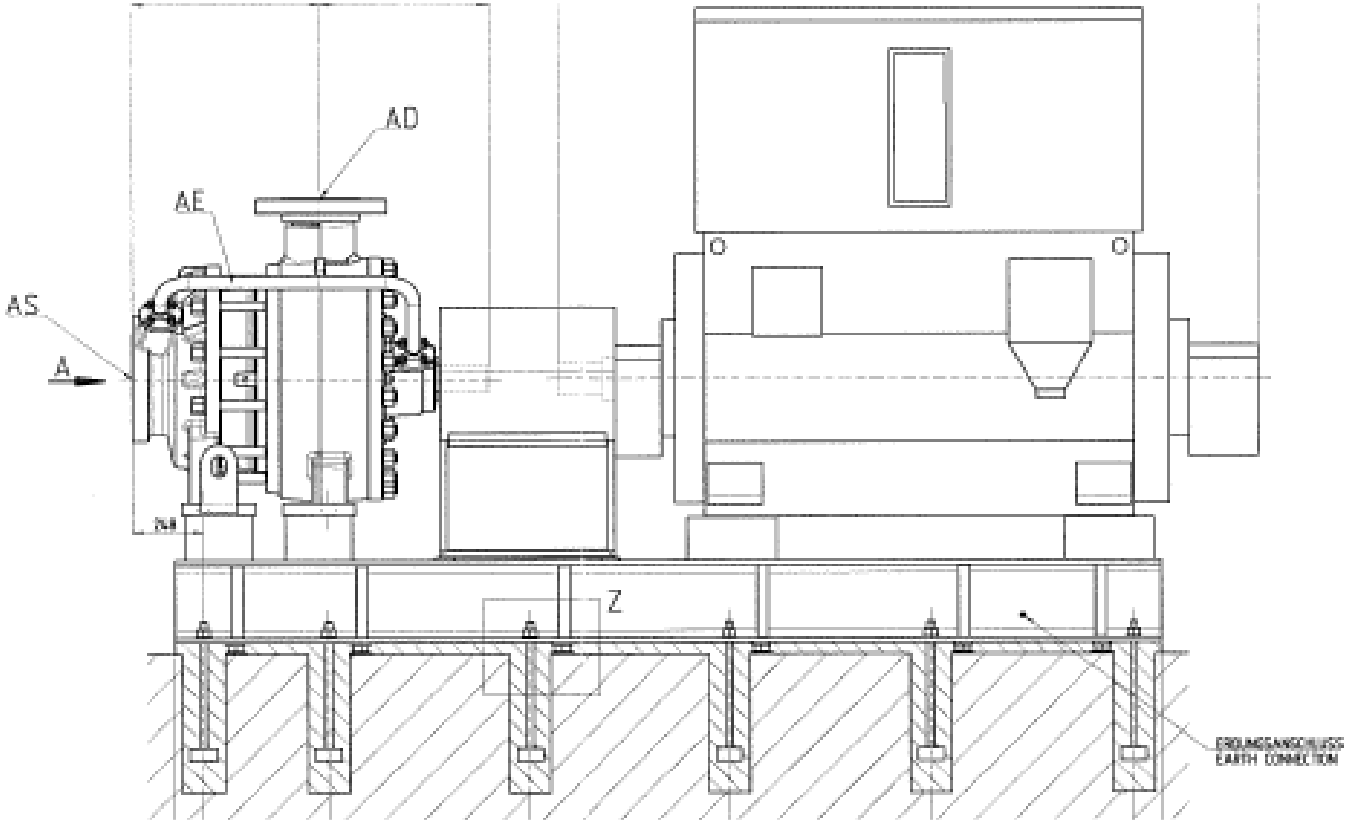
Background

- Drinking water production in **Reverse osmosis (RO)** systems requires a high-pressure pump which offers reliability and continuous optimization ensuring the best possible efficiency and low energy consumption.

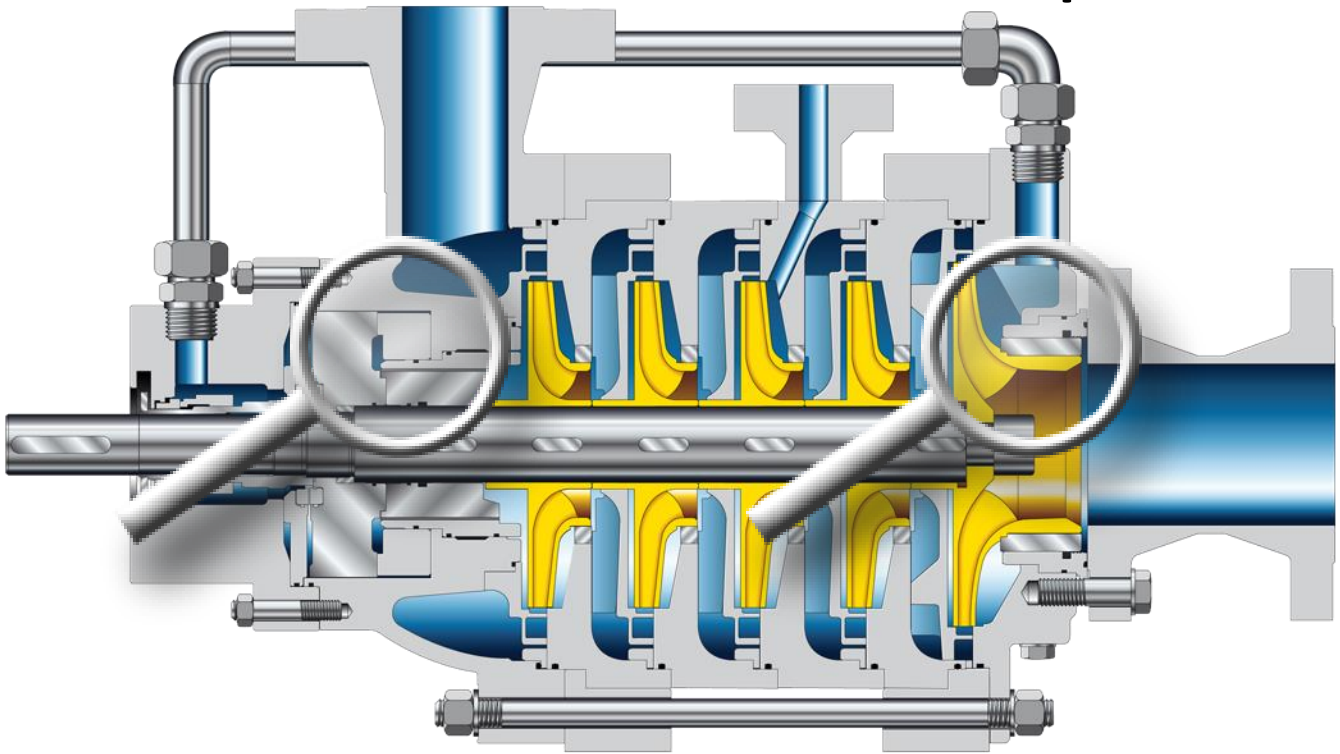
- **RO feed pump** handling sea water and delivers the high pressure water (60 Kg/Sq.cm) into the RO Membrane as the part of desalination.

- This case study represents the premature radial bearing failure in RO Feed Pump.

RO Membrane Feed Pump General Arrangement



RO Membrane Feed Pump



Horizontal, multi-stage, centrifugal pump in ring section design with medium lubricated plain bearings. Suitable for Desalination plant, boiler feed applications & condensate transport in power stations & boiler.

RO Membrane Feed Pump Design Details

Bearings Lubricated by the Fluid Handled

- The pump rotor is supported radially by two plain bearings
- The balancing fluid is returned to the impeller side clearance of the 1st stage
- There is a permanent flow of the fluid handled through the two bearings
- No lubricating oil and no cooling of bearings required

Low $NPSH_{required}$

- Special suction stage impeller
- Optimum suction behaviour due to free inlet cross-section (shaft does not extend as far as to the suction nozzle) and axial inlet design

RO Membrane Feed Pump Design Details

Pump Model		HGM RO
Capacity	Q m^3/hr	up to 280
Head	H m	up to 600
Discharge Pressure	p bar	up to 60
Temperature	t ^{O}C	upto 140
Speed	n RPM	up to 3000

Findings & Analysis

Problem statement:

The site had repeated high vibration complaint in the installed RO Feed Pumps (Total – 9 Nos.) within one year and the same was attended by the customer maintenance team to some extent. In this particular pump the alignment correction is not possible due to no shim available in the motor feet to correct the vertical offset.

History:

Nearly 3 pumps alignment was corrected with the help of available shims in the motor foot to correct the vertical offset in the last one year.

Findings & Analysis

Observation in the 3rd Pump:

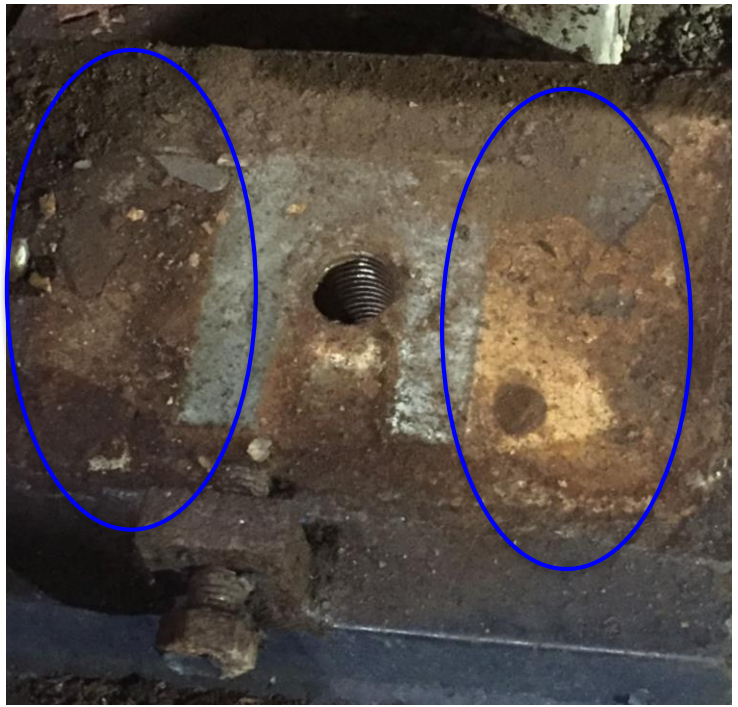
There was thick layer of rust sludge built-up underneath the motor foot which rises the motor to 0.6 mm.

Rust is another name for iron oxide, which occurs when iron or an alloy that contains iron, like steel, is exposed to oxygen and moisture for a long period of time. Over time, the oxygen combines with the metal at an atomic level, forming a new compound called an oxide and weakening the bonds of the metal itself. If salt is present, for example in seawater or salt spray, the iron tends to rust more quickly, as a result of electrochemical reactions.

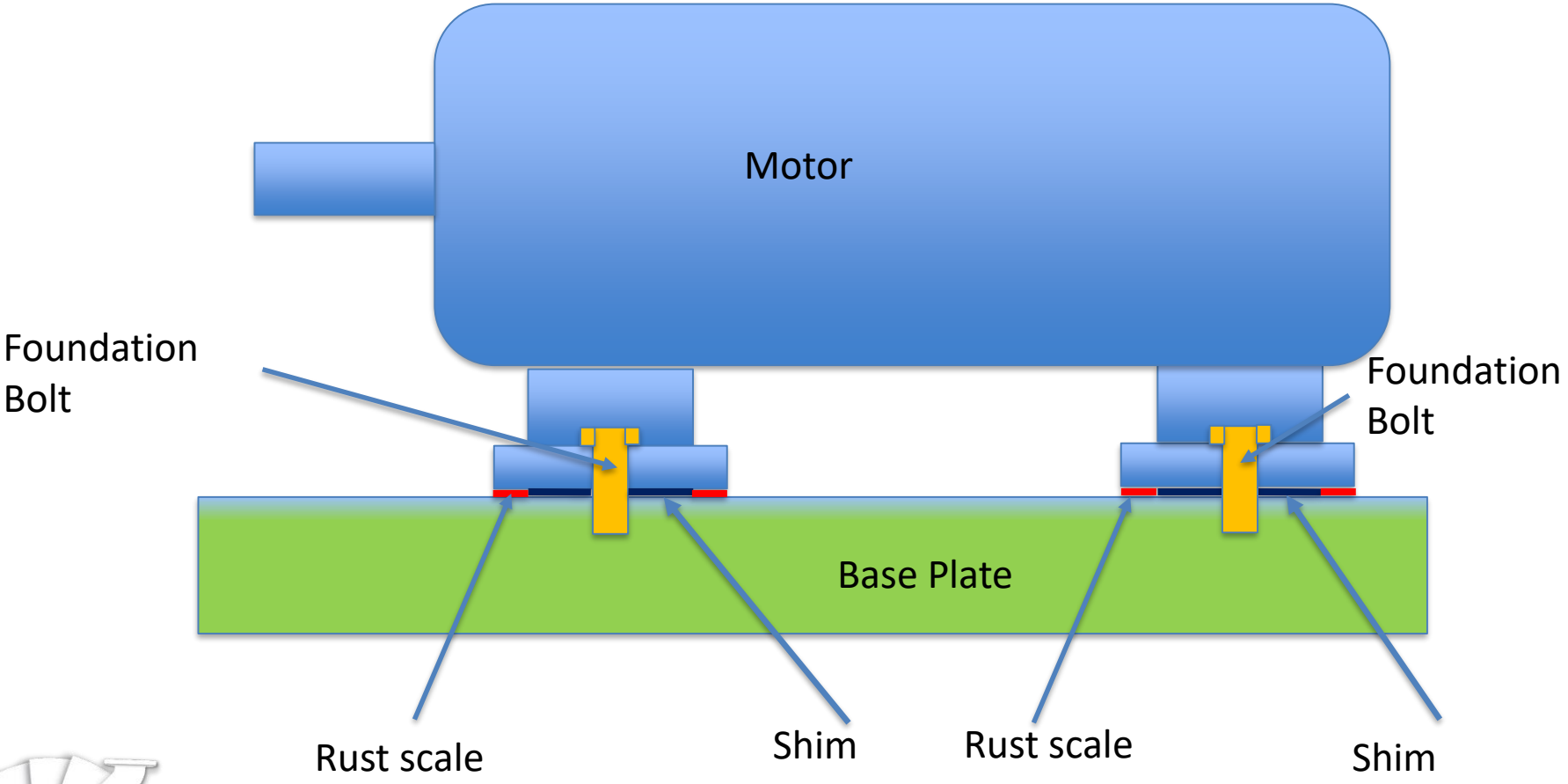
The rust sludges have tendency to grow up between the gap and will increase the gap and even crack the structure.

Findings & Analysis

Motor Front Feet



Motor Front Feet abut area in Base plate


Motor
Foundation Bolt
Foundation Bolt
Base Plate
Rust scale
Shim
Rust scale
Shim

Findings & Analysis

Root cause Analysis

RCA was performed to analysis the abnormal noise and high vibration from the Pump DE side and as follows

Primary Sources:

- ✓ Excess clearance in the DE side Radial bearing.

Secondary Sources:

- ✓ Motor vertical offset due to rust sludge built up in the foot
- ✓ Coupling misalignment leads to overload the Pump radial bearing.

Conclusions

- ✓ The primary source of the premature failure of the bearing was identified as the rust sludge formed in the motor foot.
- ✓ As there is no shim available to correct the vertical offset that leads to further investigation.
- ✓ The vertical offset corrected after removal of rust sludges with 0.7 mm shims.

Recommendation

- ✓ Extra care need to be given for the Pump base plate to prevent any Rust/corrosion.
- ✓ Stainless steel laminated shims size need to match with the base plate contact surface and custom design if required.

Lesson Learnt

- ✓ Rust prevention is important for the Equipment performance.
- ✓ Good housekeeping.

References

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- Rust-the longest war by Waldman.J (2015) Simon & Schuster, New York
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Thank You