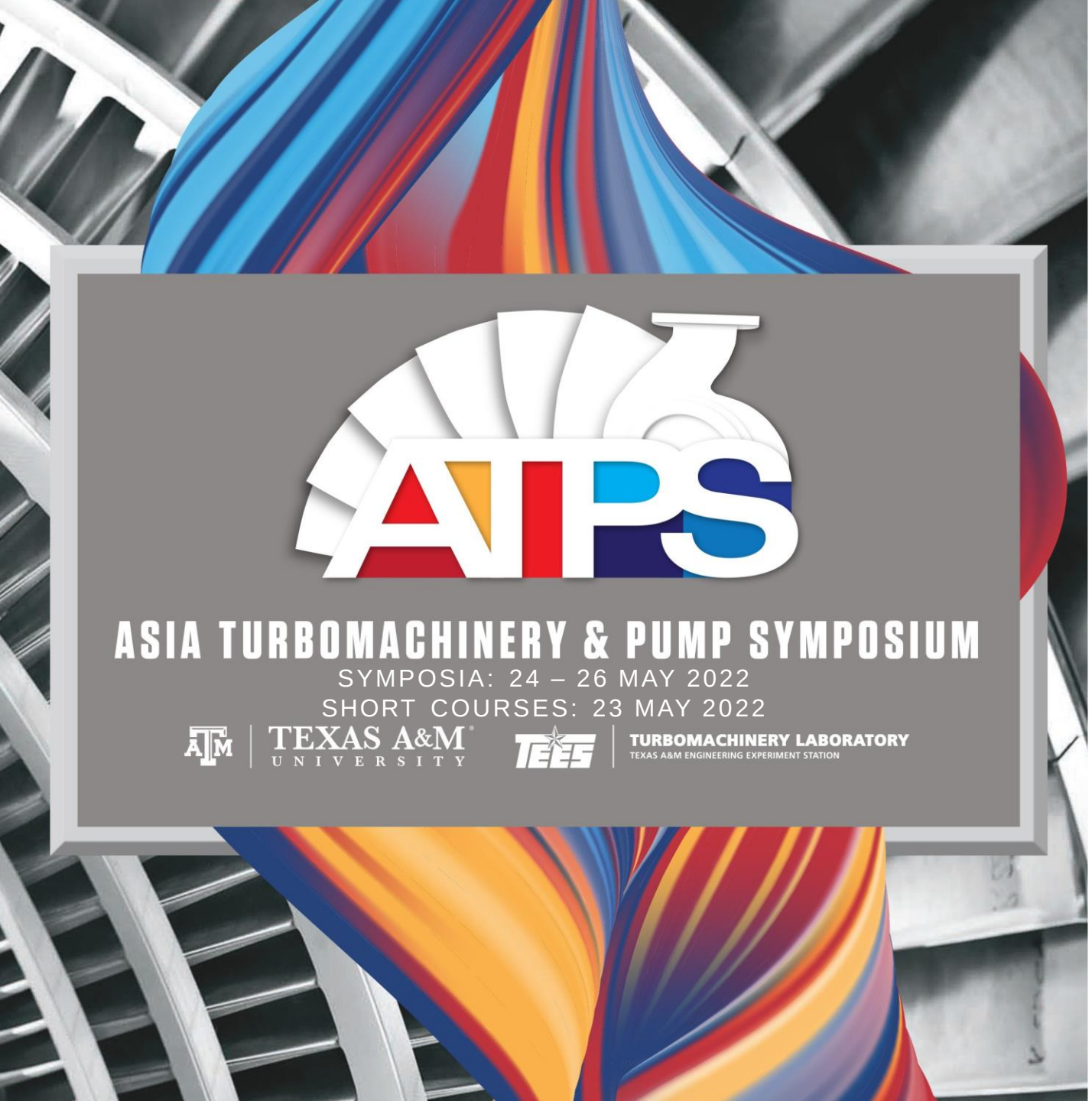

HIGH SPEED PUMP: MECHANICAL SEAL BAD ACTOR RESOLUTION

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ASIA TURBOMACHINERY & PUMP SYMPOSIUM

ABSTRACT

Case study include a vertical pump in sour water service running at high speed of 17200 rpm. Pump originally equipped with single seal & Plan21 configuration since day one. In 2018, as part of a reliability upgrade, seal was converted to a double seal design (Plan53A). Pump MTBF reduced from 24months to 6months.

While utilizing existing Plan53A, a practical & cost effective approach is to have external cooling supply to seal chamber. Plan32 then is introduced; together with seal scallop design upgrade and reducing amount of elbows on current seal piping system.

With new upgrade changes, the pump seal has been operating satisfactory since commissioning, exceeding its previous operating life.

AGENDA

1. Case Study Background
2. Problem Description
3. Analysis
4. Mitigation Implemented and Results
5. Key Learning

Equipment General Info

Figure: Pump at site

Pump Details (Original Design)

- Pumpage: Sour water
- Vertical Centrifugal Single stage
- Operating Speed 17200 rpm
- Motor Speed 2960 rpm
- Rated flow 12.5 m3/ hr
- Suction Pressure 450 kPa
- Discharge pressure 9000 kPa
- Seal Plan21 (choke tube) & Plan13

Problem Description

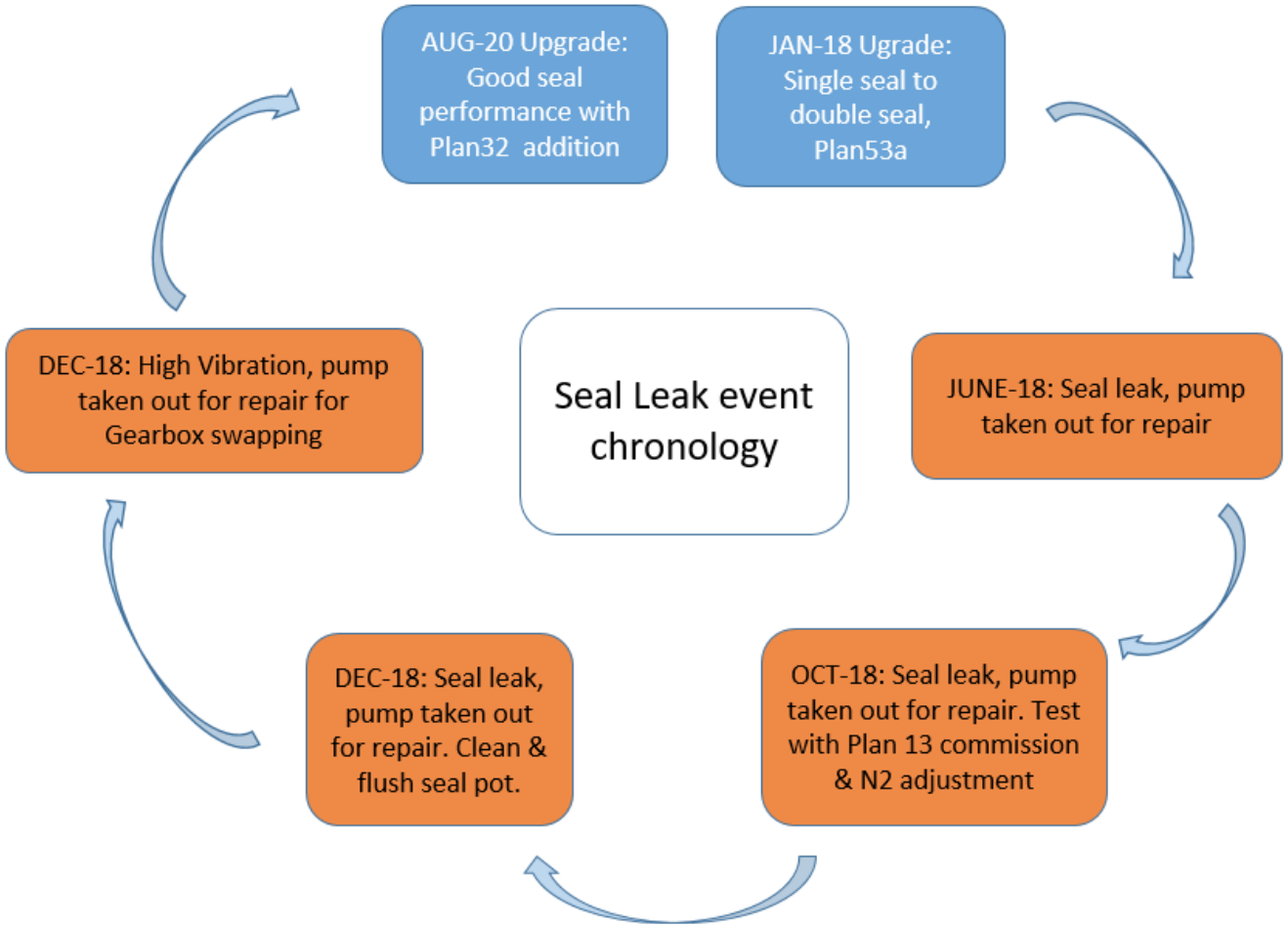


Figure: Seal leak chronology

Findings during failure:

- Average life of 0.5 years
- Commission Plan13 and adjusting N2 pressure *(not helping much)*
- Product reversal to seal pot

Figure: Sample of liquid in seal pot (flow reversal indication)

Analysis: Design Audit

Failed seal: Wear & blistering marks; indication of “dry run”

Figure: Seal face worn out and blistering

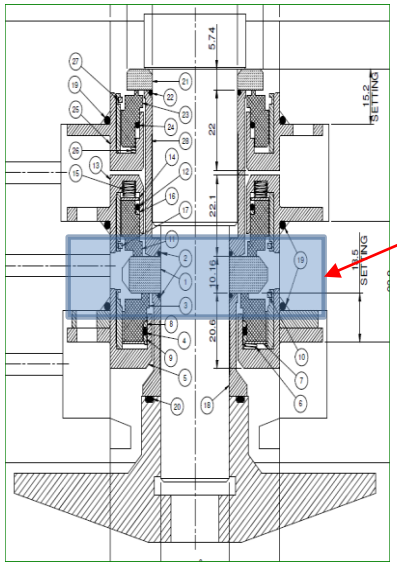
- Process Nature:
  - Pumpage (Sour water) contain undissolved H2S in solution
- Operating Condition:
  - Pumpage temperature fluctuates between 40-75 DegC.
  - High operating speed promotes vapor coming out from solution
- Mechanical Design
  - Too many elbows installed during previous design upgrade

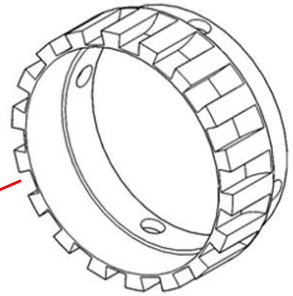
Analysis: Design Audit

Failed seal: Wear & blistering marks; indication of “dry run”

Figure: Seal face worn out and blistering

Promote more barrier fluid flow across seal (Scallop Design)





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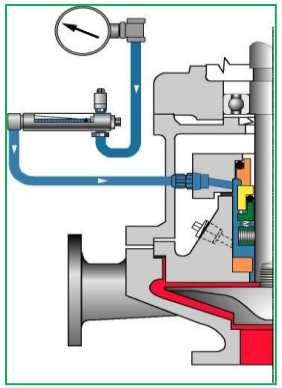
Cool it Down (Plan32)



Reduce elbows at site

Implementation & Result

- Challenges during recent upgrade:
  - Level in seal pot gaining gradually;
    - *Series of barrier fluid draining performed*
    - *Adjust N2 pressure for optimum operation (from 10 bar to 12 bar)*

Figure: Series of draining performed to remove "milky" solution; after ~1month operation

  - Realized that product temperature did increase seal pot level rate
    - *Need more cooling!*
- Increase Plan32 orifice size (10%) to provide more cooling to seal chamber

Pump seal running satisfactory since last upgrade

Key learning

- Undissolved H2S in sour water was not fully understood.
- High Operating speed and product temperature fluctuation promotes vapor formation inside seal chamber.
- Plan32 introduction help to cool the pumpage and keeping vapor in its solution. *Ideal seal Plan is Plan52 (more expensive i.e. to change the seal and route vapor to safe place)*
- Reducing elbows on seal piping & seal scallop design upgrade help to provide more flow & cooling to seal faces.

Cool Seal = Happy Seal