High Temperature Molten Salt Pumps

Presented by

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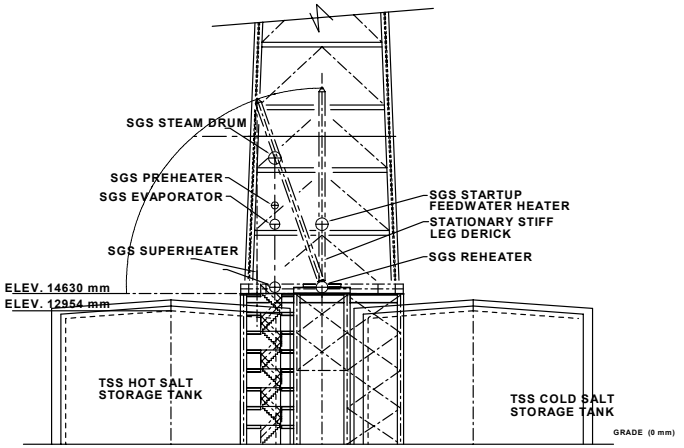
Pumps Mounted in the Tanks Would Greatly Simplify the Molten-Salt System

- Eliminate the pump sumps, control and shut off valves, level instrumentation and associated heaters
- Reduce heat loss
- Allow the steam generator system to drain directly into the tanks
- Sandia National Laboratories teamed with Nagle Pumps to develop a long-shafted salt pump as part of the DOE Concentrating Solar Power Program



Desirable characteristics of bearing materials:

- Non-galling
- Low corrosion
- Easily machined
- Low cost

Types Of High Temperature Pumps

Vertical Cantilever Pumps: Up to 6 Feet in Setting

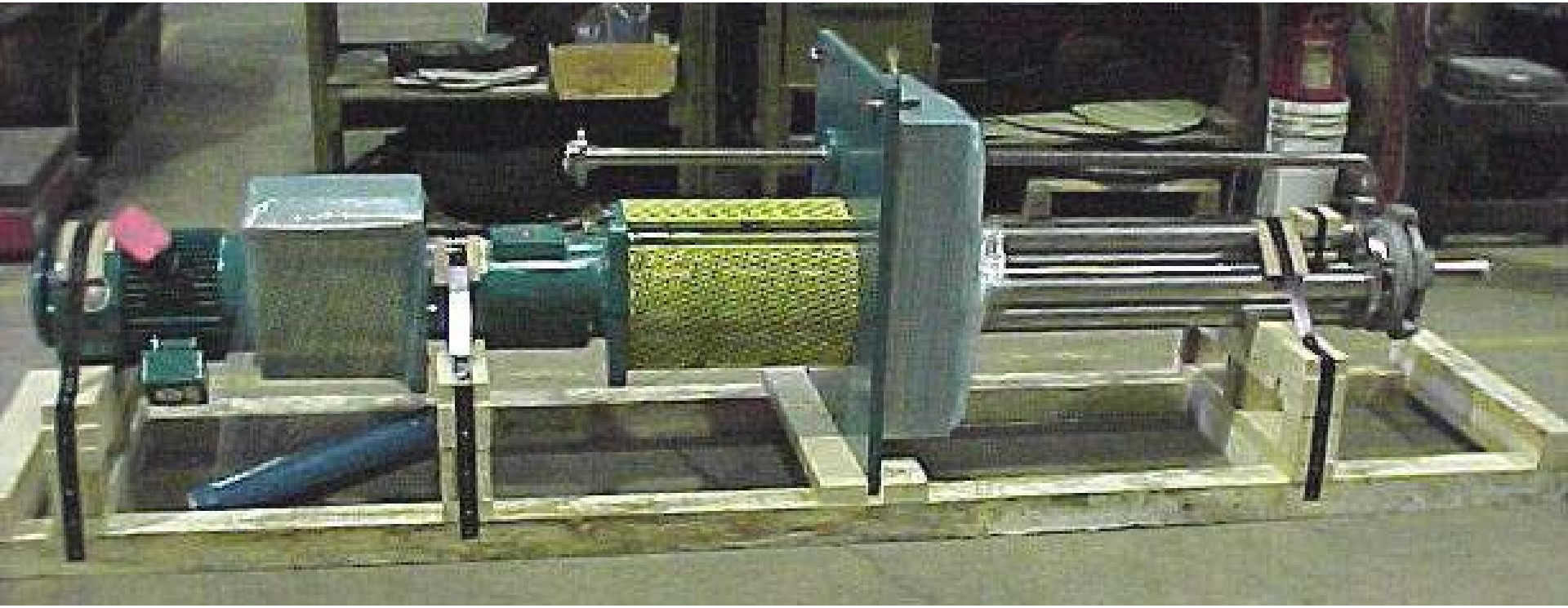
Limited Flow and Heads

Vertical Submerged Bearing: Up to 50 Feet in Setting

High Flow / High Heads

High Flow / Low Heads

High Temperature Cantilever Pump



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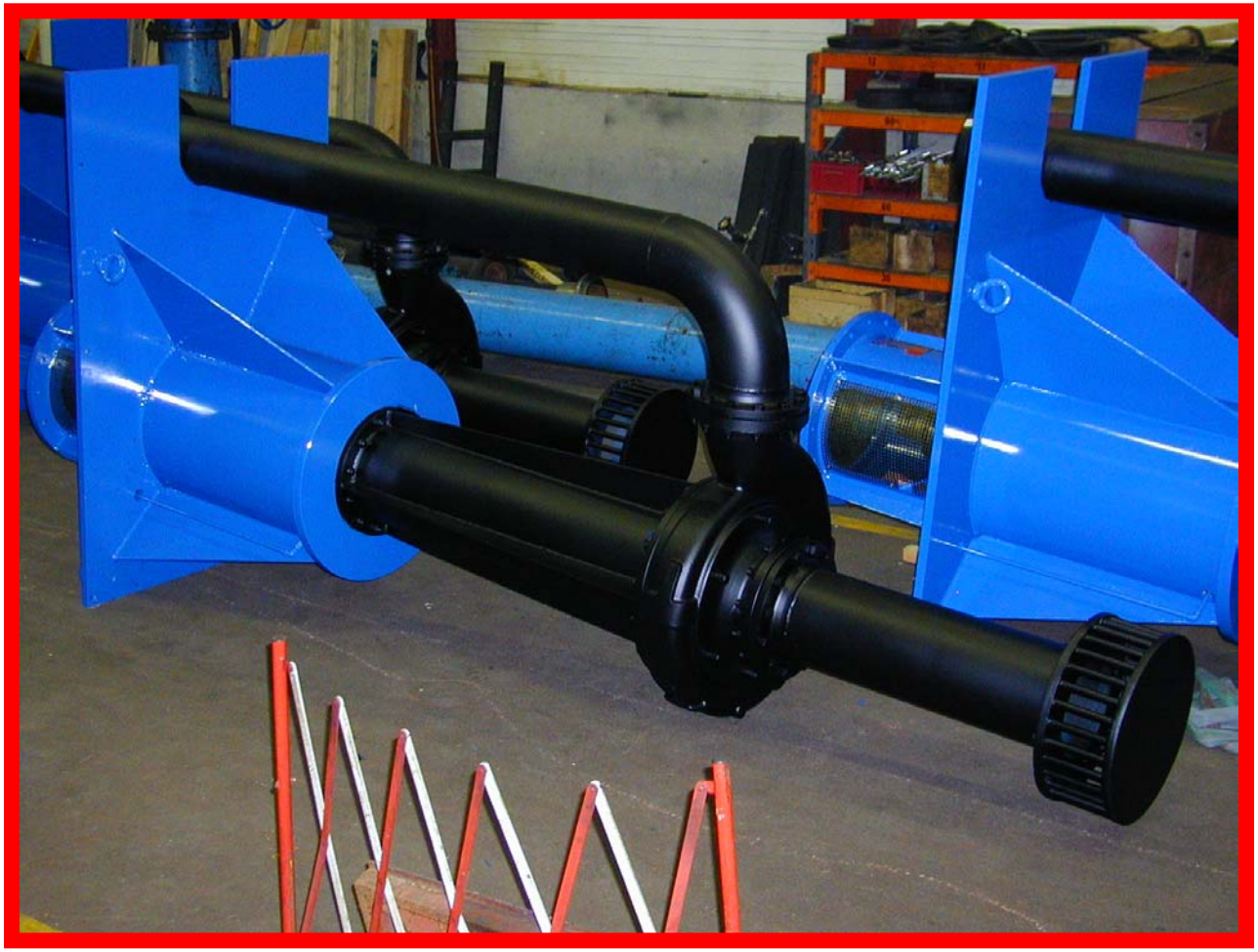
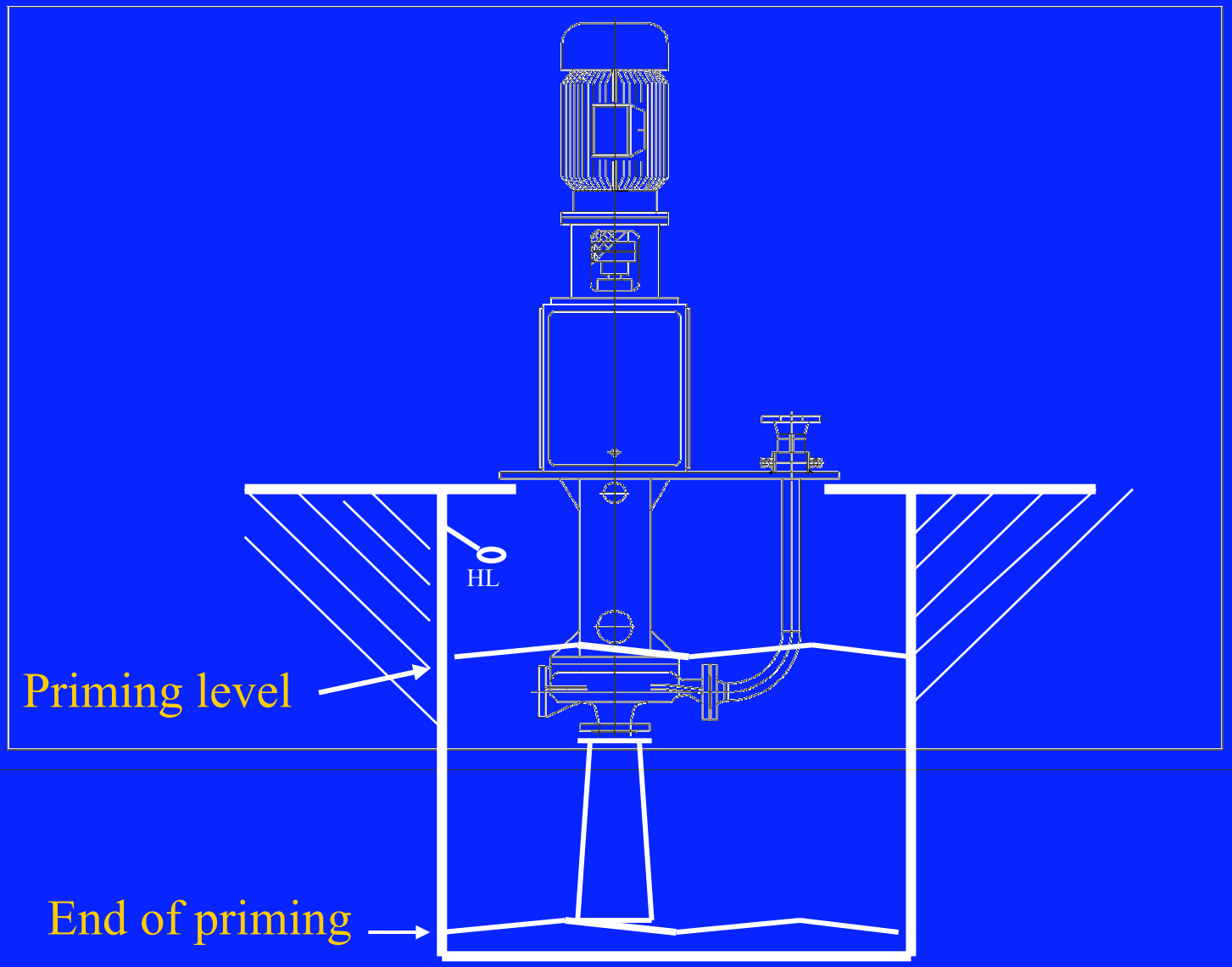
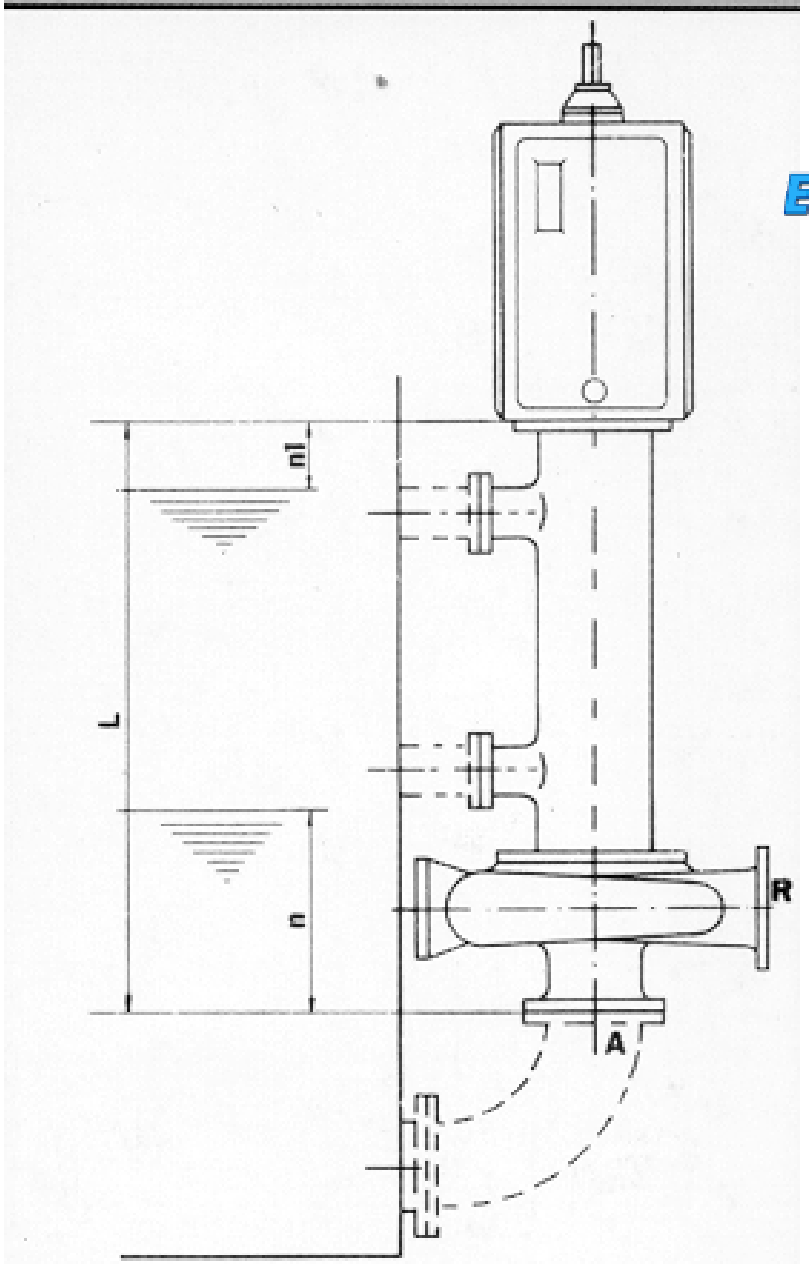


VAP - The limits





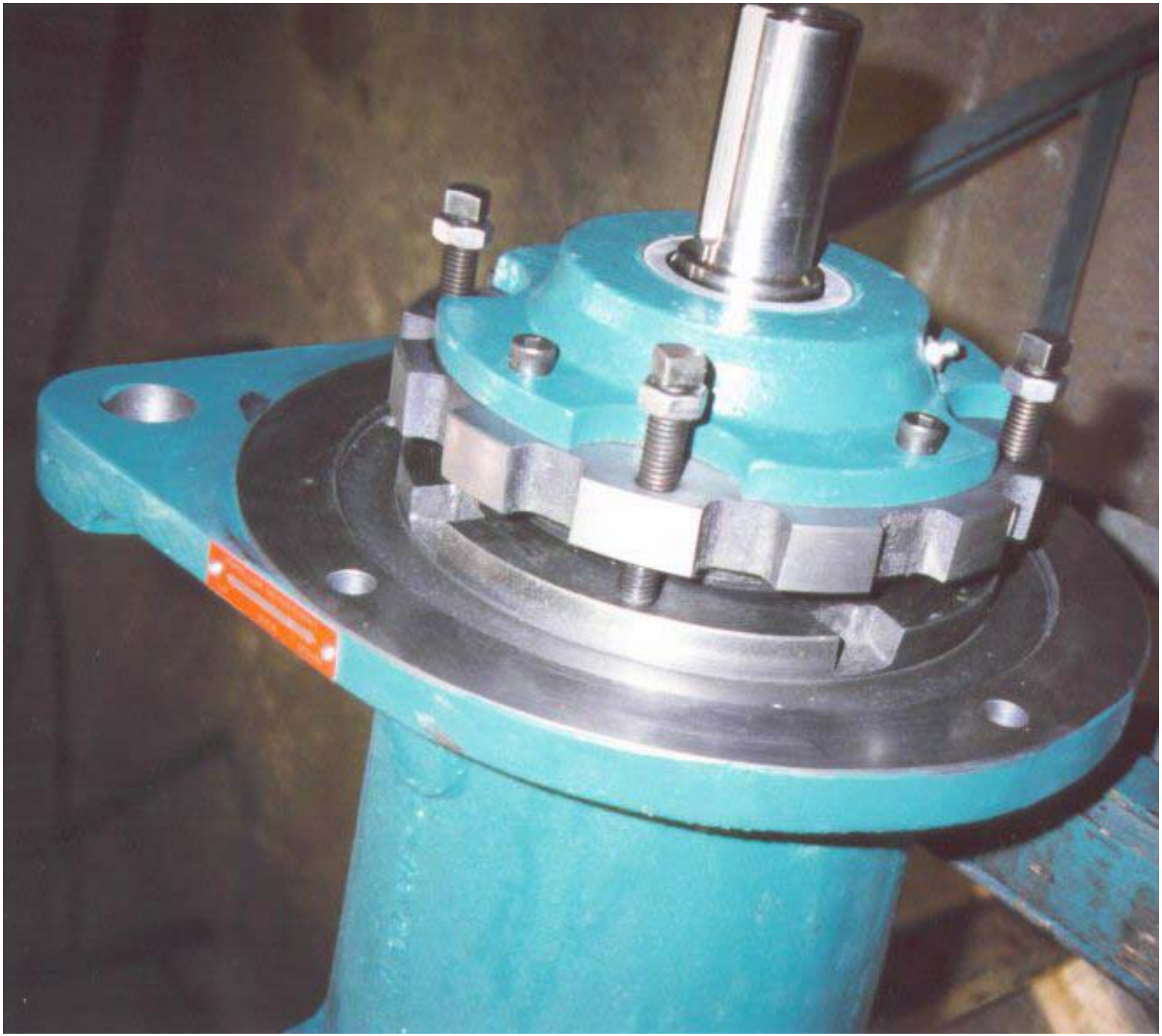
External Mounting

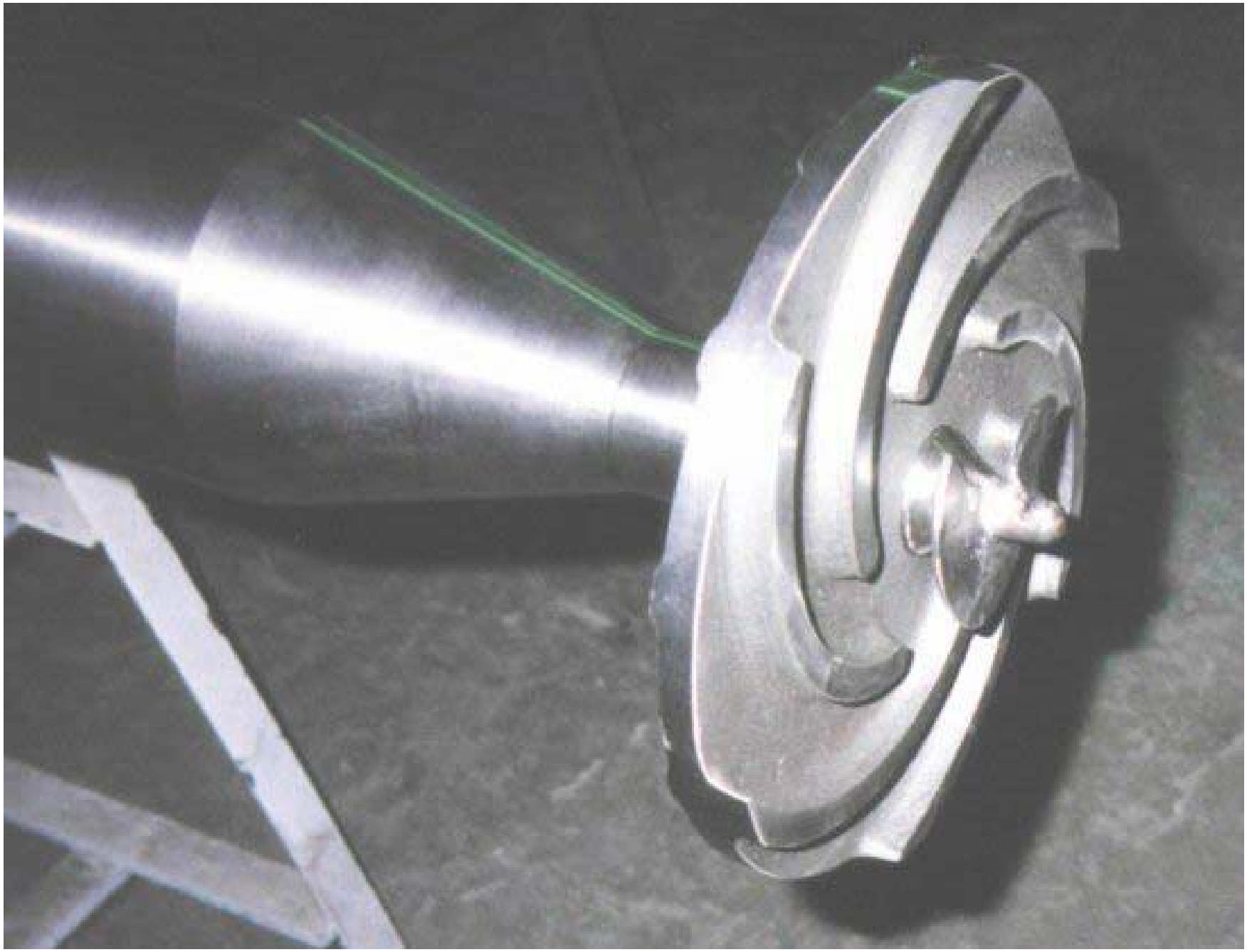
Special Features

Apply to both Vertical Cantilever Pumps

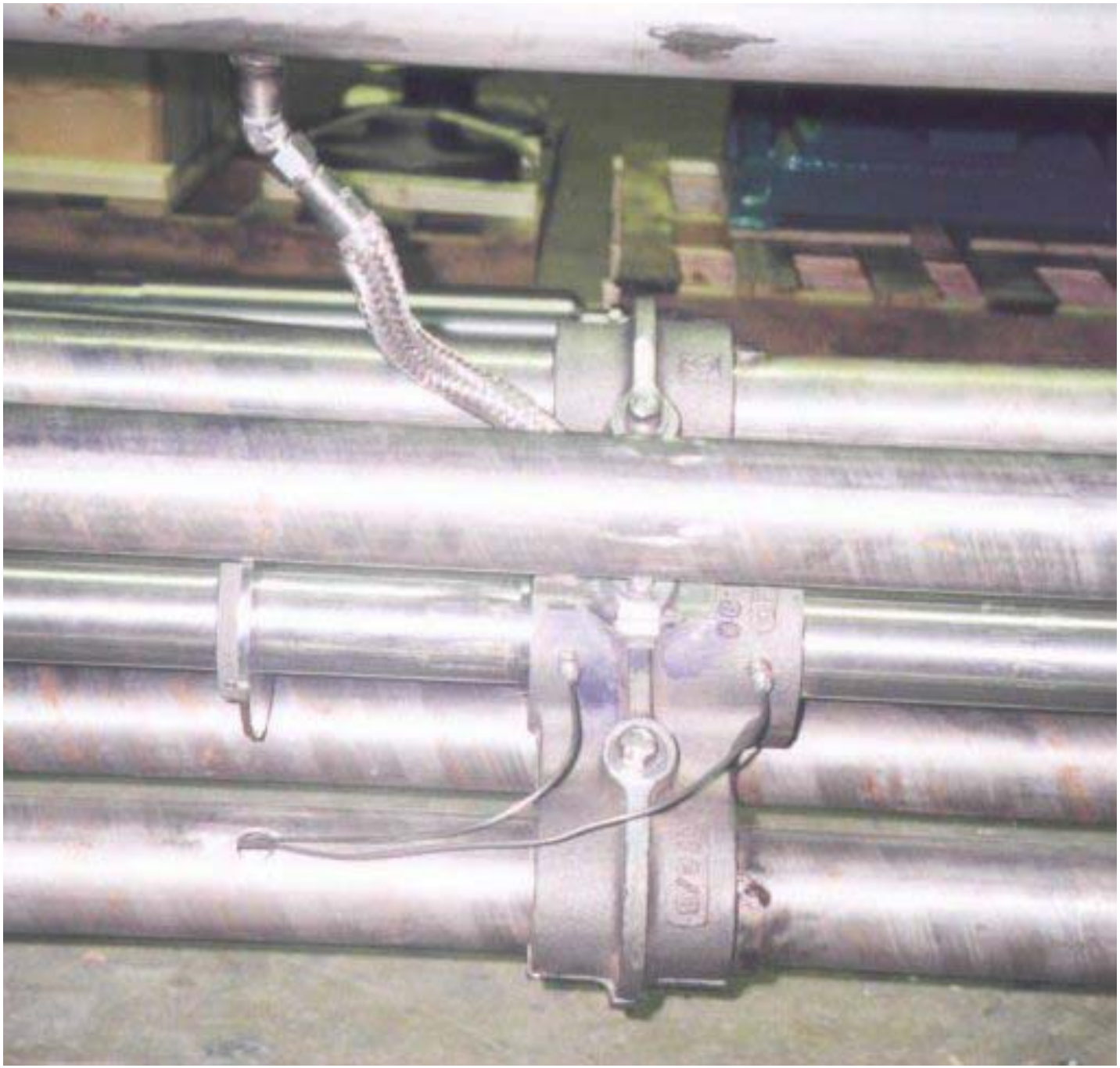
and Vertical Submerged Bearing Pumps

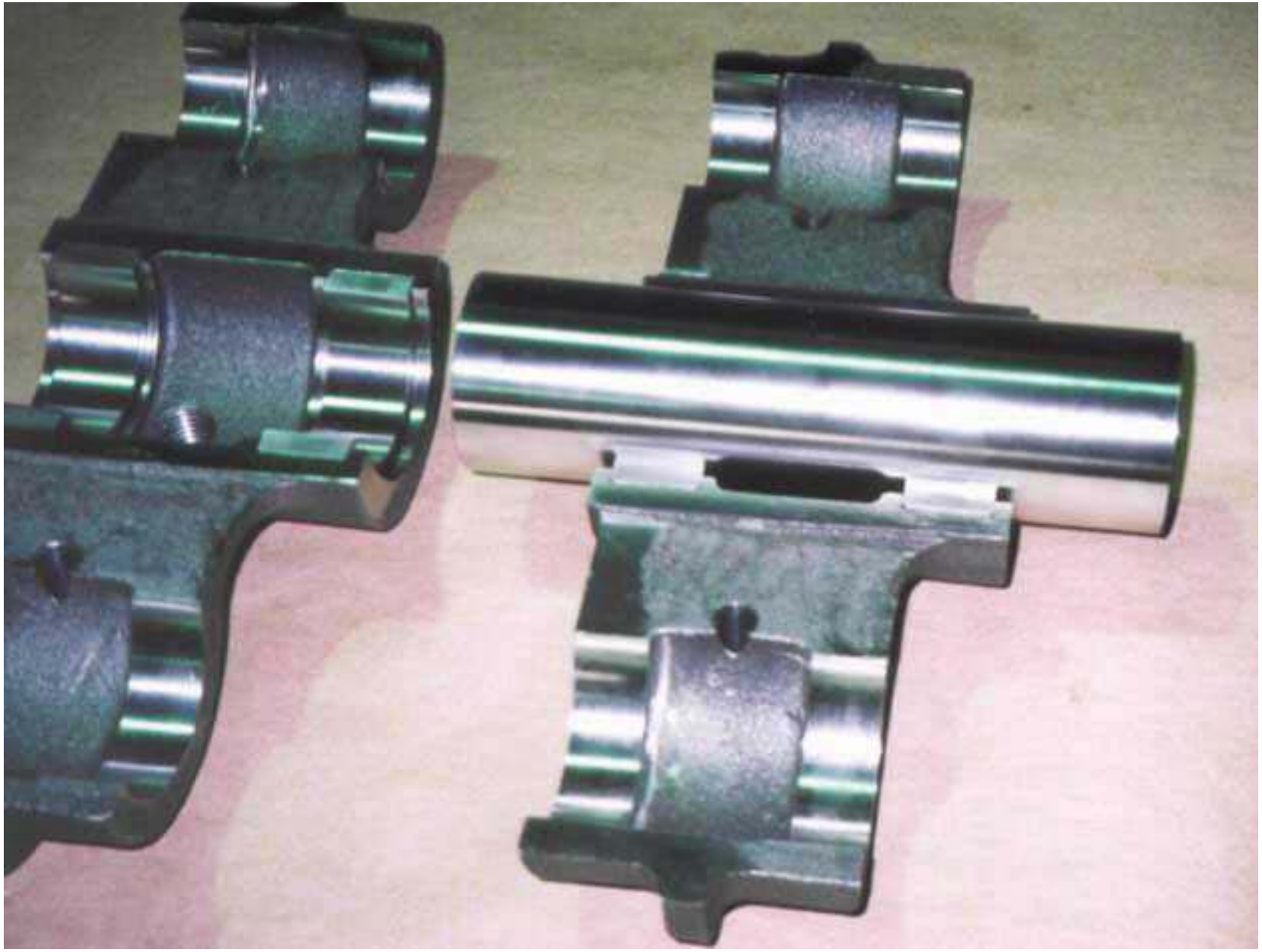
- **Impeller Adjustment From the Top of Tank**
- **Spacer Pedestal to Keep Heat From Thrust Bearings**
- **No Thrust Loads Transmitted to Motor**
- **Labyrinth Cap Seal**
- **Internal Pressure Relief of Pumpage**
- **Inducers**





Long-Shafted Pump





Validation Testing

Complete validation of a High Temperature Molten Salt Pump will insure the end user a proven system that is highly reliable. By utilizing the test stand, molten salt tank and instrumentation that was used for testing the Long-Shafted Pump, the cost could be reduced greatly.

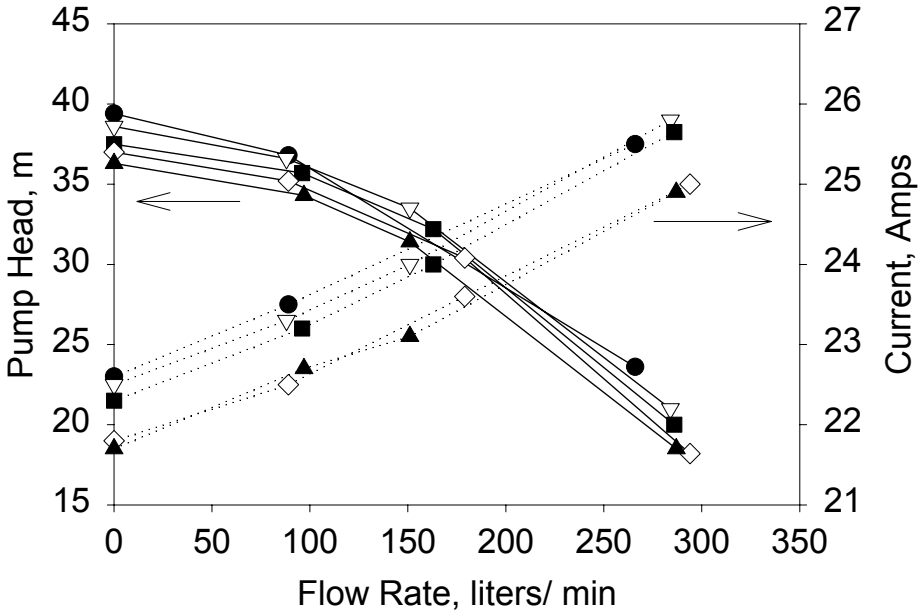
A comprehensive testing program must be developed and approved by all major parties, both in the private sector and DOE.

Tests Conducted at Sandia

- Characterize the pump, simulate operating modes and operated the pump for extended time periods
- Pump head versus motor current as a function of flow rate (at 345, 400, 455, 510 and 565 deg C)
- Simulate the typical nightly shut down, drain and dry startup with a salt temperature of 565deg. C and the valve open 19%
- Endurance test: 7 hours on, 1 hour off continuously around the clock at full flow at 565 deg C.

Test Results

- Pump curves matched design specifications
- Pump operated for over 5000 hours
- Measurements before and after showed there were no vibration problems
- After all testing was completed, the pump was disassembled, bearing and sleeve were inspected and dimensions were measured
- All bearings and sleeves were reusable, only requiring polishing of the surfaces



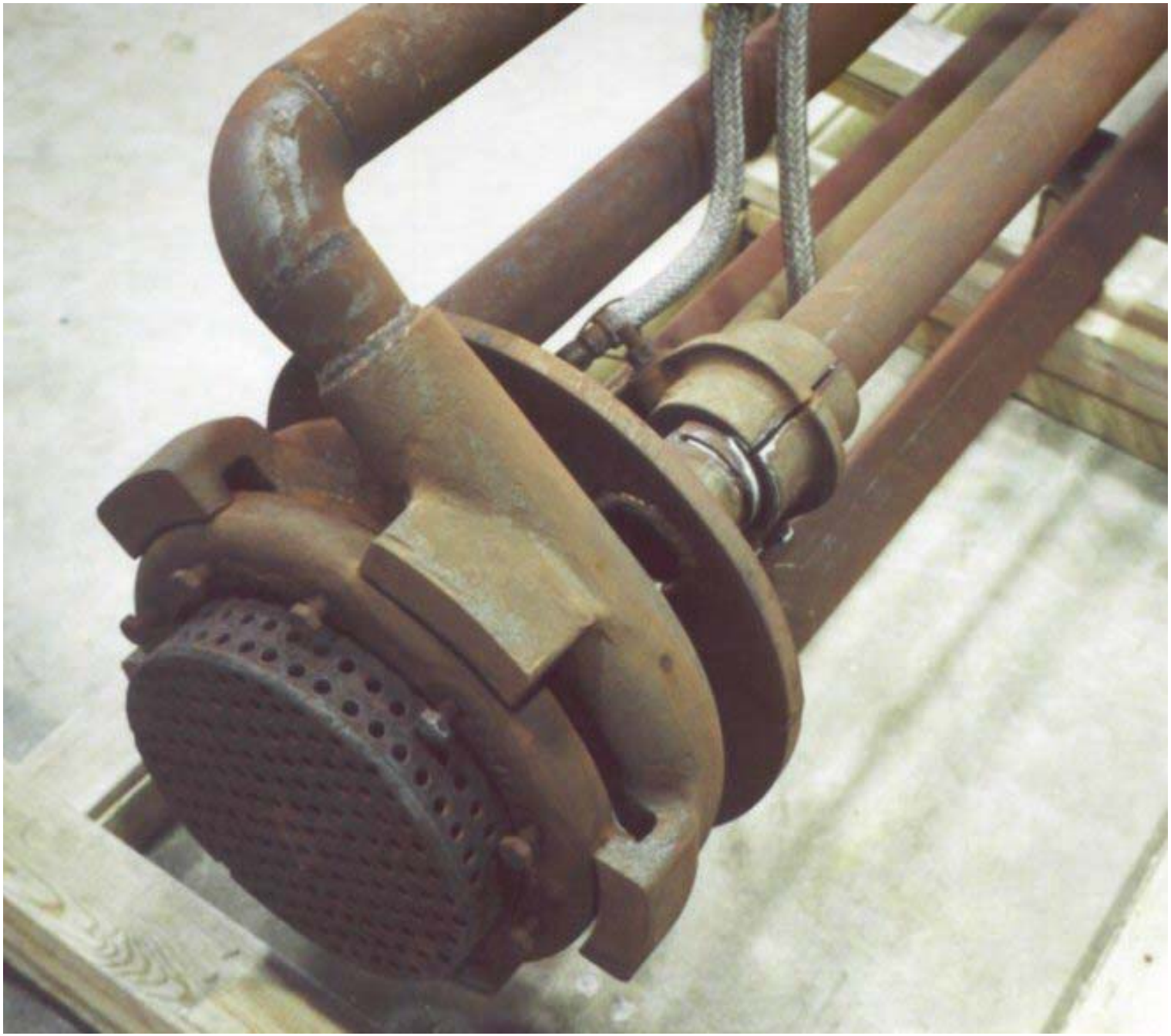
Disassembly and Handling

~ It is critical for these units to be able to be rebuilt.

~ The design must be simplistic in order for the pumps to be rebuilt.

~ Minimum parts must be required for rebuild.

~ Maximum life between rebuilds must be obtained.



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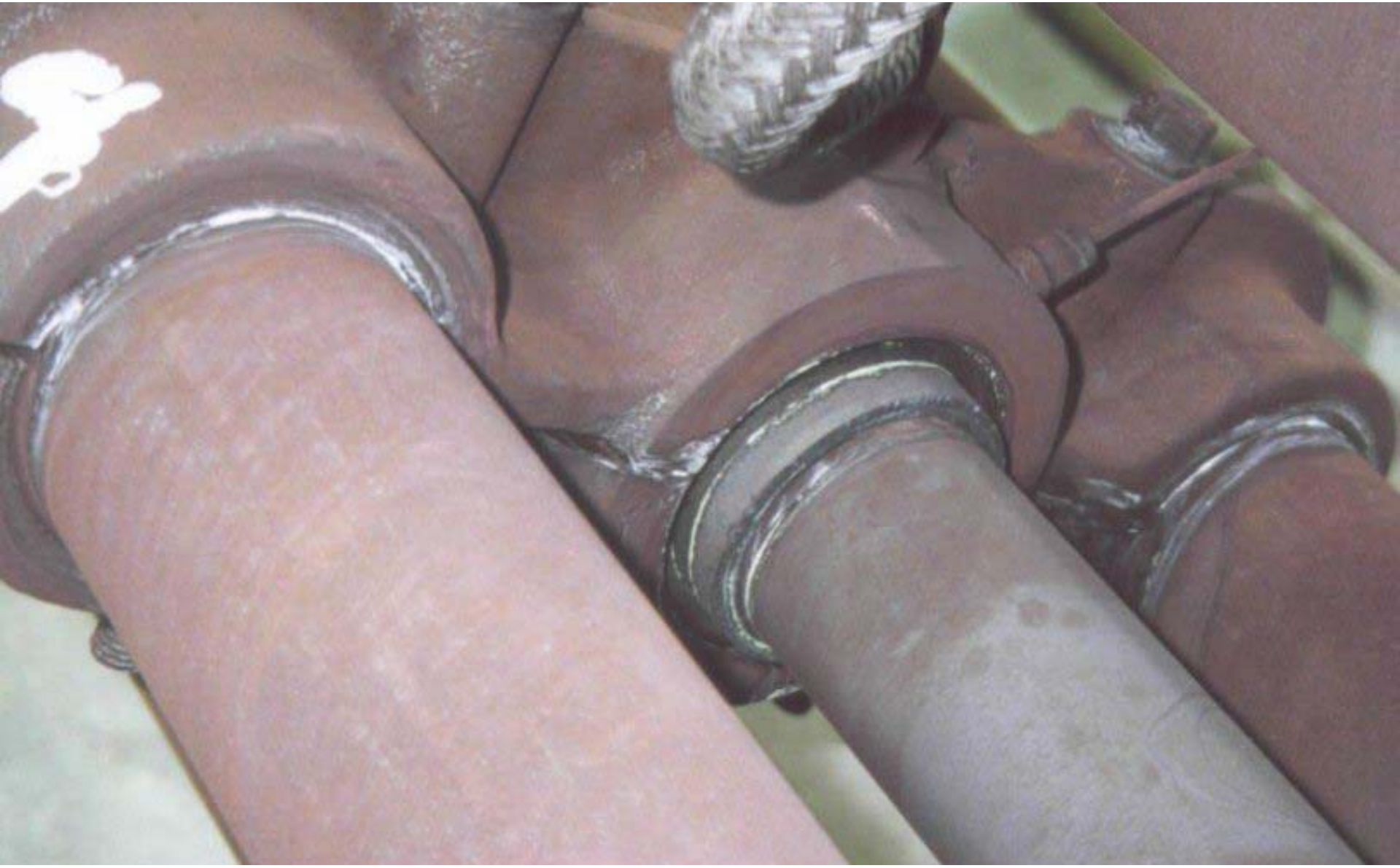
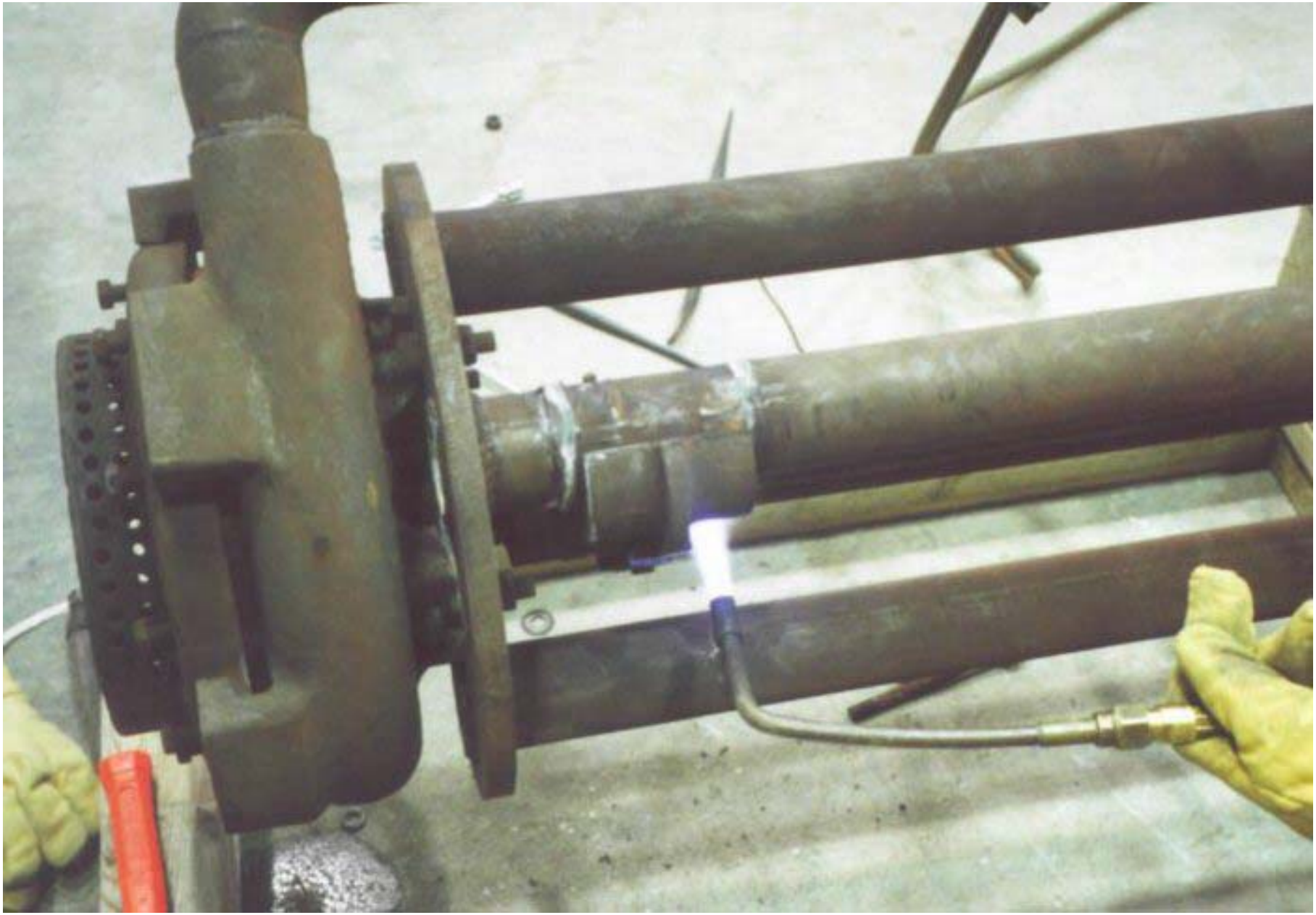
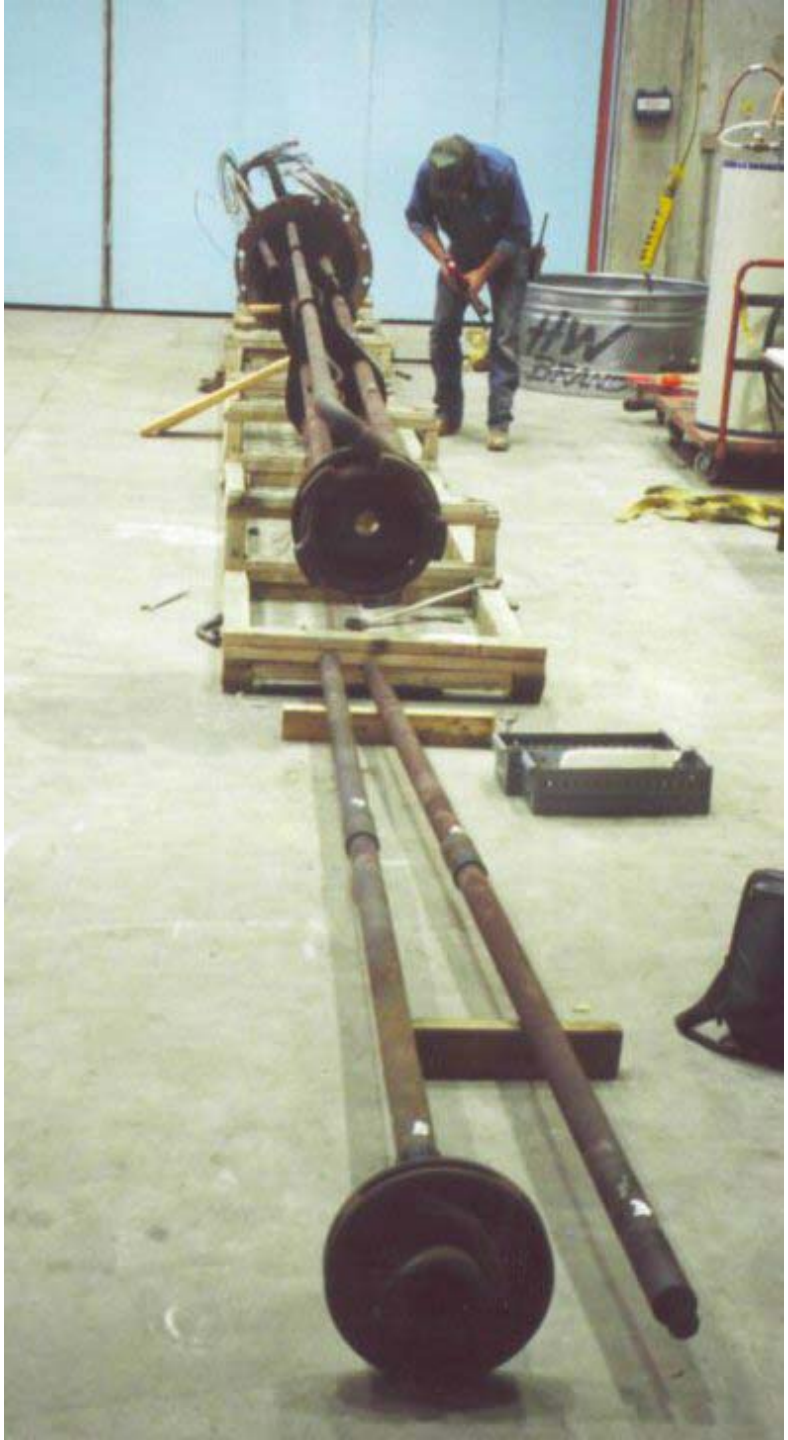


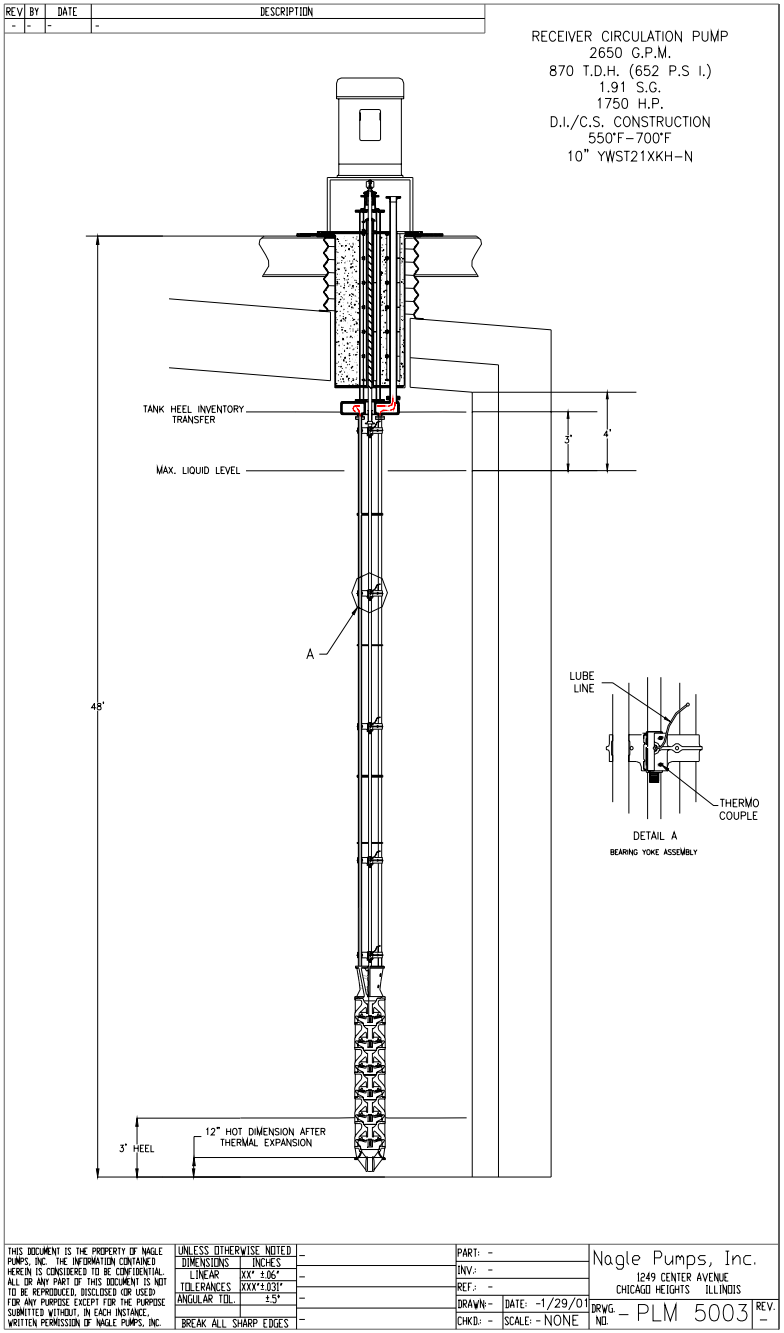




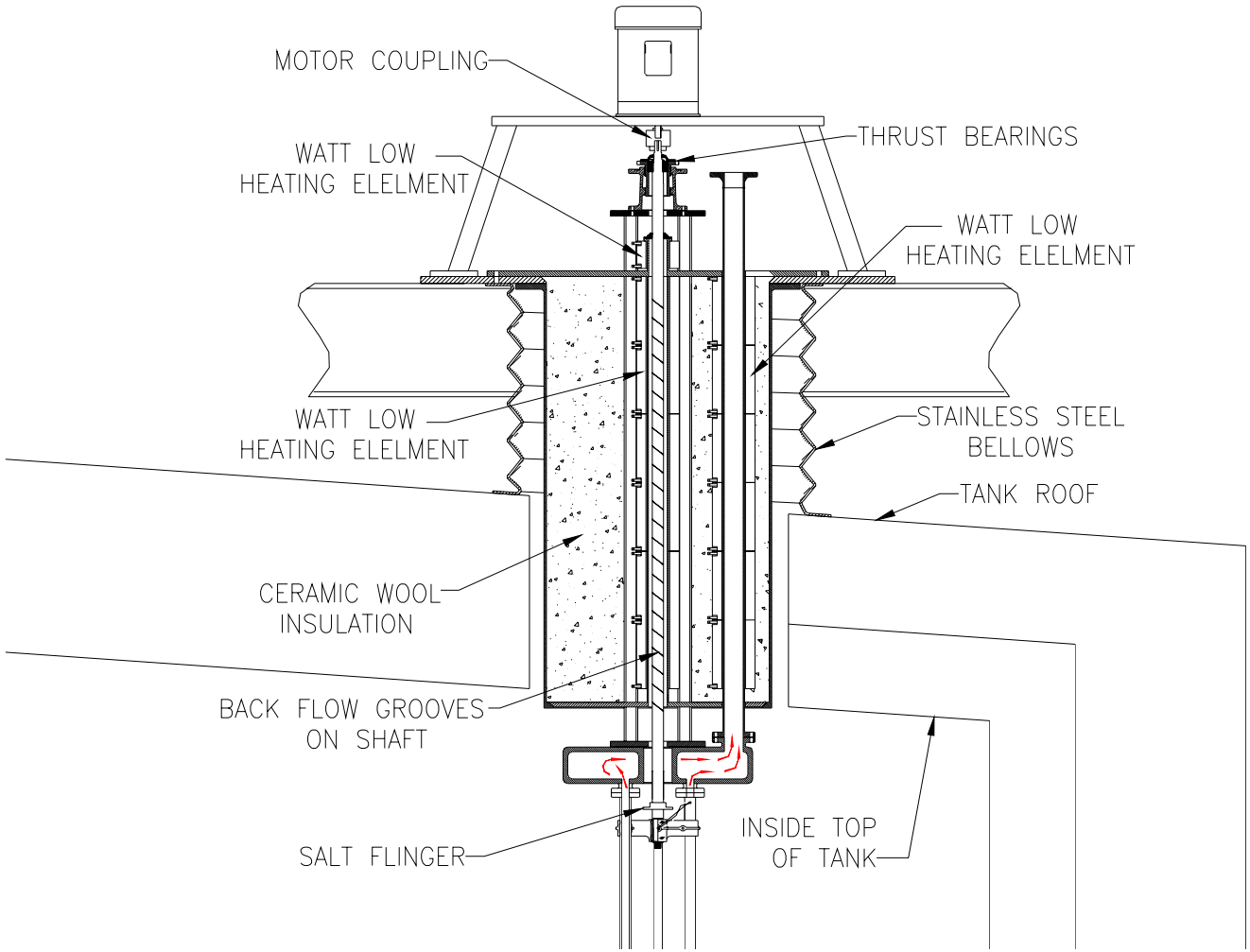
Implications of the Results

- Pump lengths of 15 m can be commercially built for mounting above the storage tanks in a molten salt power tower.
- Heat loss will be reduced by 10 to 20% over the previous design because the pump sumps, valves, and interconnecting piping will be eliminated. The capital cost of the storage system will be reduced as well.
- This pump design can also be used in parabolic trough plants that use molten salt thermal storage.

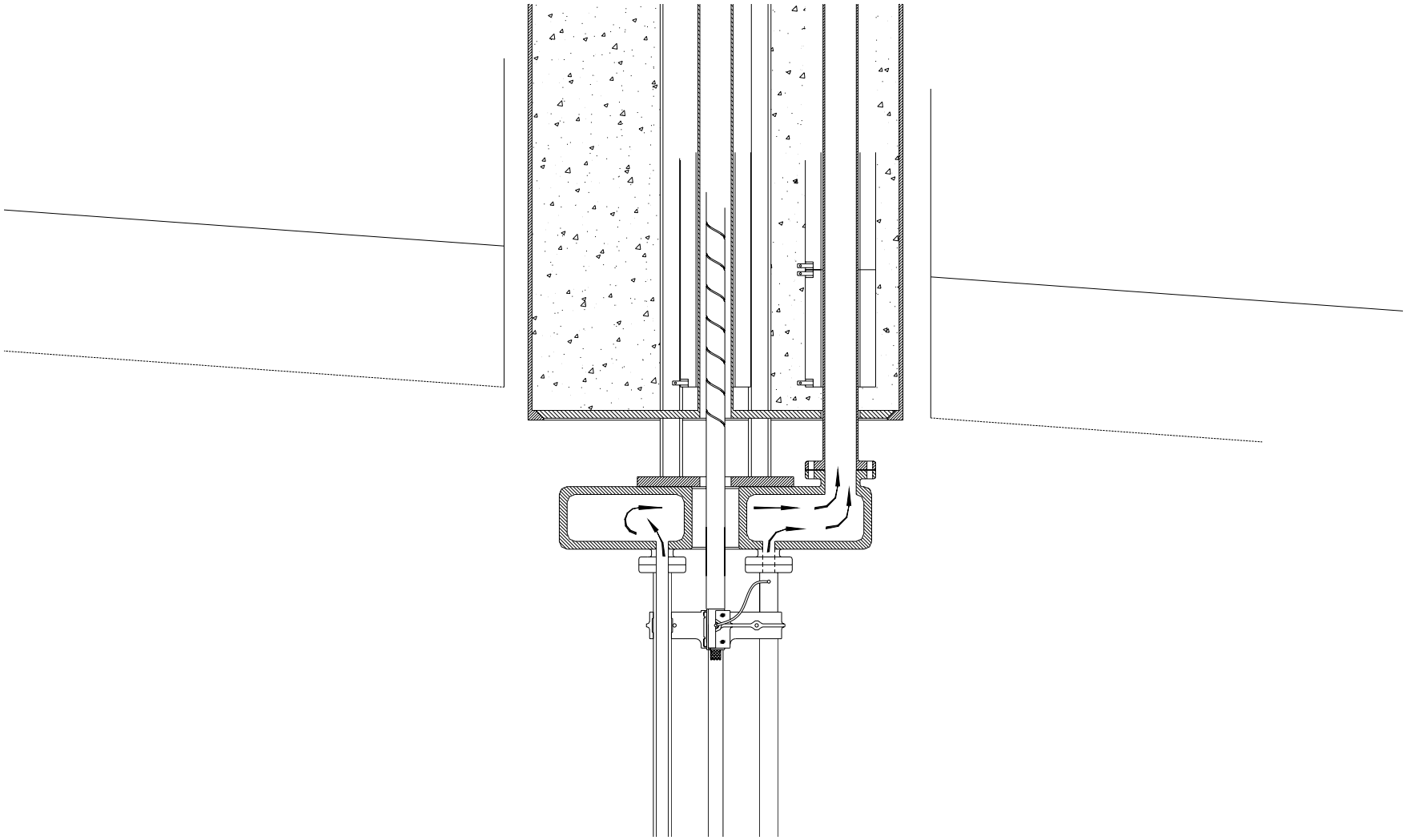
Vertical Submerged Bearing Pumps up to 50 Feet will be the most cost effective approach.



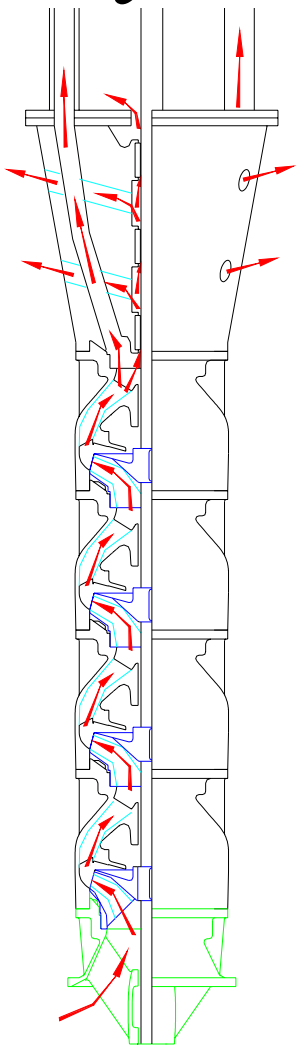
Details of Sealing Area on top of tank



Discharge Ring



Bowl Assembly and Hydro Seal



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