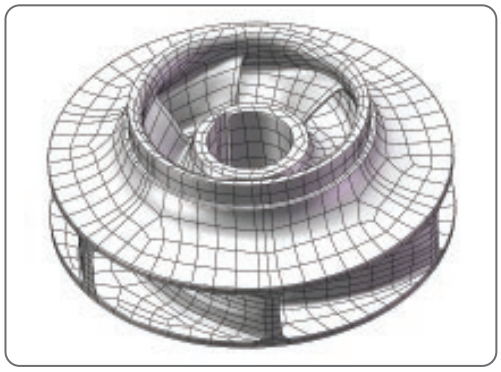
HAYWARD TYLER

ENGINEERING EXCELLENCE
SINCE 1815
200 YEARS

Advanced Scanning and Computational Fluid Dynamic Analysis on Safety Related Impeller

Utilizing advanced scanning and computer analysis to validate performance of impellers from repaired pattern

Hayward Tyler supplied a replacement impeller for use in a Nuclear Safety Related Component Cooling Water application within a nuclear power plant. The original equipment was supplied in the early 1970s and the original pattern used to cast the impellers had been subject to degradation through the years. In order to validate the pattern repairs and avoid large-scale performance testing, Hayward Tyler used computer modelling and analysis to validate the refurbished pattern and impellers produced from it.



Impeller model produced from scanning

The refurbished pattern was used to pour a new impeller that was machined complete to the original drawings. The impeller was dimensionally inspected and then sent to Shape Fidelity, an industry leading inspection company, to create a 3D Computer Aided Design (CAD) model. Traditional 3D scanning of impellers can be difficult, given the sweeping vane geometry and blind internal surfaces. This can require the CAD modeler to interpolate geometry that cannot be scanned in the center of the hydraulic passage, causing differences between the model and actual impeller geometry. Given the importance of the entire hydraulic passage to generate the required duty, a new proprietary technique was used to scan the entire passage and create the model. This new technique is non-destructive, and provides data for all surfaces.

Hayward Tyler engineers combined the 3D CAD model with the pump case model and other key features of the original pump to create the entire fluid body, which was then exported to be analyzed using Computational Fluid Dynamics (CFD) software. They used their NQA-1 Commercial Dedication Program to validate the CFD software. The results of the CFD were compared to the original test pump curves and proved that the finish machined impellers, based on the pattern modifications, would meet the original contract requirements.

The entire process, from the start of scanning to completed and validated CFD results, took less than 2 weeks. This new approach can be used to validate pattern changes, reverse engineer existing equipment, or upgrade existing equipment, all without the need to performance test.

Project Summary

SITE / LOCATION:

USA

SCOPE OF WORK:

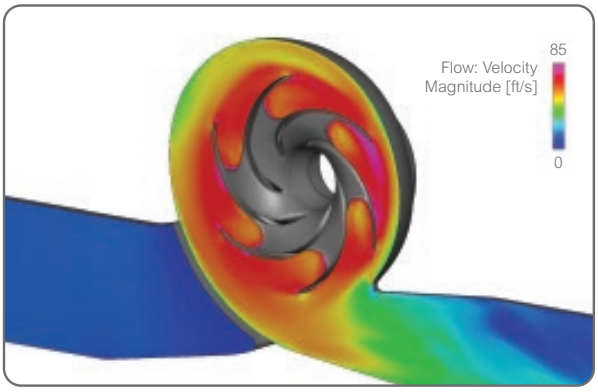
- → Refurbishment of a legacy impeller pattern
- → Finish machined impeller produced from refurbished pattern
- → Advanced scanning techniques to produce CAD model of actual impeller
- → Computational Fluid Dynamics (CFD) analysis using Simerics PumpLinx®
- → NQA-1 Commercial Dedication of CFD Software
- → Validated modifications to pattern by comparing CFD result to original test curves

BASIC PUMP DESIGN DETAILS:

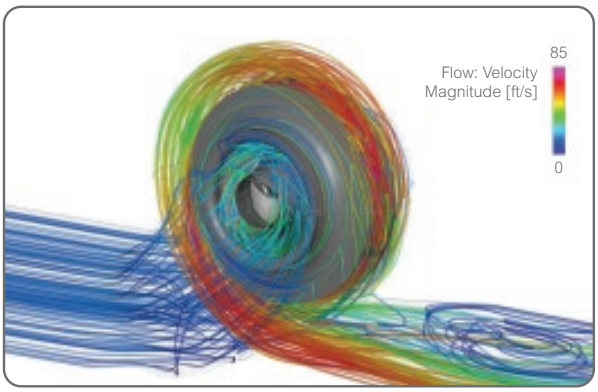
- → Type D, Horizontally split case, double suction pump, 8x10x16 DI
- → Rated Flow: 3500 gpm
- → Rated Head: 179 ft
- → Design Pressure: 150 psi
- → Design Temperature: 160° F
- → Driver: AC Motor, 200 hp, 1800 rpm
- → Power Supply: 4000V/3ph/60Hz

Project Pump Data Sheet

Product	Component Cooling Water, Double Suction Pump	
Quantity	8	
Codes and Standards		
Design	ASME Section III 1971 Class 3 Winter Addendum 1971	
Flange Standard	ANSI B16.5	
Materials Standard	ASME / ASTM	
Nozzle Loading	Customer defined	
Pump Details		
Pump Type	10" Suction x 8" Discharge with 16" Double Suction Impeller	
Fluid Pumped	Demineralized Water	
Operating Temperature	160° F	71° C
Rated Flow	3500 gpm	795 m3/hr
Specific Gravity	1.0	
Rated Head	179 ft	55 m
Design Pressure	150 psig	10 bar
Design Temperature	160° F	71° C
Impeller Material	ASTM A216 WCB	
Pump Case Material	ASME SA216 WCB	
Motor Details		
Motor Rating	200 HP	150 kW
Service Factor	1.25	
RPM	1800	
Power Supply	4000 V / 3 ph / 60 Hz	
Weights (Approximate dry)		
Rotating Element	380 lbs	172 kg
Pump	1500 lbs	680 kg
Pump and base	3950 lbs	1792 kg



CFD model sectioned, showing velocity magnitude



CFD model showing impeller and velocity streamlines

Impeller pattern

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