HAYWARD TYLER

ENGINEERING EXCELLENCE SINCE 1815 200 YEARS

NUCLEAR
Pumps, Motors & Services

Safe, reliable, and economical solutions
for the nuclear industry

Supporting the nuclear industry as an OEM for over 60 years.

At Hayward Tyler, we have been active in the nuclear industry since the mid 1950's, when we supplied pumps to Calder Hall, the world's first full-scale nuclear generating plant.

As a leader in performance-critical pumps and motors, we continue to support all generations of nuclear power plants across the globe. We are committed to the needs of the nuclear industry and are continuously looking at ways to deliver value to our customers.

60+
years experience in nuclear industry

55%
of nuclear power stations in North America operate with Hayward Tyler pumps

650+
"N" stamped equipment

24/7/365
customer care and servicing across the globe

40+
year lifetime of Hayward Tyler units

Our Quality Program

Our in-house quality assurance program meets NQA-1, NCA4000 and NRC requirements 10CFR50 Appendix B and 10CFR21 with regular audits from individual utilities as well as NUPIC (consisting of international representatives).

Commercial Grade Dedication

Our Commercial Grade Dedication program provides us flexibility in supplying difficult-to-source materials. Through this program, we provide bottom-line value to our customers and combat supply chain obsolescence issues.

Safety-Related Equipment

We can supply ASME Section III, Division 1, Class 1, 2 or 3 equipment, including those deemed “Safety-related” per U.S. NRC requirements.

Hayward Tyler holds the following ASME Boiler and Pressure Vessel stamps:

N NPT NS

NUPIC NUCLEAR PROCUREMENT ISSUES COMMITTEE

RCC-M

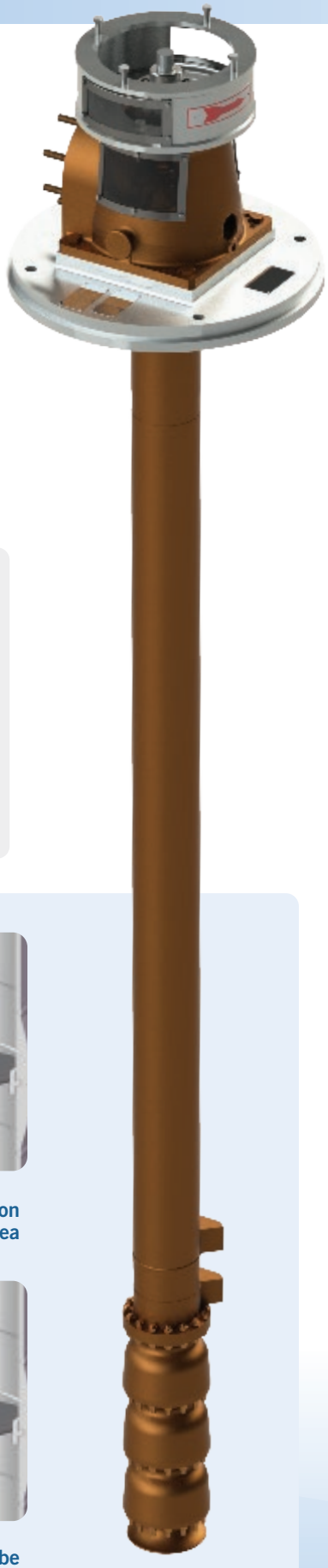
VS

Vertical Turbines

Hayward Tyler manufacturers vertical, centrifugal single or multistage pumps for applications requiring low NPSH, medium head and medium capacity. We can supply pumps for “Safety” and “Non-safety” related applications.

The VS range was designed specifically for the nuclear industry, offering three different impeller types. Each impeller type offers a different head-capacity curve ranging from steep to a flatter curve, depending on system requirements.

With decades of operating experience, Hayward Tyler is consistently providing service and technical support for nuclear service water pumps and other nuclear vertical pump applications.



Operation Parameters

Flow Range	up to 50,000 USgpm
Total Head	60–210 ft per stage
Setting length	up to 60 ft
Speeds	up to 1775 rpm

Applications

- → Service Water
- → Cooling Water
- → Circulating Water
- → Screen Wash
- → Containment Spray
- → Residual Heat Removal

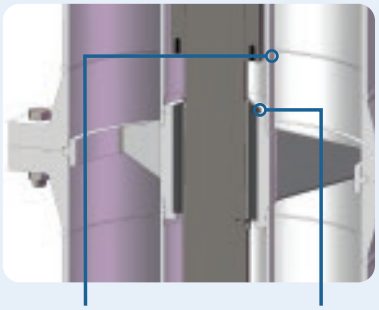
CASE STUDY:

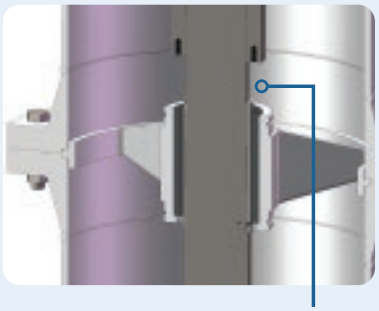
Safety-related pump upgrades for increased reliability

Hayward Tyler upgraded the design of an existing vertical turbine pump to improve its reliability and to reduce maintenance.

The original design used enclosing tubes with externally lubricated bearings, so the fit from the enclosing tube to the bearing housing was a source of maintenance issues. After evaluating the design, we eliminated the enclosing tubes, moving to a product-lubricated bearing design. This eliminated the requirements for a safety-related external water supply for the bearings.

During our design review, it was also identified that the radial bearings, shaft sleeves and wear rings could be upgraded to provide better wear resistance. We assisted the site with their Design Change Procedure and revised all required design calculations to ensure the design met or exceeded the existing requirements.





MT / MN / BN

Vertical Axial & Mixed Flow Pumps

Ideal for applications where large flow capacities at relatively low heads are required, or when suction lifts are too great for horizontal pumps.

Engineered to fit customer requirements, these pumps feature a number of hydraulic designs to provide variation in the capacity curve characteristics, from a steep to a flat curve.

Operation Parameters

Discharge Sizes	up to 7' 6" (90")
Flow	up to 178,000 USgpm
Head	up to 152 ft
Speeds	up to 1180 rpm

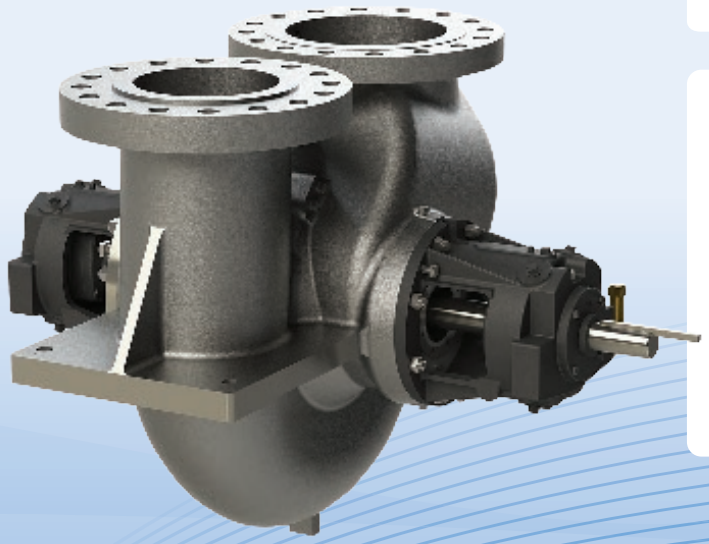
Applications

- → Circulating Water
- → Condenser Cooling Circulation
- → Cooling Water Make-up

D / KSMK

Double Suction

Single-stage horizontally or radially split pumps using a double suction impeller, this rugged design is particularly suited for hazardous, safeguard-operating conditions.



Operation Parameters

Discharge Sizes	up to 30"
Flow	up to 160,000 USgpm
Head	up to 500 ft

Applications

- → Component Cooling Water
- → Decay Heat Removal
- → Fuel Pool Cooling
- → High Pressure Service Water
- → Reactor Building Spray Pumps
- → Feed Water

SEALLESS PUMPS

Canned Motor Pump

Canned motor pumps offer a combined pump and motor on a common shaft wrapped in a pressure boundary. This eliminates the need for mechanical seals, which removes the chance of a process fluid leak. These are ideal for applications where leakage cannot be tolerated or minimal maintenance is required.

This is particularly true in nuclear applications where ALARA principles apply.

Operation Parameters

MOTOR	
Power	5–450* HP
Voltage	380–575 V
Poles	2, 4
VSD Compatible	Yes
Design Pressure	0-6000+ psig
Design Temperature	-184 to 750 °F
PUMP	
Flow	Up to 3,000* USgpm
Head	Up to 1000* ft

**Higher available upon request*

CASE STUDY:

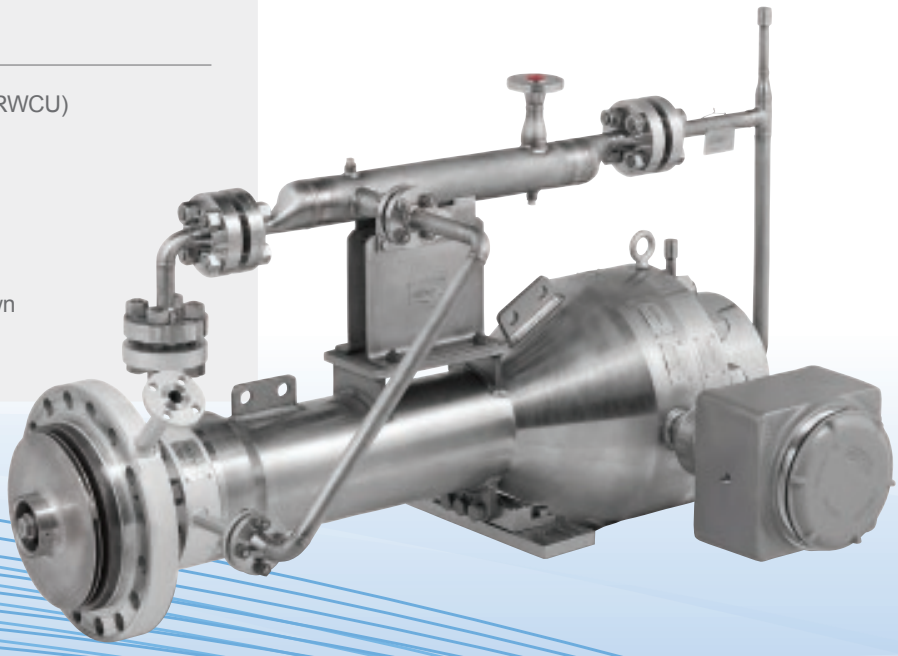
Canned Motor Retrofit reduces radiation exposure and improves reliability

Hayward Tyler has installed Canned Motor Retrofits (CMR) on Reactor Water Clean-Up (RWCU) applications at multiple sites across the U.S. Their original RWCU pump designs had a history of poor mechanical seal life, causing radioactive fluid leakage and resulting in increased personnel dose and increased O&M budgets.

The design uses the existing impeller and pump case, therefore the pump performance remains unchanged. The modification uses the existing baseplate and has minimum pipework modifications.

Applications

- → Reactor Water Clean Up (RWCU)
- → Spent Fuel
- → Boron System
- → Chemical Volume Control
- → D2O Collection/Transfer
- → Steam Generator Blowdown
- → Spent Resin



Wet Stator Unit

Vertical pump with an integrated wet wound motor. The pump and motor are designed for the same internal pressure so there is no need for a dynamic mechanical seal. Ideal for high inlet pressure and temperature applications.

Operation Parameters

MOTOR	
Power	400–3350 HP
Voltage	380–11kV
Poles	2, 4
VSD Compatible	Yes
Design Pressure	Up to 5800 psig
Design Temperature	32 to 750 °F
PUMP	
Flow	Up to 44,000 USgpm
Head	Up to 1800 ft

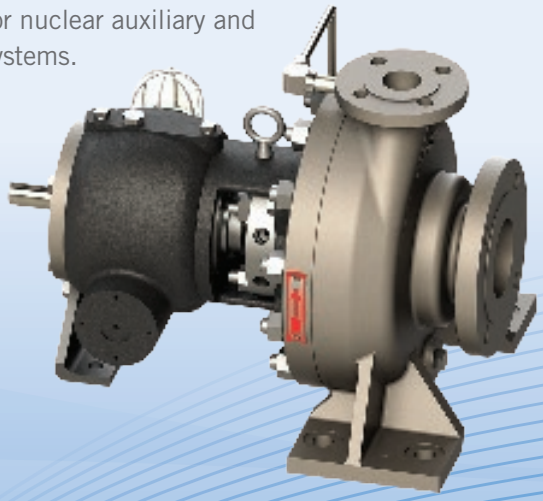
Applications

- → Reactor Water Clean-Up
- → Reactor Circulating Pump (RCP)
- → High Pressure Circulation

N3

End Suction

The N3 is an end suction, vertically split, single stage pump. It has a back pull out design, with foot or centerline mounting arrangement with a closed or semi-open impeller. It has a cantilever shaft/bearing arrangement designed for low stress/deflection and high bearing life. It is specifically designed for nuclear auxiliary and radwaste systems.



Operation Parameters

Flow Range	Up to 3,000 USgpm
Total Head	Up to 500 ft
Speed	1500–3600 rpm

Applications

- → Safeguard Pumps (ASME SIII Cl.2)
  - Sealwater Injection
  - Decay Heat Pumps
  - Reactor Spray Pumps
- → Aux. and Service Pumps (ASME SIII Cl.3)
  - Spent Fuel Pump
  - Borated Water Pumps
  - Rad Waste Pumps

Supporting the Nuclear Lifecycle

Hayward Tyler share a deep commitment to supporting the nuclear industry, from research and development through decommissioning.

R&D Test Loop Pumps

We have supplied multiple products to nuclear test loops and training facilities across North America, and we are able to work with the most rigorous specifications, complying with the requirements of flexible operational testing regimes.

Technology for Generation IV Reactors

At Hayward Tyler, we are dedicated to supporting the future generation of nuclear technologies.

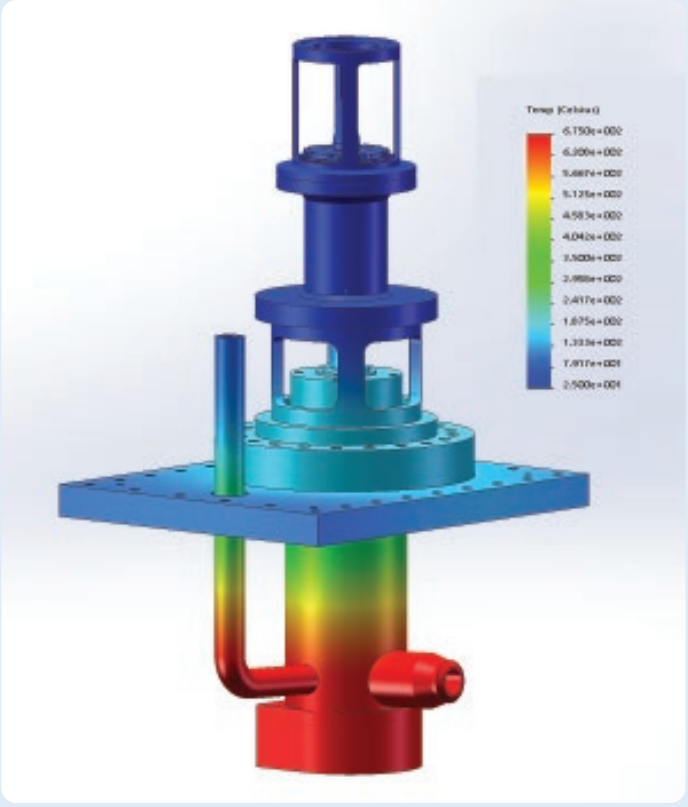
Our products and services complement the design philosophies of Generation IV reactors to ensure a high degree of safety and reliability. We offer pumps and motors capable of withstanding the high temperatures that new designs require.

Decommissioning and Fuel Reprocessing

With products installed throughout the world that have been operating for over 35 years, we fully support the nuclear plant life cycle, including decommissioning and fuel reprocessing.

Applications include:

- → Acid Waste
- → Catalyst Feed/Transfer
- → Decon Solution Transfer
- → Effluent Discharge
- → Generator Purge
- → Melter Cooling Water



Engineering Services

We having been solving problems for our nuclear industry customers for over 60 years. Our in-house design engineering teams are experienced in analyzing complex engineering problems to address your most demanding operational issues. We can support OEM and non-OEM equipment.

Engineering Design and Analysis

We offer the following engineering services:

- → Seismic and vibration analysis
- → Rotodynamic analysis
- → Pressure vessel and structural design
- → Computer modelling
  - Computational Fluid Dynamics
  - Finite Element Analysis

Upgrades and Retrofits

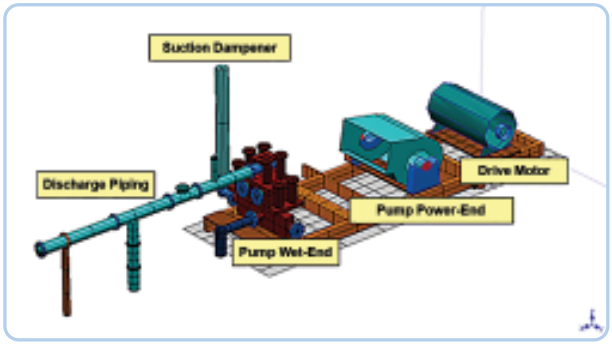
We can upgrade your existing pump and motor, including:

- → Pump and motor re-rate
- → Upgrade materials
- → Modify the existing design

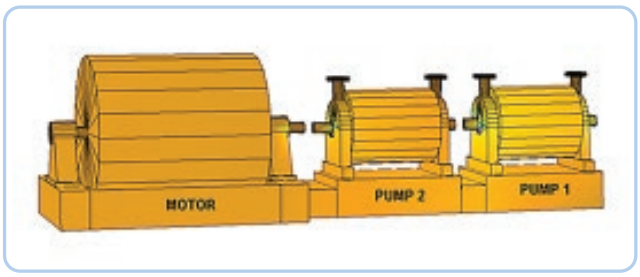
Customer Training

We offer classroom or onsite training on a variety of topics, including:

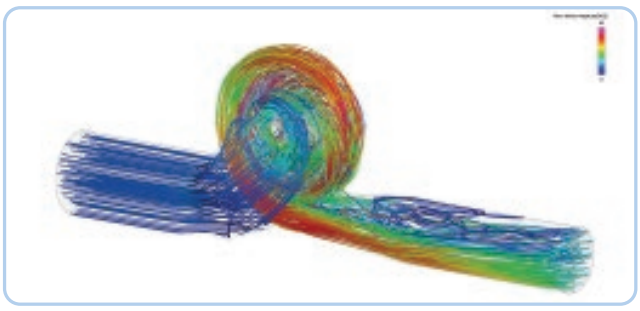
- → Pump fundamentals
  - Pump types/functions
  - Mechanical design
  - Hydraulic design
- → Testing
  - Vibration analysis
  - Pump field testing
  - Motor field testing



Vibration analysis of piping and pump



Vibration study of a pump and motor in series operation



CFD of a new hydraulic design

Field Services and Testing

We offer an extensive range of field services to help solve your pump problems or upgrade your existing equipment no matter the Original Equipment Manufacturer.

How Are Your Pump and Motor Performing?

We are able to come to your site and perform a pump and motor health check to ensure they are operating to meet your requirements.

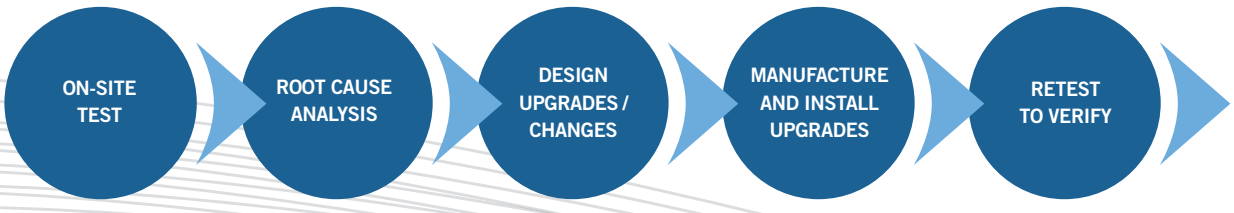
We can perform the following checks:

- → On-site pump and motor testing
- → Flow measurement with non-intrusive meters
- → Vibration testing and analysis
  - Spectral analysis
  - Modal analysis
  - Operating deflection shape
  - Seismic analysis
- → Thermal imaging analysis
- → Motor condition assessment

Pump Types

- → Sealless (Dry or Wet Stator)
- → Barrel
- → Can
- → Hot Well
- → Reciprocating
- → Segmental Ring
- → Single Stage Double Suction
- → Split Case
- → Vertical Turbine
- → Wet Pit

Hayward Tyler can evaluate, solve and implement solutions to your pump and motor problems



Root Cause Analysis

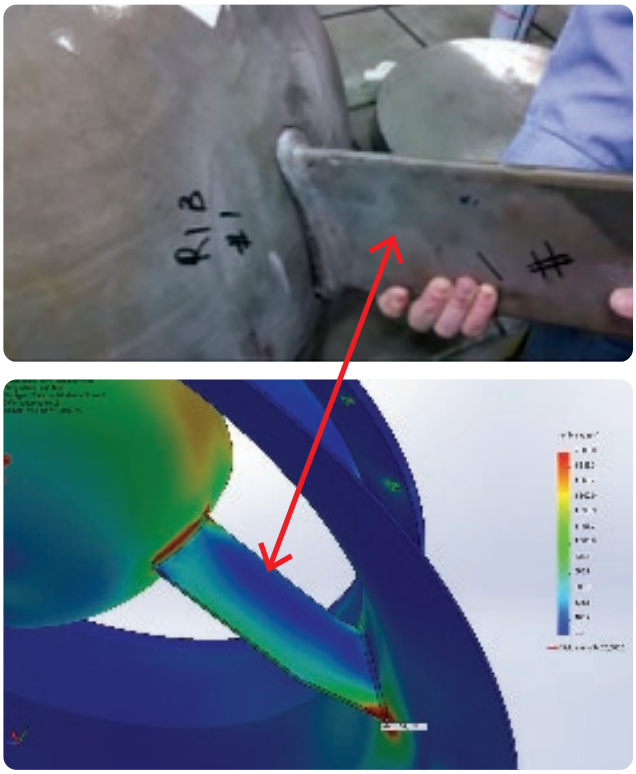
We can analyze your pump and system issues and provide a Root Cause Analysis to fix the “why” — not just the “what”. We have extensive experience in examining worn and failed components to allow us to identify when something is out of the ordinary, and quickly determine how to fix it.

We have the field experience, combined with the engineering design knowledge, to properly analyze complex issues and offer practical solutions.

Field Services

Our factory-trained and experienced personnel are available 24/7 to support your on site needs. We can provide:

- → Installation/removal
- → Laser alignment and commissioning
- → Overhauls and rebuilds

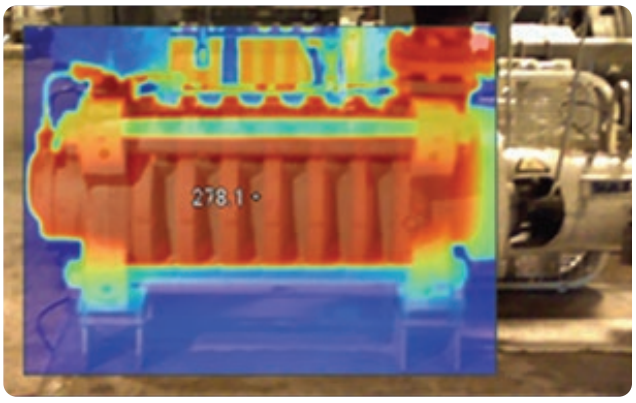


Cracked suction bell with FEA showing high stress areas

Thermal Imaging

We can perform thermal imaging to measure surface temperature, allowing us to:

- → Identify potential issues
  - Hot bearings
  - Valve leaks
  - Plugged coolers
- → Compare images with duplicate equipment
- → Establish baseline for trending



Thermal imaging of a multistage pump

Our Nuclear Customers

At Hayward Tyler, we have been supporting our nuclear customers for over 60 years. We continue to support all our own, as well as competitors', equipment.

With installations at over 55% of all nuclear plants in North America, along with multiple installations worldwide, Hayward Tyler is committed to supporting the nuclear industry.

aps · BNFL · Bruce Power · Dominion Energy · DUKE ENERGY.
ENERGY NORTHWEST · Entergy · Exelon · FirstEnergy · ICHNP
Luminant · NEXTera ENERGY · nrg · ONTARIO POWER GENERATION · PSEG Nuclear
Southern Company · Savannah River NUCLEAR SOLUTIONS · STP Nuclear Operating Company · TVA · VATTENFALL

For further information on Hayward Tyler's nuclear expertise and products, please contact us at a location below or visit: **www.haywardtyler.com**

HAYWARD TYLER

Engineered solutions for the global energy sector

UNITED KINGDOM
Hayward Tyler Ltd
Luton, United Kingdom
+44 (0)1582 731144
luton@haywardtyler.com

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

INDIA
Hayward Tyler India
Haryana, India
+91 129 251 3579/251 0124
delhi@haywardtyler.com

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

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