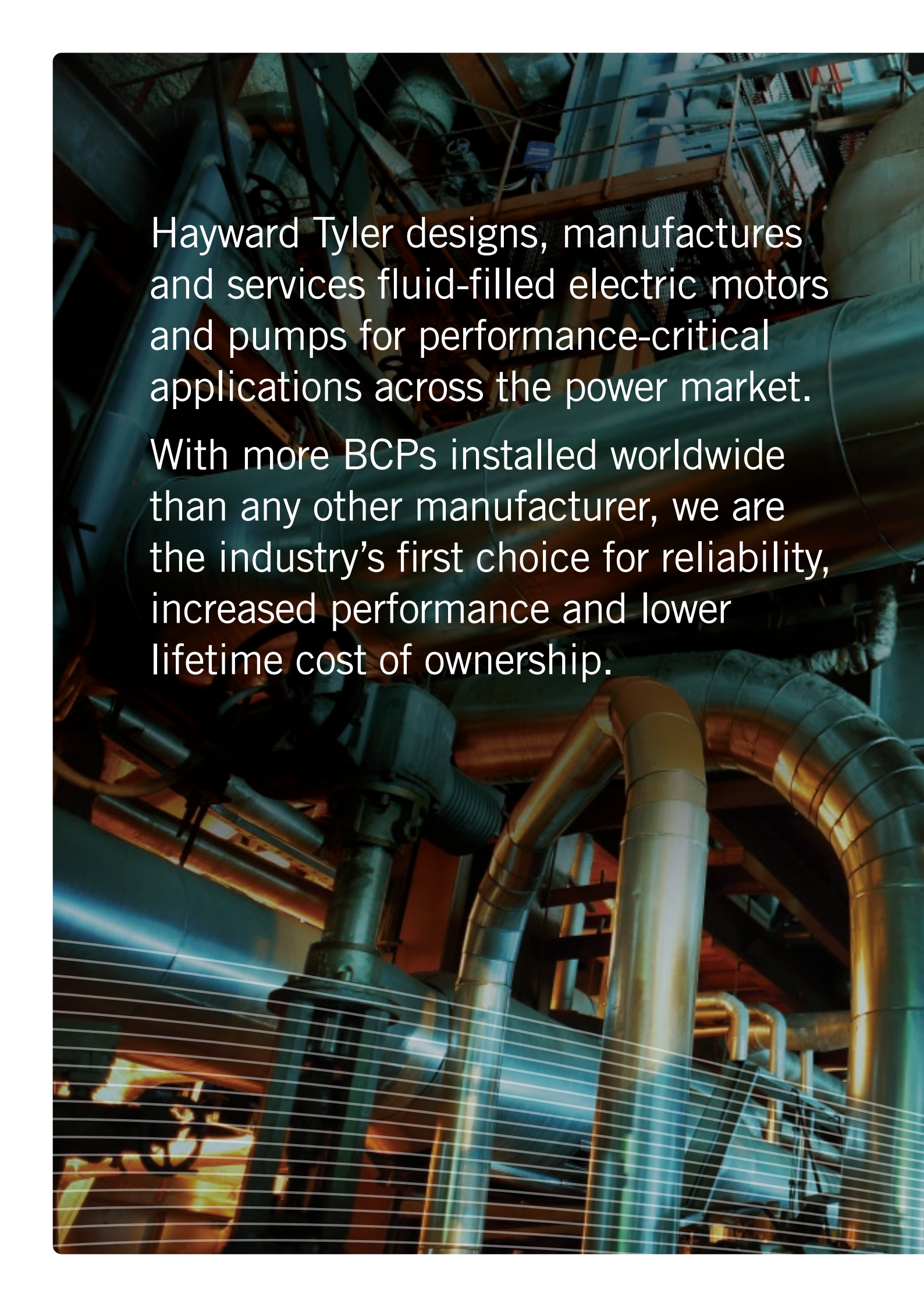


Next generation of performance-critical boiler circulating pumps for the power industry


Industry's first choice for reliability, increased performance, and lower lifetime cost of ownership



The background image shows a complex industrial environment with numerous large, metallic pipes and machinery. The scene is dimly lit, with a strong blue color cast over the entire image. The pipes are arranged in a dense, crisscrossing pattern, and some machinery components are visible in the lower-left corner. The overall impression is one of a large-scale industrial facility.

Hayward Tyler designs, manufactures and services fluid-filled electric motors and pumps for performance-critical applications across the power market.

With more BCPs installed worldwide than any other manufacturer, we are the industry's first choice for reliability, increased performance and lower lifetime cost of ownership.

- 
- **60 years' experience**
 - **Designed world's first glandless BCP**
 - **Largest installed base**
 - 2,300 BCP units worldwide
 - **11kV high voltage design**
 - **Sub, super and ultra-supercritical capability**
 - **30+ years' design lifetime**
 - **40-week standard lead time**
 - **24/7/365 customer service**

OUR BCP MOTORS
OPERATE FOR UP TO
65,000 HOURS
BETWEEN MAINTENANCE

Faced with today's tough market challenges, you can't afford to take any risks. You must know who you can always rely on to deliver to specification — on time, and on budget.

For over 200 years, Hayward Tyler has been meeting and exceeding client expectations. We have built a global reputation for industry-leading innovation, quality, and reliability.

Global reputation

Hayward Tyler is recognised worldwide as a leading manufacturer of glandless wet stator circulating pumps for the power industry.

We invented the technology over 60 years ago and now have more than 2,300 units operating in both nuclear and conventional fossil-fuelled power generating plants. These include GT combined cycle, fluidised bed, and coal gasification installations.

Our market leadership is underpinned by our commitment to continuous technical improvement, product quality and reliability.

Proven where performance is critical

Our circulation pumps are a tried and tested solution for performance-critical, high pressure, high temperature boiler systems. We are a preferred supplier to major EPCs and boiler manufacturers worldwide who recognise us for our unsurpassed experience and engineering know-how.

Trusted partner

We are the 'go-to' trusted partner for tough challenges, and we work with operators and EPCs to develop the next generation circulation pump technology needed to operate at the high pressures and temperatures demanded by state-of-the-art super and ultra-supercritical boiler systems.

Quality and reliability

We understand that you can never achieve reliability without quality, and we have an over-arching commitment to continuous improvement.

Our exceptional workforce, our state-of-the-art production line, and our fully flexible supply chain allows us to deliver the most complex projects anywhere in the world against an average 40-week lead-time and with an assured 65,000 hours Mean Time Between Maintenance (MTBM).

Centre of Excellence

We have created the world's most advanced Centre of Excellence for specialist motor manufacture, a cutting-edge facility where our enhanced test capability and lean manufacturing processes will enable our next generation technology to be delivered with unrivalled quality assurance and even shorter lead times.

Central to the Centre of Excellence is the continued development of our Marketing, Sales & Operational Planning (M,S&OP) award winning information systems. A business differentiator which is recognised by our peers in the UK.

We have embedded "What-if" scenario planning capability through highly customised Witness Simulation software. This benefits our strategic partners throughout the entire supply chain using predictive simulation technology proven to maximise performance, optimise throughput and resource utilisation.



OUR BUSINESS-WIDE CONTINUOUS IMPROVEMENT PROCESSES ARE FURTHER ENHANCING OUR COMMITMENT TO PERFORMANCE, RELIABILITY, SERVICE LIFE, AND EASE OF MAINTENANCE.



CASE STUDY:

Leading the way in large-scale coastal power generations

China's Zhejiang Ninghai Power Plant is breaking new ground in large-scale coastal power generation and is the first of its kind to use a desalinated seawater circulation cooling system so eliminating any environmental impact on adjacent sea areas caused by warm water discharge.

The operators chose Hayward Tyler glandless wet stator boiler recirculation pumps for both the Zhejiang Ninghai Phase II 1,000MW super-critical once-through boilers, and the project has won a gold medal in China's prestigious National Quality Project Award as well as the Year 2010-2011 Luban Award.

Our BCPs are chosen by the world's leading operators including:

- APGENCO
- China Guodian Corporation Co.
- China Huadian Group
- China Huaneng Group
- China Shenhua Energy Co.
- CLP
- Datang International Power Generation Co.
- Duke Energy
- DVC
- East Delta
- ENEA (Poland)
- EON
- EGAT
- Eskom
- HPGCL
- MAHAGENCO
- NTPC
- PGESCO
- Tata Power



Performance-critical pumps for the toughest power generation environments.

You must be able to rely 100% on the technology that drives your operations, and with Hayward Tyler you can be confident you're in safe hands.

Our high-availability, low-maintenance glandless motor and pump units are recognised worldwide as the most reliable and robust available today.

Global service capability

Our status as an industry-leading OEM supplier is reflected in our commitment to world-class after-sales service.

We have dedicated facilities in the UK, USA, India, and China delivering though-life support. Our specialist field personnel provide the full range of service and repair options for all planned and predictive maintenance cycles as well as a comprehensive electrical and mechanical inspection capability. Our after-sales support can be delivered on a supervised or turnkey basis, with turnkey now growing in popularity as an effective means of reducing staffing overheads.

All Hayward Tyler service centres also offer design updates, troubleshooting and root cause failure analysis, with our engineering field support teams available to work with you on-site.

We hold all the original parts and service drawings not only of our own original products but also for GE-manufactured BCPs, and we also provide field and shop service capabilities for GE, Westinghouse, KSB, IR, Fuji and Torishima BCPs.

Our service centres can supply identical part-for-part spares or our teams can take advantage of design upgrades and improvements and deliver smaller, lighter replacement products.

Many clients opt to invest in spare motors designed to the original's specification, which we can store at one of our facilities and that can be routinely overhauled during non-premium time. This allows rapid swap-out when the main motor is out of action, reducing maintenance costs and significantly cutting outage times.

CASE STUDY:

Ultra-supercritical support for first lignite-fired power plant in Asia

Hayward Tyler supplied a BCP for use as an efficient start-up pump on the Mae Moh power plant - the first lignite-fired power plant in Asia operating with ultra-supercritical conditions.

The electric wet wound motor, which provides the drive to the pump, is 2-pole 400Kw operating off 11Kv voltage.

The ultra-supercritical boiler has an integrated Selective Catalytic Reduction of NOx (SCR), its ultra-supercritical steam turbine and generator, as well as the air quality control systems composed of a Wet Flue Gas Desulphurisation (WFGD) system. It will enable reduction of sulphur oxides by more than 98%, and Electrostatic Precipitators (ESP), designed to capture particulate and dust emissions, with an efficiency of more than 99.9%.



Simplicity is a key feature of the Hayward Tyler BCP, with both pump and casings designed for the full range of boiler pressures and temperatures. All our products meet standards set by ASME, PED, IBR, EN and ISO.



Quality Standards:
ASME, PED, IBR
EN, and ISO



HIGH RELIABILITY
(30+ YEARS DESIGN
LIFETIME)



LONGER SERVICE
INTERVALS
(PROVEN 8 YEARS)



400bar
@ 400°C
SUB, SUPER AND
ULTRA-SUPERCRITICAL
CAPABILITY



LOWER TOTAL COST
OF OWNERSHIP

Quality and durability

Our commitment to continuous improvement means all our products are durable and meet - or exceed - quality standards.

A key reason for our worldwide recognition as the leading supplier of glandless motor pumps is the simplicity of pressure containment within our design, which comprises three continuously connected vessels.



Pump case

Accommodates fluids to the highest boiler temperatures and pressures.

Heat exchanger

Sized to maintain the motor cavity coolant at low temperatures while at full system pressure.

Motor case

Provides pressure tight housing for the stator and rotor assemblies whilst allowing circulation of the cooling and lubricating medium.

CASE STUDY:

Increasing power capacity at South Helwan power plant in Egypt

Hayward Tyler supplied three BCPs for use as start-up pumps to increase efficiency on the South Helwan supercritical power plant in Egypt. The electric wet wound motors providing the drive to the pump are 2-pole 500Kw motors operating off 6Kv voltage.

The plant comprises three identical units, each of 650 MW gross capacities. The plant will be cooled by a once-through cooling system using water from the Nile River.



High power, high performance, low maintenance.

Simplicity of design, unrivalled manufacturing numbers and operational experience all make Hayward Tyler the boiler and utility sector's preferred choice.

Our products incorporate an array of industry leading features to help drive efficiency, ensure reliability and deliver low maintenance, a long lifespan, and a high ROI - however challenging the operating environment.

Seal-less canned motor pumps

By eliminating the need for shaft seals and oil-lubricated ball bearings, we greatly improve the Mean Time Between Failure (MTBF) through designing out the two most common pump failure components.

Instead, we rely on a proven process lubrication bearing design, and also integrate the motor and wet end of our canned pumps, removing the need for a coupling, guard or heavy-duty baseplate and so reducing installation costs.

Glandless retrofit motors

If you have issues with your existing fan cooled motor driven mechanical seal pumps - such as excessive noise or leakage - these can be solved with a Hayward Tyler glandless wet stator motor.

- Two-pole (2950 rpm) or 4 pole (1450 rpm) based on 50HZ frequency
- Two-pole (3500 rpm) or 4 pole (1750 rpm) based on 60HZ frequency
- Design parameters to meet supercritical boilers 400 Deg C / 400 Bar g pressure

The motors can be easily retrofitted to your boiler system using the existing pump case and impeller to provide a leak free, quiet pumping solution capable of running for many years maintenance free. Based on continuous operation, overhauls are typically at five or six-year intervals, and we can retrofit regardless of pump case orientation.

Unit arrangement

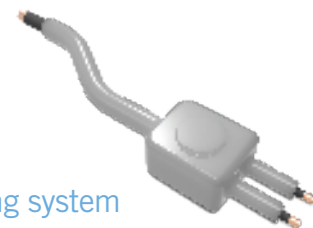
Our glandless pumps are arranged vertically, with the motor usually suspended below the pump case which is welded to the boiler suction and discharge pipework. The unit does not need foundation bolts and can therefore move as the boiler pipework expands and contracts.

We can also install above the pump when retrofitting glandless wet stator motors to existing units, and this is particularly useful where there are problems with mechanical seal pumps driven by conventional air-cooled motors.

Motor stator

Our motor stator windings comprise copper cores covered in an XLPE insulation, with a PVC sleeve delivering additional protection. The stator is easily removed from the casing for repair.

We use PVC wedges to secure the windings in the stator slots, and the ends turns are bound together and tied to supports on the stator shell to minimise movement.



Moulded jointing system

Our proprietary injection moulded jointing system has been approved by an independent industry body which subjects the joints to accelerated lifetime testing.

The process ensures that the high-integrity internal joints meet the exacting standards needed for high-duty applications and deliver long-life performance.



2,300

UNITS
- LARGEST GLOBAL
INSTALLED BASE

40 WEEK

AVERAGE LEAD-TIME IN
DELIVERING COMPLEX
PROJECTS

65,000

HOURS MEANTIME
BETWEEN
MAINTENANCE

200

OVER 200 YEAR HERITAGE
IN DESIGN, ENGINEERING
AND PRODUCTION



Hot neck

The unique hot neck arrangement, which is part of the motor case forging, limits the transfer of heat from the pump to the motor and negates the need for a separate heat barrier with independent cooling water supply.

Ultra-supercritical, supercritical, subcritical capabilities

OPTIONS:

Pumps

- Cast or forged pump case
- Single or double discharge

Motors

- Any voltage up to 11kV
- Fluid-filled wet stator or canned dry 'seal-less' motors

KEY FEATURES:

- High-pressure units
- Tilting pad bearings
- Removable stator cartridge
- Single external cooling water supply
- No external filters
- Common pump / motor shaft removes alignment issues
- 400 Deg C - 400 Bar g
- Meeting performance criteria on the most demanding applications
- Reduced lead times through standardisation concept

APPLICATIONS:

Hayward Tyler offer pump solutions for:

- Ultra-supercritical boiler start-up
- Subcritical drum boiler forced circulation
- Fluidised bed boiler circulation
- Economiser re-circulation
- Nuclear auxiliary and safety systems
- Reactor primary circulation
- Retrofit motors for existing conventional pumps

ROUTINE TESTS FOR ALL BCPs:
(included as standard)

- No load test
- Locked rotor current test
- Hydrostatic test
- Vibration test
- Insulation resistance and high voltage withstand test
- Winding resistance test
- Pump performance test
- Starting currents

Tilting pad design

All Hayward Tyler pump and cover end motor radial bearings are high-capacity, asbestos-free and of the tilting pad design. They are exceptionally tolerant to magnetite ingress from boilers, and the pump end radial bearing is positioned to minimise impeller overhang while limiting temperature rise.

Engineering capabilities.

Optimising performance and extending equipment lifetime.

Engineering

Hayward Tyler has a multi-disciplinary team of engineers including mechanical design, hydraulic and electrical engineers along with quality and production engineers who are organised in concurrent teams to deliver standard and bespoke design solutions using the latest CAD modelling and simulation tools to design, develop and verify the product.

Design

For combined pump / motor products, the design process begins with hydraulic engineering to define pump capability to meet the customer duty requirements. This is followed by selection of the appropriate motor specification to deliver the required power to suit the customer's on-site electrical supply specification. Finally, the mechanical design is developed to produce the manufacturing and assembly design data in order to productionise the design solution. All mechanical designs are completed in 3D using Solidworks design package.

Verification

A number of simulation tools are utilised to verify the performance of the designs, including Maxwell electrical simulation, ANSYS Computational Fluid Dynamics (CFD) for hydraulic flow simulations, ANSYS Finite Elements Analysis (FEA) for structural analysis and XLRotor for torsional dynamic simulation. In addition we use Motor Design Limited (MDL) software for analysis of electrical thermal data. All designs meet as default ASME, PED or customer specific pressure standards and quality requirements such as API610, IBR and RCCM codes.

New bearing materials are validated in Hayward Tyler's R&D laboratory to assess wear resistance and durability, dimensional stability in water and other key performance parameters. Unit electrical and hydraulic performance is validated in the test area where full scale testing can be completed, and the results fed back into the design to improve correlation between simulation and test. For new high power, high speed motor developments FEA tools are used for new component design and evaluation. Testing of these comprises high pressure cycling, thermal cycling and vibration tests. Fluid dynamics are then evaluated with a high speed rotor test rig.

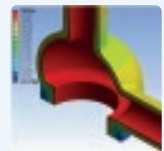
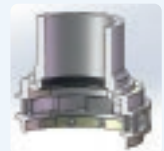
Engineering competencies of our world-class engineers:

- Electrical analysis
- Rotor dynamics analysis
- Shaft deflection analysis
- Casing stress analysis
- Bearing analysis
- Radial & axial thrust analysis
- Hydraulic design of cooling pump
- Cooling system analysis
- Thermal analysis
- Internal hydraulic losses
- Electrical losses



ANSYS Structural Analysis

- Key components including the pump case and rotating components can be analysed and optimised for prolonged life at stricter conditions
- A shorter start up time or greater temperature differential range can be achieved through analysing effects of thermal stresses and loading patterns



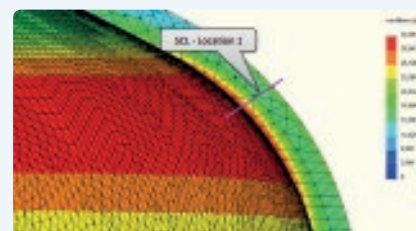
ANSYS Fluid Flow Analysis

- Accurate modelling of heat exchangers and fluid flow within pumps ensures the correct pressure and thermal values are obtained for the application



Motor CAD Modelling

- Modelling to understand the thermal performance at component level; windings, laminations, airgap, rotor bar etc



Centre of Excellence – the most advanced facility for specialist motor manufacture in the world.



Centre of
Excellence
SPECIALIST MOTOR MANUFACTURE

Our Centre of Excellence provides cutting-edge process capabilities, for the design and manufacture of our performance-critical motors and pumps - enabling our products to be delivered with unrivalled quality assurance and even shorter lead times.

The manufacturing centre is certified as Fit for Nuclear (F4N) and ISO Class 9 nuclear compliant. We are the UK's only provider of industry-specific hotbed testing.

To respond to your needs we use predictive simulation technology to emulate load effect on engineering, supply chain, production, assembly and test resources.

This ensures we deliver orders to you right first time, on time in full, providing you with peace of mind and confidence in our ability to deliver against our promises.

→ State-of-the-art facilities

With an extension of over 2,300sq.mtrs to the existing factory, the CoE is fitted out with state-of-the-art facilities such as particulate control systems and a specialist test loop

→ Increased throughput

Single process flow-lines increases throughput, with the potential to double capacity whilst reducing lead times

→ Dedicated product build & assembly test pits

Customer units are assembled and tested within our access controlled ISO Class 9 clean assembly and test area

→ Investment in training

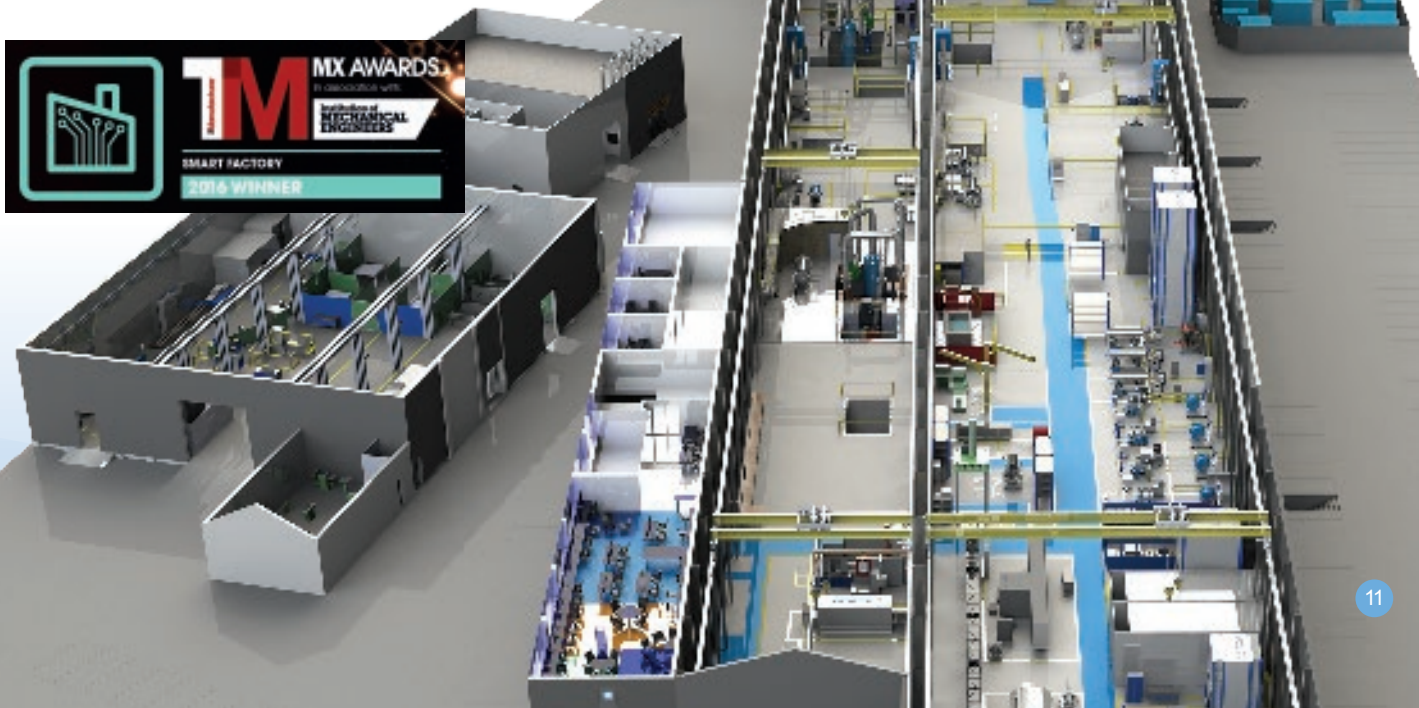
Award winning investment in the learning and development of our people with over 47,000 hours in 2016

"The investment in the Centre of Excellence demonstrates our commitment to delivering orders at reduced lead-times and cost, whilst ensuring right first time customer quality."



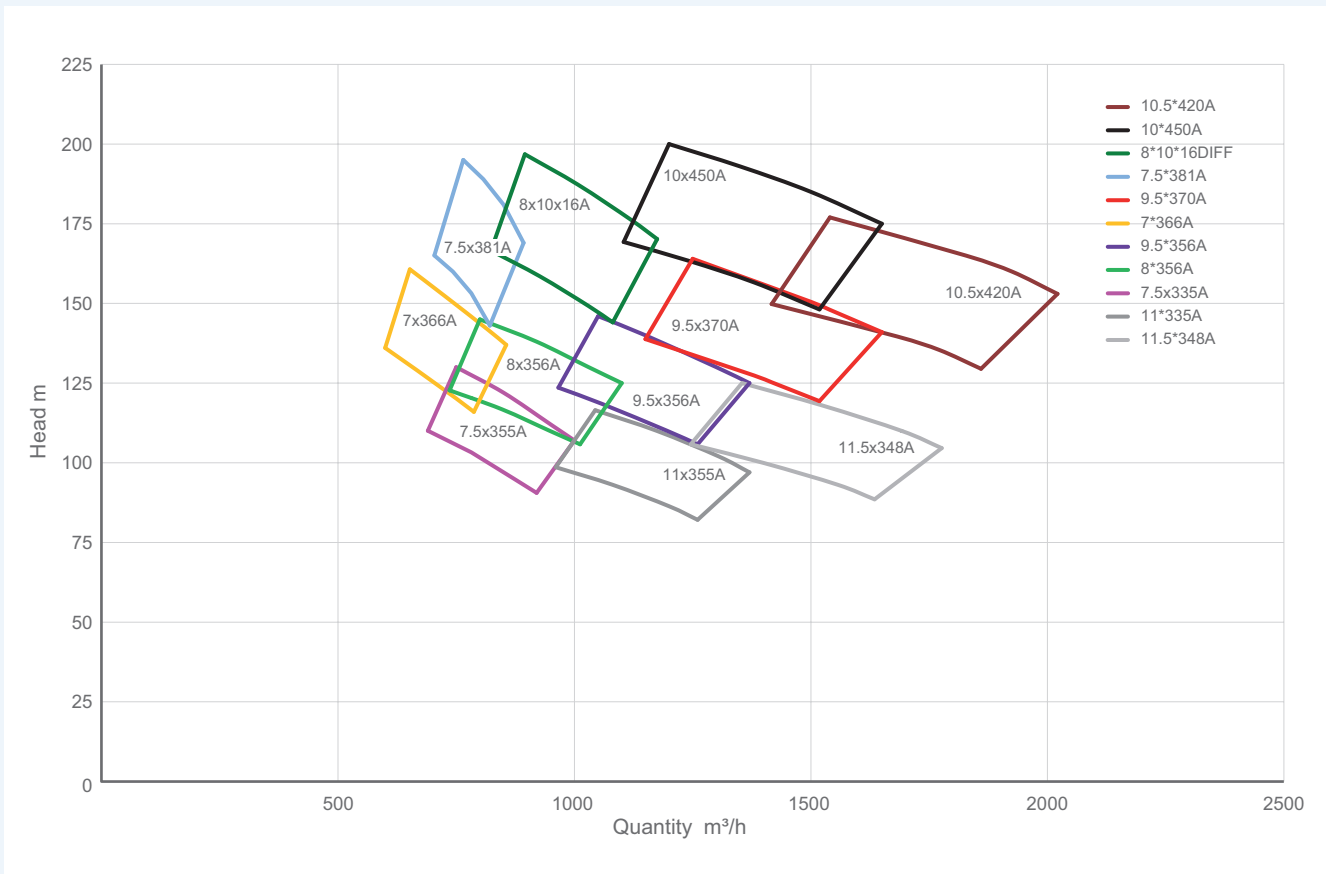
NUCLEAR AMRC

F4N
Fit For Nuclear



Delivering performance-critical solutions for the most demanding requirements to meet current and future global energy needs

Boiler circulation pump standardisation for 2-pole 50Hz (2960rpm) speed



Motor

Power Ratings	Voltage	Frequency	VSD Compatible	Design Life	Motor Design	Speeds
300-2500kW	400V-11kV	50/60Hz operation	Yes	25+ years	2/4/6 pole designs	Up to 3,600rpm

For further information on Hayward Tyler’s next generation of performance-critical boiler circulating pumps for supercritical and ultra-supercritical applications, please contact us at a location shown below or visit www.haywardtyler.com/power



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Engineered solutions for the global energy sector

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