

User/Vendor Collaborative Seal Selection

From Problem Evaluation to Commissioning

Problem Statement

- Problematic dual seals in Ethylene Service
 - ◆ Vertical 16 stage pump
 - ◆ 1485 psig discharge
- High Maintenance costs
- MTBF of 2 to 6 months
 - ◆ Residue build up on ID of primary
 - ◆ Heavy wear on secondary





Assessment Criteria

- Team effort with seal/pump vendor and end user.
- Selection based on Life Cycle Cost
- Minimize engineering changes in the field
- Quick implementation and validation
- Reuse the existing support systems
- 60 month MTBF Target

Original Seal Design

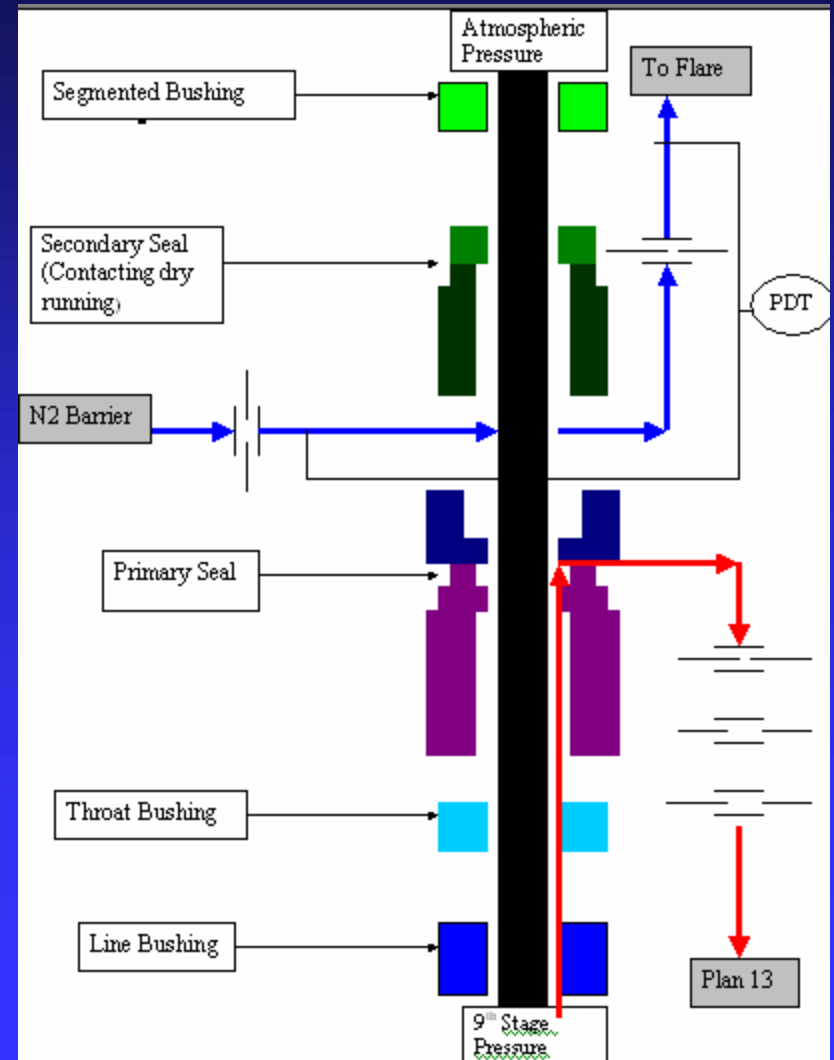
Primary – Wet contacting Pusher seal with hydropads

Secondary – Dry Running Contacting Seal with N₂ sweep

Plan 13 through a triple orifice with flush supply from 9th stage

Balance Ratio of 85.6%

Stuffing box press. 780 psig
(super critical state)



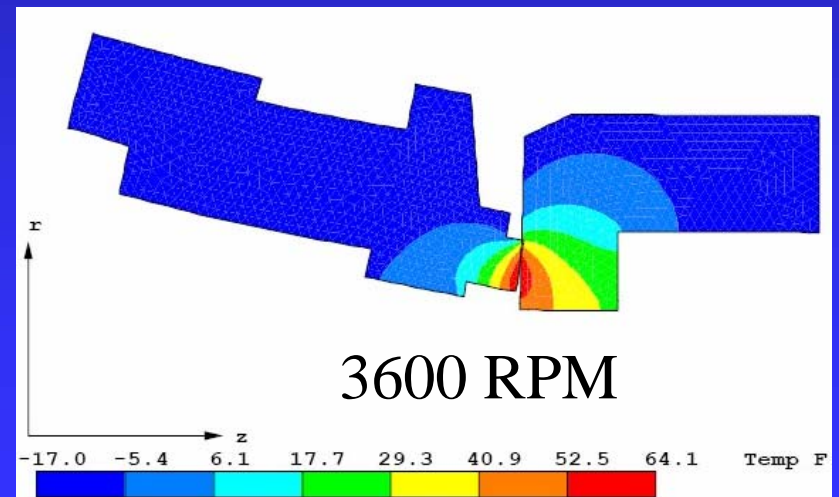
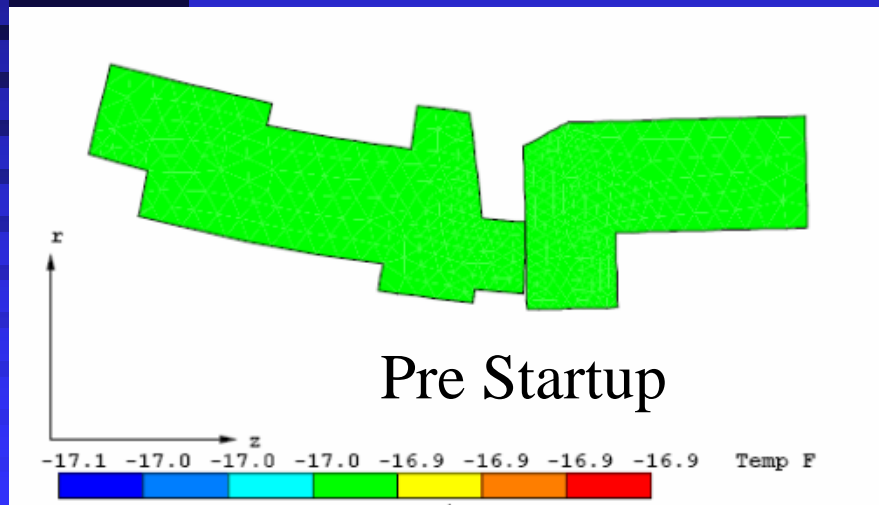


Analysis of Original Seal

- Field testing of secondary seals
- Trending of primary leakage
- Samples of residue from primary seal
- Review of the flush plans
- Literature Searches/Consultation

Analysis (Detailed Analysis)

- ◆ Face distortion
- ◆ Heat generation (face temperature)
- ◆ Liquid fraction
- ◆ Seal Leakage
- ◆ Face Contact pressure
- ◆ PV numbers





Alternative Selection

- Plan 53 Wet Contacting (dual seal - pressurized barrier from accumulator)
- Plan 54 Wet Contacting (dual seal - pressurized barrier from external pump)
- Tandem Vaporizing Non Contacting (Plan 13/76)
- Optimized Existing Wet Primary and Containment seal.



Evaluate Options Against Assessment Criteria

- Selection based on Life Cycle Cost
 - Minimize engineering changes in the field
 - Quick implementation and validation
 - Reuse the existing support systems
 - 60 month MTBF Target
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- Targeted the optimization of the existing seal configuration for detailed analysis.



Optimization Process

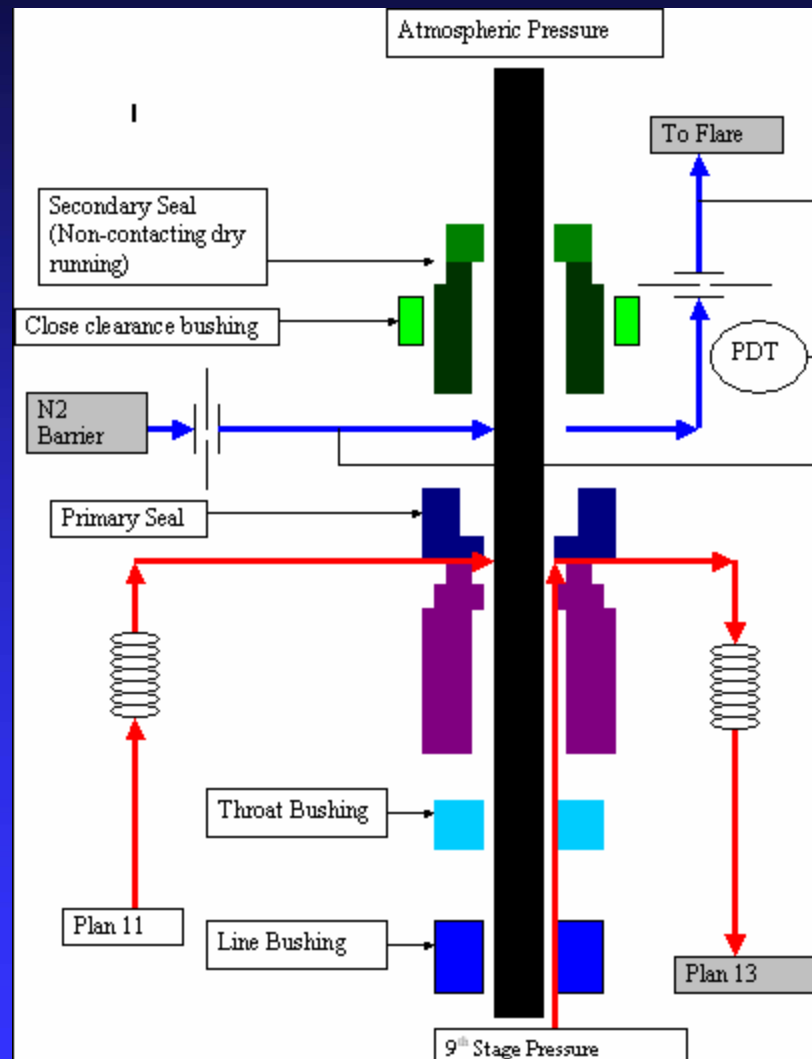
- Seal performance parameters
 - ◆ Changes in flush configuration
 - ◆ Balance ratio changes
 - ◆ Stuffing box pressure changes
 - ◆ Flush flow modifications
 - ◆ Face geometry changes
 - ◆ Additional FEA analysis to validate heat generation and face distortion



Proposed Solution

- Primary seal
 - ◆ Face Geometry Change
 - ◆ Balance ratio reduction
 - ◆ Optimized flush distribution for cooling
- Non Contacting Secondary seal
- Intermediate bushing
- Changed Flush Plan
 - ◆ Reduced stuffing box pressure by orifice change in Plan 13 (seal gland to suction)
 - ◆ Added Plan 11 to increase flow
 - ◆ Incorporated Pressure reducing coils

NEW SEAL DESIGN



Performance Parameter Comparison: Old/New Seal

SEAL DESIGN ANALYSIS SUMMARY (Steady state- hydropadded area)

	Avg. Face Temp. F	<u>PVnet</u> (based on average contact pressure) <u>psi-ft/min</u>	Vapor Pressure <u>psig</u>	Face pressure <u>psi</u>	Balance %	Friction heat BTU/h
Old Seal	56.11	443586	780	142	85	4067
New Seal	29.7	314409	458	101	76.5	3599

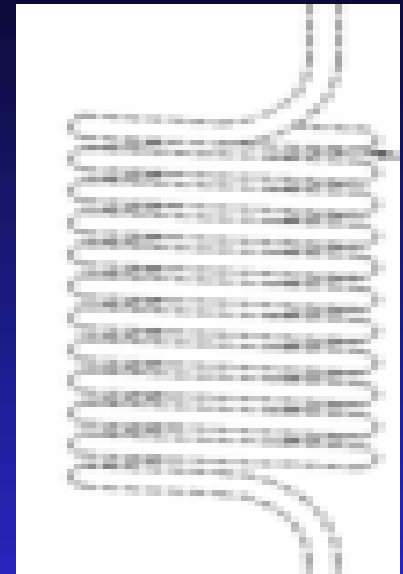


Implementation Plan

- Staged installation
- Validation testing
 - ◆ Leakage Verification
 - ◆ Secondary seal tests
 - ◆ Stuffing Box measurements
 - ◆ Flush flow verification

Implementation results

- Test results on secondary seals
- MTBF to date on the pumps
 - ◆ 3 pumps modified
 - ◆ No removals to date
 - ◆ Lead pump has 28 months
- Trending of leakages.
- Cost was 1/3 of the alternative
- Implementation was fast
- No added complexity





Learnings

- Detailed Engineering Review allowed for a fast, low cost, reliable alternative.