HAYWARD TYLER

ENGINEERING EXCELLENCE SINCE 1815 200 YEARS

Engineered Pump Assists Nuclear Plant Life Extension

Hayward Tyler custom designed a pump for the existing footprint whilst allowing a lower discharge pressure

A North American nuclear power plant needed to reduce their service water system pressure to allow them to continue to use buried pipework as part of their life extension plans. This required a change out of their service water pumps. These pumps are vertical, multistage turbine pumps. The replacement pumps were required to fit within the existing footprint and mate to the existing interfaces while hitting multiple performance requirements. Additionally, they were limited to a specified shut-off head to ensure the system didn't exceed its new maximum pressure. This required a custom pump design, including a customized hydraulic end.

Hayward Tyler engineers used existing nuclear pump design features as a base and customized a new hydraulic end. The pump curve was required to have a continuous rise towards shut-off (and a max shut-off head value) while also hitting multiple performance requirements at both full speed and slip adjusted motor speeds. Hayward Tyler's hydraulic engineers were able to achieve these characteristics utilizing a two-stage design. The pump design was created using CFturbo and then analyzed using PumpLinx. This included hydraulic performance, flow stability, NPSH and bearing loading (radial and axial) analyses. The performance was validated during factory testing at Hayward Tyler's facility.

These pumps were classified as Seismic Class 1 and "Safety-related" requiring to be operated during normal and emergency shutdown, post-accident shutdown, hot stand-by, refueling and other special events. Hayward Tyler engineers performed all the necessary ASME B&PV Section VIII code calculations including a full seismic analysis validating the pump design. The existing installed pumps used two different motor manufacturers. Hayward Tyler engineers performed the new seismic analysis, considering either motor allowing site to have interchangeability of the motors.

Hayward Tyler's technical expertise and engineering capabilities allowed the design of a custom engineered, vertical turbine pump to extend the operating life of the station. This supports carbon-free energy to power the equivalent of nearly 1 million homes for an additional 20 years.

Project Summary

SITE / LOCATION:

Nuclear Plant, North America

SCOPE OF WORK:

- → Supply of 9 vertical turbine pumps
- → Custom designed hydraulic hitting multiple performance requirements
- → Not to exceed max shut-off head value
- → No seismic supports allowed – pump must take forces
- → Pump natural frequency designed to avoid forcing frequencies such as 1/2x, 1x, and 2x operating speed
- → First shaft critical speed above 150% of operating speed
- → CFD validation of design prior to manufacture
- → Pump performance testing at HT facility
- → ASME Sec. VIII Safety-related design
- → Seismic analysis considering 2 different motor drivers

BASIC PUMP DESIGN DETAILS:

- → Two-stage, vertical turbine pumps
- → Rated Flow: 4000 gpm
- → Rated Head: 461 ft
- → Speed: 1780 rpm
- → Design Pressure: 250 psig
- → Design Temp: 100° F

Pump prior to testing in Colchester, VT.

Project Data Sheet

Application	Service Water Pump
Quantity	8 installed + 1 spare
Codes and Standards	
Design	ASME B&PV Code Section VIII Division 1, 2017 Ed.
Materials	ASME B&PV Code Section II Part D
Hydrostatic Test	ASME B&PV Code Section VIII Division 1, 2017 Ed
Performance Test	ANSI/HI 14.6 ASME PTC
NPSH/Submergence Test	ANSI/HI 14.6 ASME PTC
Pump Details	
Pump Type	Two-stage vertical turbine
Pump Model	15 x 20 VSO2
Fluid Pumped	Fresh water
Rated Flow	4000 gpm
Rated Head	461 ft
Operating Temperature	32-92° F
Design Pressure	250 psig
Design Temperature	100° F
Bearings	Product lubricated
Motor Details (not supplied)	
Motor Rating	1000 HP
Service Factor	1.0
RPM	1780
Power Supply	4000 V / 3 ph / 60 Hz

Pump being lowered into the test loop for performance testing.

Complete pump shipping to customer site.

HAYWARD TYLER

Engineered solutions for the global energy sector

USA
Hayward Tyler Inc.
Vermont, USA
+1 (802) 655 4444
vermont@haywardtyler.com

ENGLAND
Hayward Tyler Ltd.
Luton, England
+44 (0)1582 731144
luton@haywardtyler.com

SCOTLAND
Hayward Tyler Fluid Handling
Glasgow, Scotland
+44 (0)1355 225461
glasgow@haywardtyler.com

INDIA
Hayward Tyler India
Delhi, India
+91 11 4575 6831 / 4507 5971
delhi@haywardtyler.com

CHINA
Hayward Tyler Kunshan
Kunshan, China
+86 512 57723311
kunshan@haywardtyler.com

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