

WORLD-CLASS OUTSTANDING INTERNATIONAL  
PROGRAM | EXHIBITION | NETWORKING

# CASE STUDY: IMPROVING PUMP RELIABILITY AND LONGEVITY BY RUNNING IN THE SWEET ZONE

By:

Joseph A. Silvaggio, Jr.

Siemens Demag Delaval Turbomachinery, Inc.

Carolyn B. Smith

Siemens Demag Delaval Turbomachinery, Inc.



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29<sup>th</sup> Pump SYMPOSIA



# Problem Statement

Current boiler feed pumps are reliably running 5 to 7 years. How can their reliable running time be extended to 10 to 14 or more years?



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# What is the “Sweet Zone”?

The “sweet zone” is the area or zone of pump performance curves which is not susceptible to hydrodynamic instabilities that can shorten the pump lifespan and therefore, permits long term, trouble free pump operation.



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# Case Study Outline

- Pump Description
- Background
- Test Curves
- Test Curve Interpretation
- Types of Failures to be Avoided
- Performance Curve Areas to Avoid
- Developing the “Sweet Zone”
- Conclusions



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# Pump Description - Pump Type

The type of pump for this case study is a high speed, turbine driven boiler feed pump in a 500 to 600 megawatt power plant using two 50% pumps to supply the boiler.



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# Pump Description - Design Parameters

- Double Case Barrel Type
- 4000 to 5000 GPM
- 5000 to 6000 RPM
- 7000 to 8000 FT Total Developed Head
- 10000 to 14000 Horsepower
- Up to 5000 PSIG Discharge Pressure

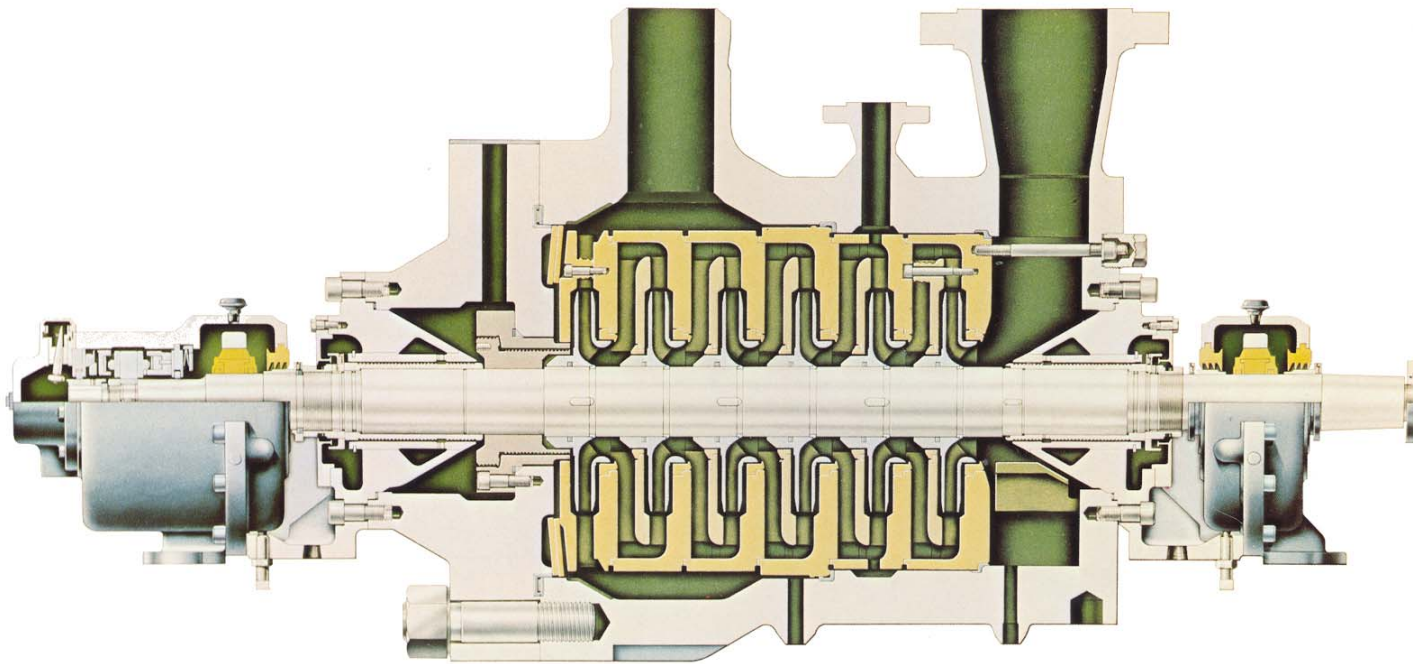


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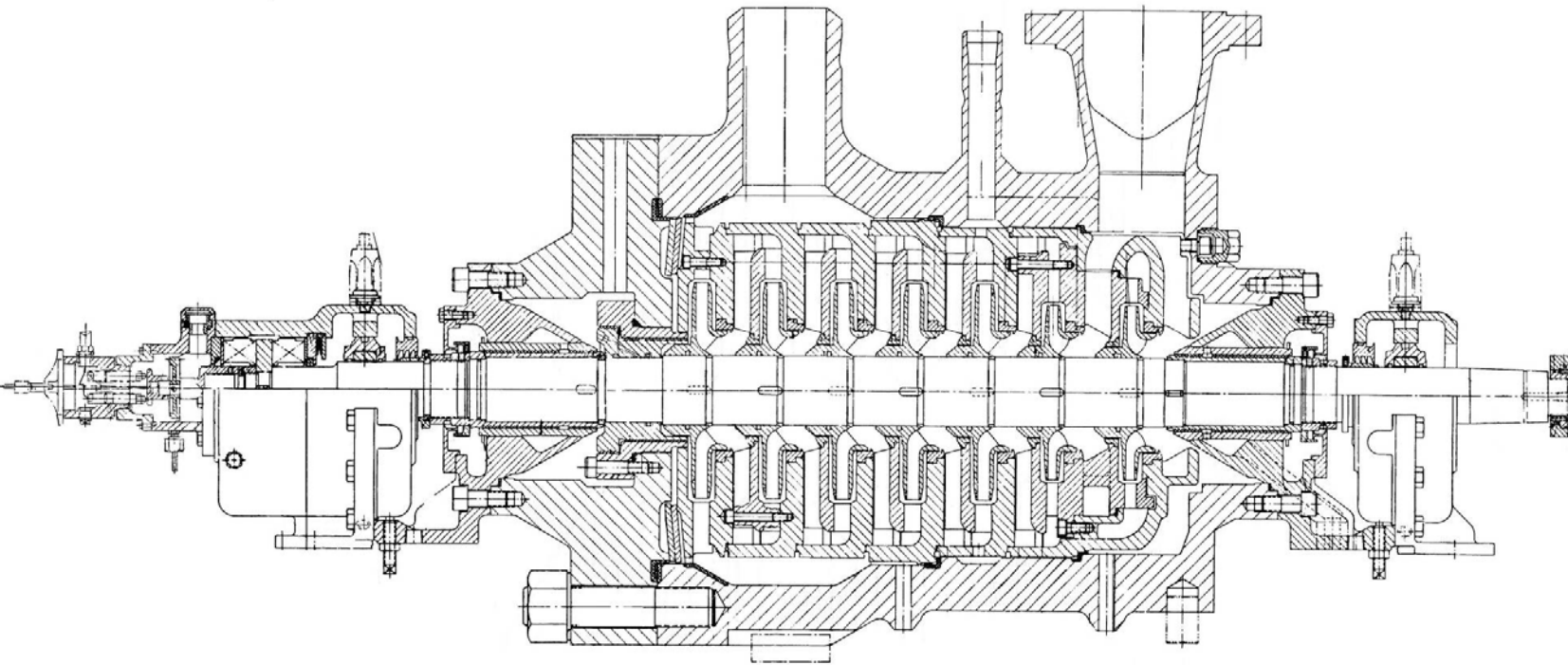
# Background - Pump Assembly (high speed, multistage, turbine driven)



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# Background - Pump Assembly (high speed, multistage, turbine driven)



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# Background - Pump Under Test



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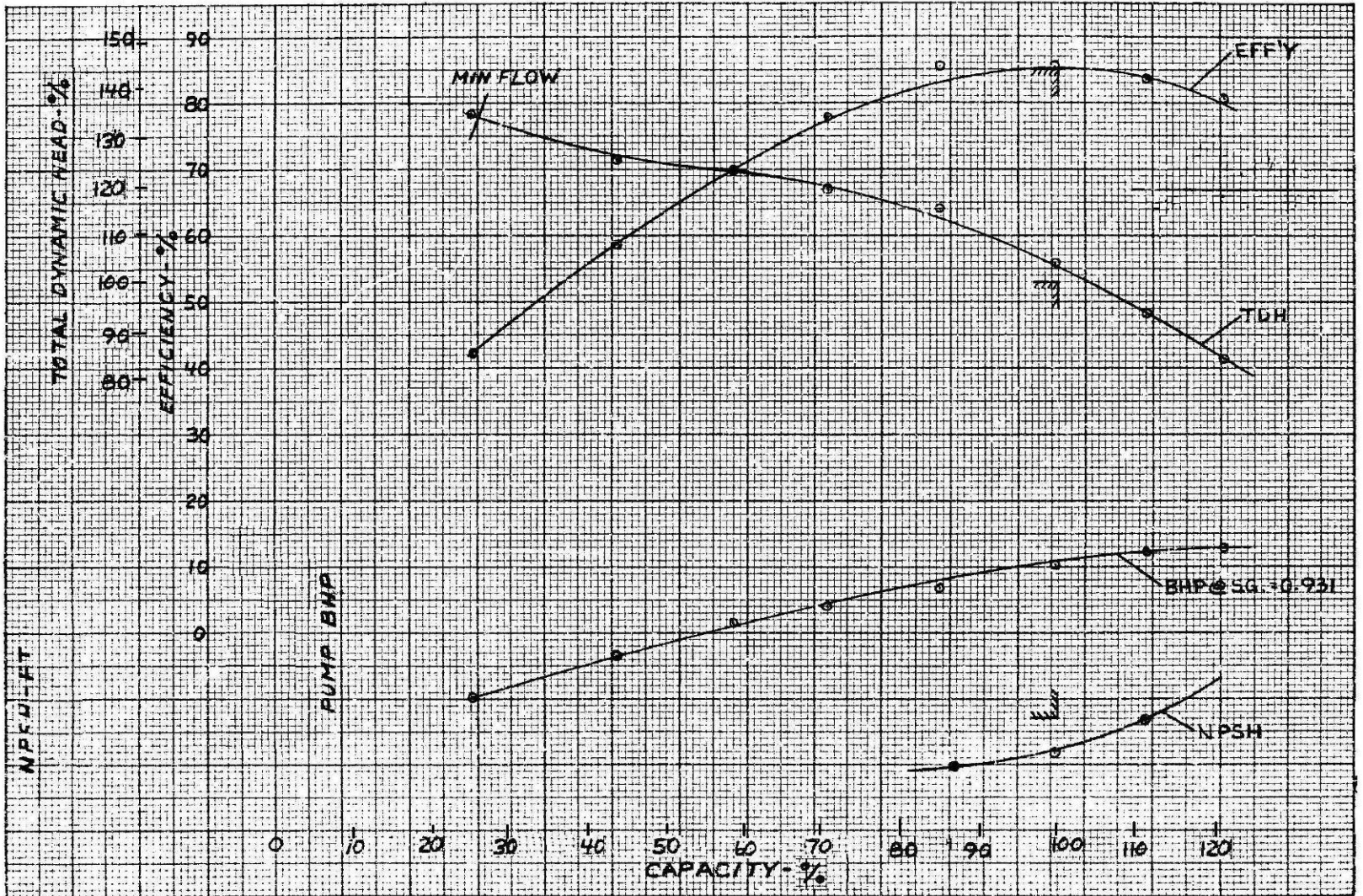
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# Test Curve

ORDER NO. \_\_\_\_\_  
 TYPE \_\_\_\_\_  
 SPEED 5000 RPM  
 SUCTION 278°F  
 DATE 3-6-78

CG NO. \_\_\_\_\_  
 TEST RESULTS OF BARREL TYPE BOILER FEED PUMP  
 FOR: \_\_\_\_\_





# Test Curve Interpretation

- Test curve shape can indicate potential low flow issues.
- Usually, the test curve does not indicate high flow issues within test data for this type of pump.
- Although not observed on this particular pump, an example of a curve shape effect at high flow will be shown.



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# Example Of Another Test Curve Of A Different Pump With Both High Flow And Low Flow Issues.





# Types of Failures to be Avoided

- Performance issues due to increased seal clearance (observed reduced discharge pressure while running at the same speed, reduced efficiency, pressure pulsation, increased vibration).
- Catastrophically failed parts (impellers).



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# An Example Of Failed Impeller (With A & B Gap Modification) That Was Run At Low Flow.



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# Performance Curve Areas to Avoid

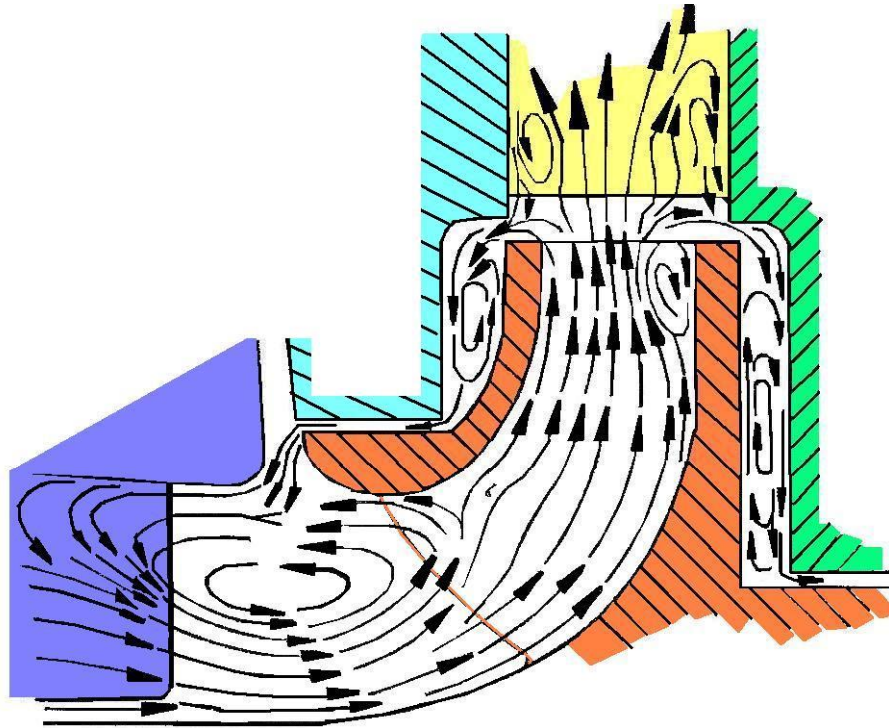
- Low and minimum flow that may cause potential issues.
- Suction and discharge recirculation.
- Resulting pump operation effects from recirculation flows, (pressure pulsations and vibration).



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# Artist Representation of Suction and Discharge Recirculation.



## *Recirculating Flow Pattern in the Meridional Plane of a Centrifugal Impeller.*

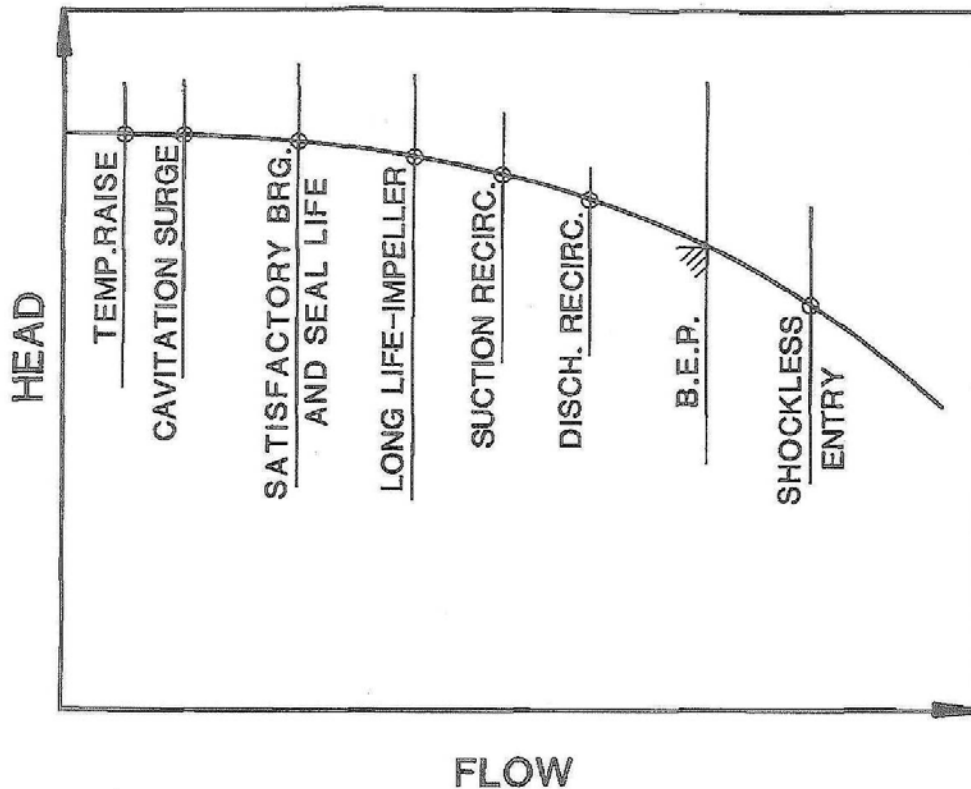
Gopalakrishnan, S., "A New Method for Computing Minimum Flow", presented at 5<sup>th</sup> International Pump Users Symposium, (1988)



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# Where Is Minimum Flow?



*Typical Head-Flow Characteristic of a Centrifugal Pump Indicating Several Important Flow Rates.*

Gopalakrishnan, S., "A New Method for Computing Minimum Flow", presented at 5<sup>th</sup> International Pump Users Symposium, (1988)



# Developing the “Sweet Zone”

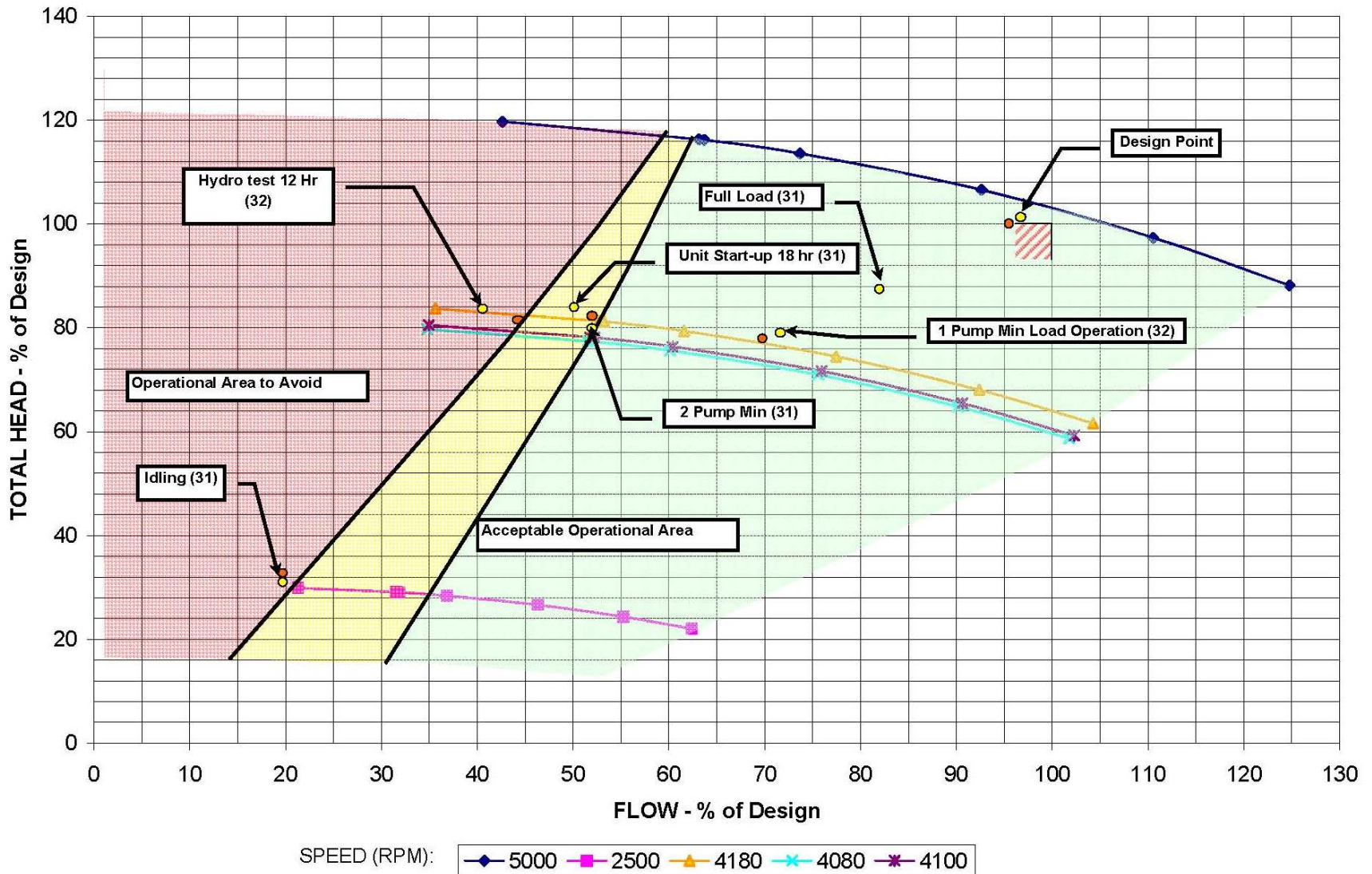
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# Developing the “Sweet” Zone





# Conclusions

- Shop tests can provide insight on areas to avoid.
- The “Sweet Zone” of operation is being successfully applied to boiler feed pumps.
- Although this case study is for a high speed, multistage boiler feed pump, the principles can be applied to many centrifugal pumps.



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