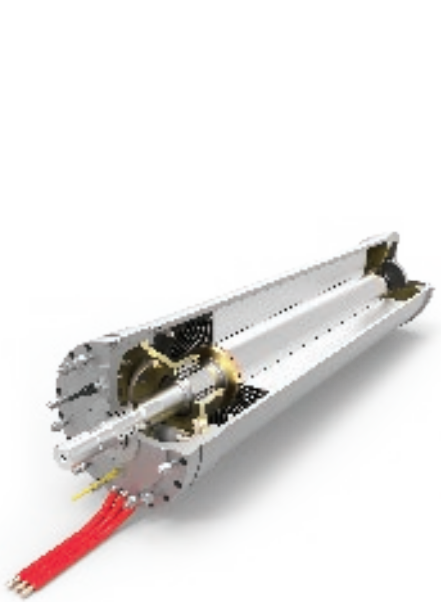
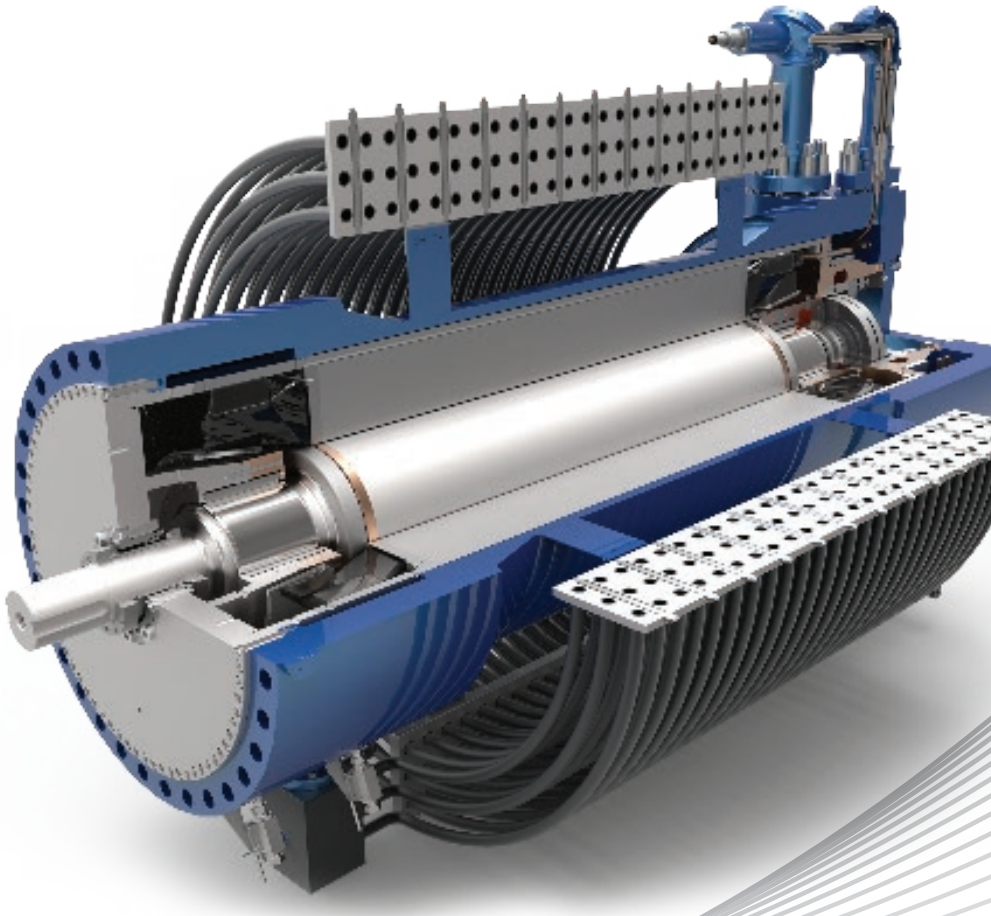
HAYWARD TYLER

ENGINEERING EXCELLENCE
SINCE 1815
200 YEARS

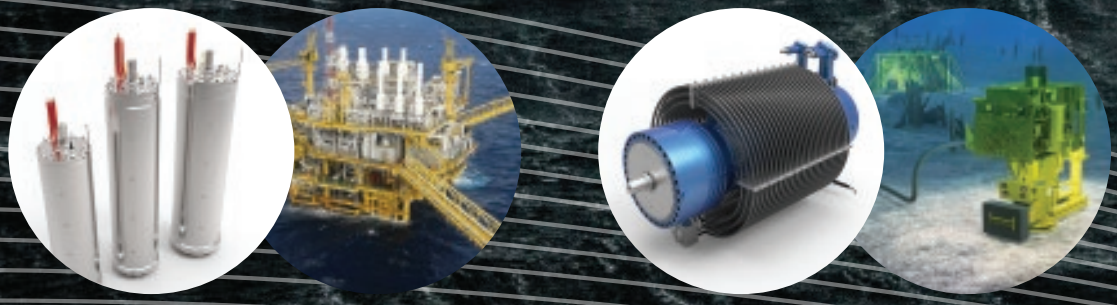
# Next generation of performance-critical motors for submersible and subsea applications

Performance-critical topside and subsea solutions
for the harshest offshore environments





Hayward Tyler designs, manufactures and services fluid-filled electric motors and pumps for performance-critical applications across the global upstream oil and gas market, where reliability is crucial and the cost of lifetime ownership is key.



→ **50 years' offshore experience**
– 250 units installed worldwide

→ **3,000kW subsea motor qualification**
– 6MW design capability

→ **11kV high voltage design**

→ **3,000m subsea capability**

→ **25 years design lifetime**

→ **35-week lead time**

→ **24/7/365 customer service**

**OUR SUBSEA MOTORS OPERATE FOR UP TO**

**40,000 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 on specification, on time, and on budget.

## Global reputation

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

We designed and built the world's first electric submersible motor back in 1908 and ever since we have shown the way, developing world-beating fully-certified technology that now drives a wide range of performance-critical topside and subsea applications.

## Trusted partner

Our high power, high voltage, water-glycol range is used for topside pumping and subsea applications worldwide and we are a preferred supplier to major upstream operators who recognise us for our unsurpassed experience and engineering know-how.

We are the 'go-to' trusted partner for tough submersible power challenges and we work with operators and EPCs to develop next generation motor and pump solutions capable of operating at depths up to 3,000m, in the harshest, most extreme and environmentally sensitive of marine environments.


## Continuous improvement

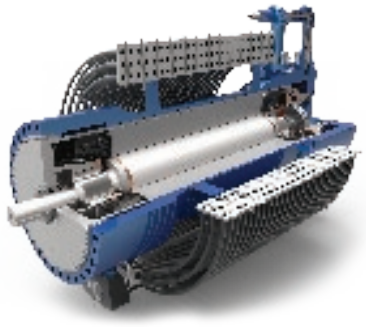
We understand that you can never achieve reliability without quality, and we have an over-arching commitment to continuous improvement.

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 35-week lead-time and with an assured 40,000 hours Mean Time Between Maintenance (MTBM).

## Centre of Excellence

We are creating 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.

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



CASE STUDY:

## The world's most advanced deepwater submersible motor

Hayward Tyler is responsible for designing and engineering the world's most advanced deepwater submersible motor.

With a rating of 2.5MW and capable of operating at depths as low as 3,000m, the motor was launched in 2008, with a bespoke version later developed for the GE Oil & Gas Universal Subsea Boosting research project. This 3MW, 4-pole, 60Hz wet-wound motor is driven by a variable speed drive and can operate over a range of frequencies and speeds.

It was built for GE Oil & Gas at Hayward Tyler's UK manufacturing facility and was first deployed in 2011 at the Nuove Pignone USB facility in Bari, Italy, following a two-year development programme.

Our motors are used by the world's leading operators, including Agip, Aker, BP, Chevron, GE Oil & Gas, Kvaerner, Shell, Statoil and Transocean.

# Submersible motors and pumps for the toughest of environments.

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

Our fluid-filled submersible motors and pumps have a pedigree stretching back more than 100 years, and in an increasingly challenging technical and regulatory arena we deliver the industry's most reliable low maintenance, performance-critical power solutions whether your application is topside or subsea.

## Topside pumping

Our motors are integrated into mission and safety critical topside pump systems on a wide variety of assets worldwide, including semi-sub, jack-up, tension-leg, FPSO, and FLNG platforms. Hayward Tyler seawater lift motors and process pumps are designed to operate continuously, providing the cooling water needed for a variety of topside applications, while our firewater lift motors are configured for an instantaneous high-demand response capable of auto-starting during an emergency.

## Subsea operations

We are leading the way with our deepwater power solutions, developing ever more sophisticated performance-critical designs for applications that deliver increased output, long life and low maintenance however complex the conditions and remote the locations.

Capable of operating at depths up to 3,000m and at speeds of up to 6,000rpm, our high temperature, high pressure, fluid-filled subsea motors are all designed for a five-year service cycle and have proven operating spans of eight years or more between recoveries.

Key applications include seawater injection and use in multi-phase boosting pumps.

CASE STUDY:

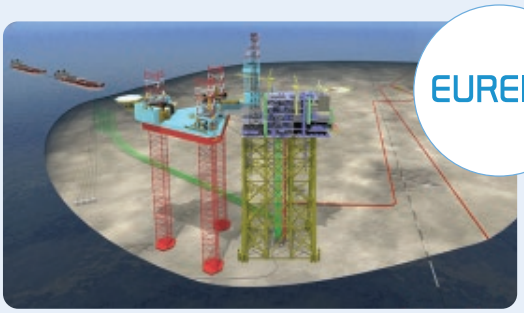
### Chevron's topside challenge

Hayward Tyler designed and engineered three bespoke submersible motor systems for use on Chevron's gravity-based structure in the challenging Hebron field, offshore Newfoundland in the Canadian Jeanne d'Arc Basin.

Working in partnership with Eureka Pumps AS, we built on our established wet-wound design for these firewater lift, seawater lift, and standby seawater lift units, all of which had to be capable of performance-critical operations in an extreme environment meeting rigorous client and international standards.

Hayward Tyler was an integral part of the supply chain for the project, we in fact led the design and compliance process, including meeting the exacting conditions demanded by the Canadian Standards Association before the units were approved for use.

Our close working relationship with Eureka Pumps has also seen us win orders for 14 units for the Eldfisk, Aasta Hansteen, and Martin Linge *(image shown below)* projects in the North Sea Norwegian sector.



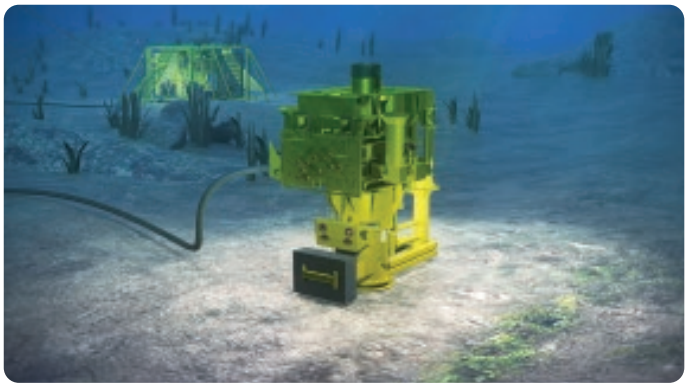

HIGH RELIABILITY

LONGER SERVICE INTERVALS

3,000

OPERATE AT DEPTHS OF 3,000M (10,000FT)

LOWER TOTAL COST OF OWNERSHIP



Hayward Tyler has operational references in a range of key markets – UK, Norway, Canada and Malaysia among them – and we comply with all international standards, including ASME, BS, EN, DNV, IEC, ISO, NEMA, Norsok, and PED.

CASE STUDY:

## Statoil's tough subsea specification

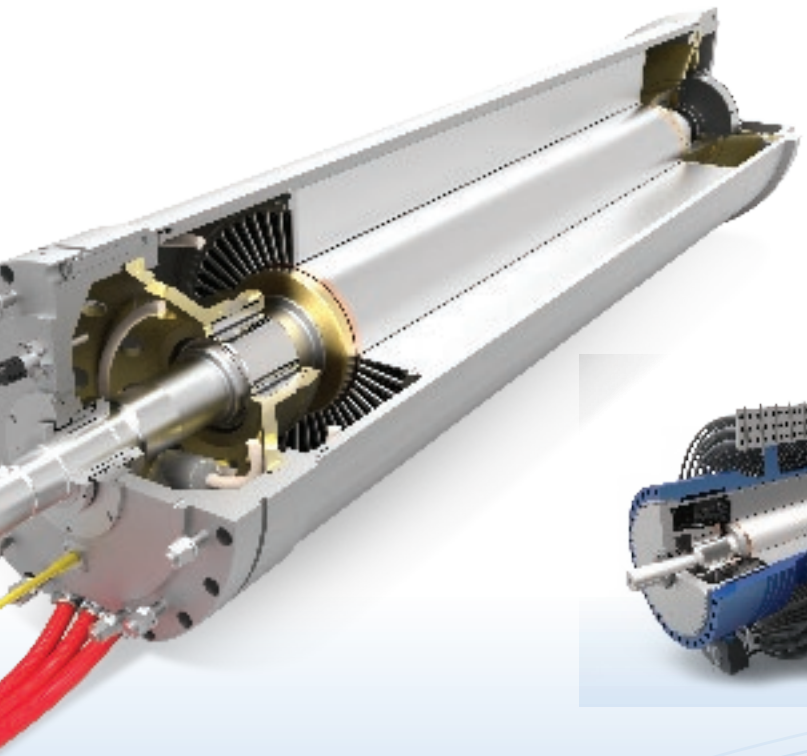
When Statoil and Aker Solutions needed a subsea electric motor that could survive for at least five years without maintenance, they came to Hayward Tyler.

The specification was for three 2.5MW fluid-filled induction motors to drive the seabed seawater injection pumping station for the Norwegian Sea Tyrihans field with a power source more than 30km away on the Kristin platform.

We developed our established water-glycol wet-wound technology to produce a motor which not only met the five-year maintenance interval requirement but also delivered a 25-year design lifetime and a start/stop value of 4,500 – all within a unit with minimal overall length and weight.

While refining the design, we were able to draw on our experience in the power generation industry where stand-alone stator shells are standard for boiler circulating pumps. For Tyrihans, we created a ground-breaking non-pressure retaining shell in which the stator, bearing housing and rotor are housed separately from the motor case.

© Harald Pettersen - Statoil ASA



Fluid-filled submersible motors such as those supplied by Hayward Tyler do not require ATEX certification as they are submerged in an intrinsically safe salt-water environment.

# High power, high performance, low maintenance.

Hayward Tyler leads the way in offshore submersible electric motor design, and the biggest benefits for our end users derive from our use of fluid-filled technology in preference to the conventional oil-based approach.

But we also incorporate an array of other industry-leading features which help drive efficiency, ensure reliability, and deliver low maintenance, a long lifespan, and a high ROI – however challenging the operating environment.

## Why choose water-filled?

We generally use a water-glycol mix that allows our motors to operate for longer, at higher temperatures and at higher speeds, and in the unlikely event of seawater ingress, they continue to work, unlike oil-filled products which catastrophically fail.

Our motors are also 100% safe in even the most sensitive of marine environments, and when used for topside applications they have a significantly smaller deck footprint than oil-filled solutions.

## Water-glycol vs Oil-filled motors

### Water-glycol-filled motors

- Low viscosity = *lower frictional losses, higher speeds*
- Run-with-leak capability = *increased uptime*
- Cooler operation = *longer motor life*
- Environmentally friendly = *regulatory compliance, peace of mind*
- Small topside footprint = *easier logistics*
- Lower weight = *increased versatility*

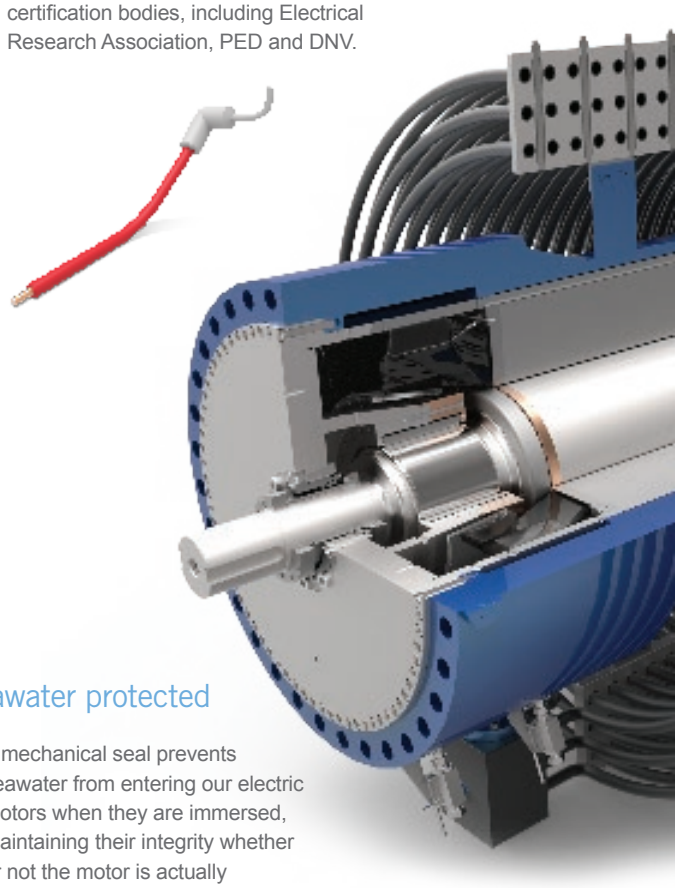
VS

### Oil-filled motors

- High viscosity = *high frictional losses, especially at higher speeds and higher operating temperature = risk of increased corrosion*
- Seawater ingress = *immediate catastrophic failure, environmental risk*
- Complex deployment = *increased costs*
- Large topside footprint = *pressure on space*
- Prohibited by many water authorities = *fewer applications*

## Unique jointing approach

Hayward Tyler is the only supplier to the offshore market offering motors with fully qualified high voltage injection moulded internal joints. A development that has had a dramatic impact on lifespan and has extended service intervals to a ground-breaking five-plus years. All our technology has been verified regularly over the past 20 years by a range of independent certification bodies, including Electrical Research Association, PED and DNV.



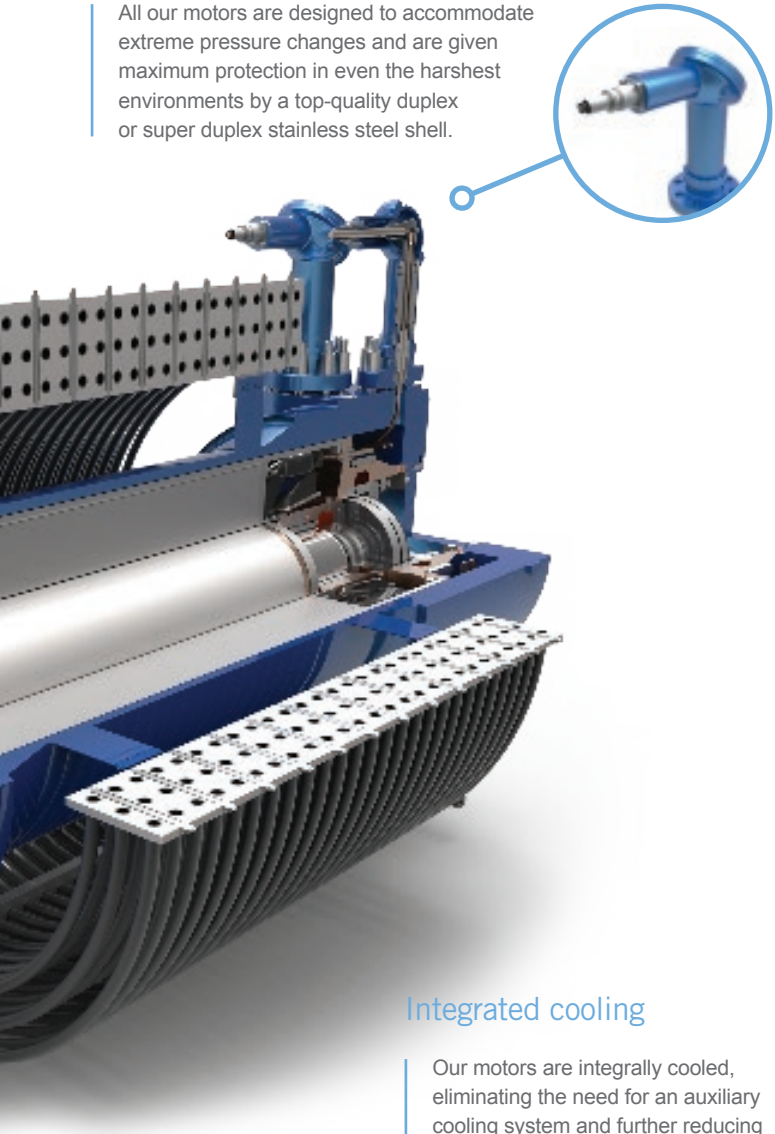
## Seawater protected

A mechanical seal prevents seawater from entering our electric motors when they are immersed, maintaining their integrity whether or not the motor is actually in operation.

| 100% | 35 WEEK | 40,000 | 200 |
|---|---|---|---|
| SAFE EVEN IN THE MOST SENSITIVE OF MARINE ENVIRONMENTS | AVERAGE LEAD-TIME IN DELIVERING COMPLEX PROJECTS | ASSURED HOURS MEANTIME BETWEEN MAINTENANCE | YEAR HERITAGE IN DESIGN, ENGINEERING AND PRODUCTION |

## High protection

All our motors are designed to accommodate extreme pressure changes and are given maximum protection in even the harshest environments by a top-quality duplex or super duplex stainless steel shell.



## Integrated cooling

Our motors are integrally cooled, eliminating the need for an auxiliary cooling system and further reducing the topside space requirement.

## Reduced noise and vibration

When deployed topside, the pumps driven by our submersible motors only generate noise at levels below 80dB – from the movement of the fluid being pumped through deck level pipes – and the design is naturally damped to generate minimal vibration (2.8mm/s maximum).

KEY TECHNICAL FEATURES:

### Subsea

- → 1MW-6MW and 6.6kV-11kV options
- → 3,000m subsea capability
- → Environmentally safe
- → Proven induction designs across range
- → ROV connector options
- → Service interval of 5-years+
- → Fully qualified design
  - thrust/radial bearings
  - motor windings
  - cable joints
  - mechanical seawater seal
  - cooling coils
  - latest tilting pad bearing technology

### Topside

- → 500kW-2.5MW and 6.6kV-11kV options
- → Header tank for visual check
- → High endurance with proven service life of over 25 years
- → 35-week lead time
- → Run-with-leak capabilities
- → Fully insulated cable designs, even with seawater ingress
- → Over pressure designs to ensure no seawater ingress, even after seal failure
- → Minimal environmental impact
- → Low running temperatures = longer lasting motors
- → Low frictional losses = higher efficiencies
- → Environmentally friendly, uncoated designs
- → Dual skin for superior cooling
- → Custom designed hydrodynamic bearings made from low friction materials
- → Totally enclosed to IP68

# Staying in front as the offshore sector's top choice.

We are always striving to maintain and grow our position as the offshore oil and gas industry's first choice for performance-critical motors and pumps, and we are achieving this through an ambitious programme of continuous improvement.

Across our bases in England, the US, China, and India, we are putting in place a strategy that focuses fully on our company-wide 'people, products, processes' philosophy and links back to our 200-year heritage.

A cornerstone is the development of our ground-breaking Centre of Excellence at our headquarters in England, a facility perfectly suited to our ambition to continue to remain at the forefront of design, engineering and production in the 21st century.


ENGINEERING EXCELLENCE
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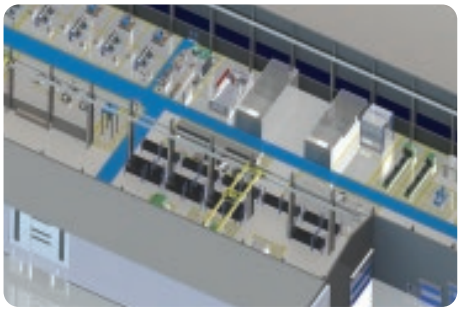


## People

Our people are the very heart of everything we do. We have a highly skilled global workforce passionate about our business, and we have created the right workplace environment for them to grow. As part of our ongoing commitment to their development, we have rolled out lean foundation training for all staff and offer universal access to both in-house and external learning opportunities, including MBAs for our senior managers.

## Products

We have a reputation for reliability and the long-term durability of our fluid-filled motors and pumps and their ability to perform in complex applications and challenging environments. All our products and services are designed to give our customers a competitive advantage and enhanced ROI through excellent lifetime cost of ownership. We invest heavily in world-class research and innovation to ensure our offer remains the best available.

## Processes

Reduced lead times, superior test capability, lean manufacturing and Six Sigma methodologies delivered from our Centre of Excellence all contribute to giving our customers exceptional peace of mind and confidence. We constantly drive operating efficiencies – both internally and in supply chain partnerships – to generate enhanced quality assurance, and our continuous improvement programme is fully focused on eliminating sub-optimal processes across our business.

# Into the future with our Centre of Excellence.

Our multi-million pound investment in the new Hayward Tyler Centre of Excellence is adding new facilities to our already extensive facility in Luton, as well as significant extra support for R&D and the training and development of our workforce.

Hayward Tyler already leads the way in innovative design, engineering and production processes across the energy sector – not just in upstream oil and gas, but also fossil, nuclear, and renewables – and we are committed to further enhancing the products and services we can offer.

For our clients, this means reduced lead times, even better certainty of supply, reliable project delivery, and top-level engineering support and analysis.

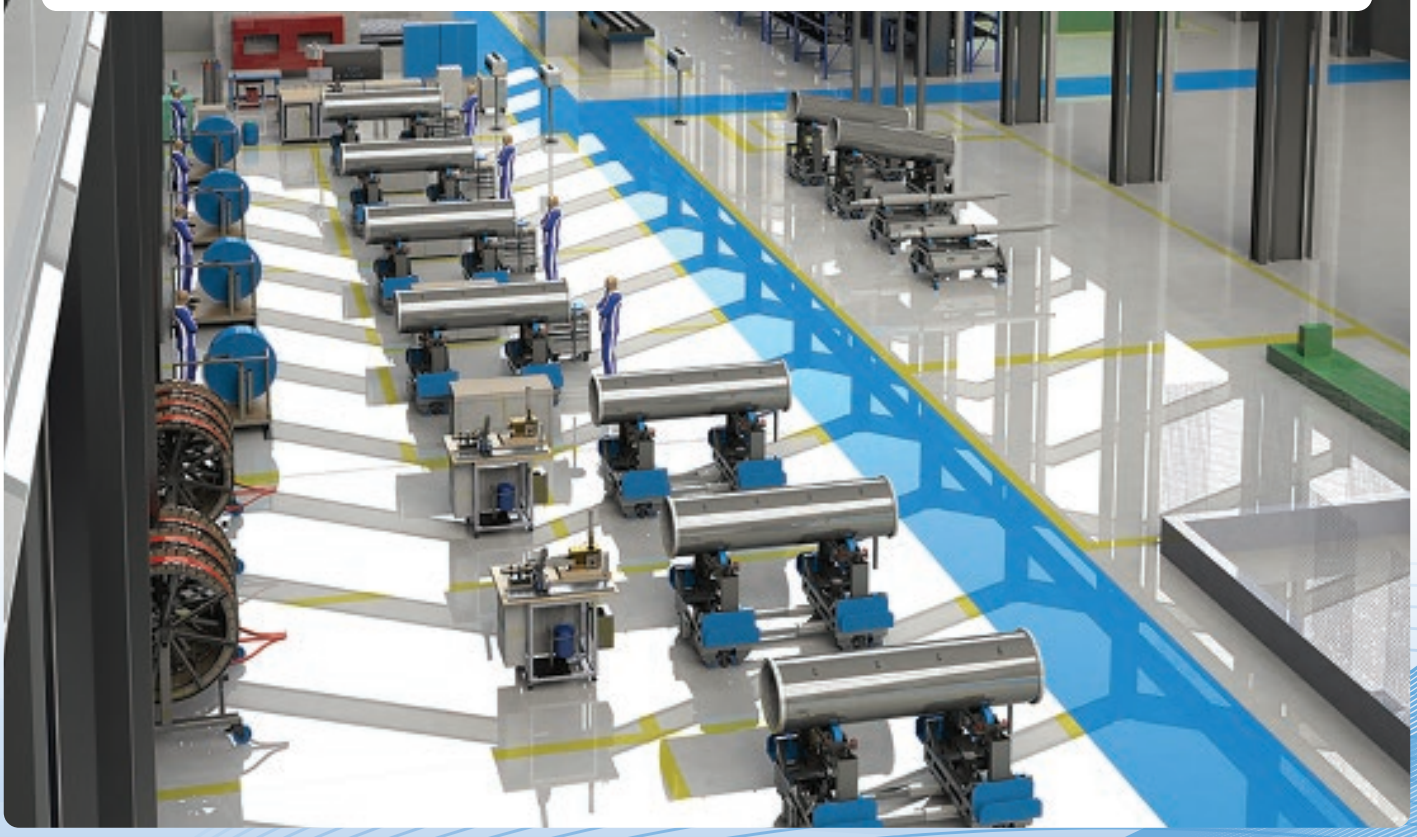
As part of this customer-centric quest for continuous improvement, we have achieved a Civil Nuclear Sharing in Growth award that is allowing us to up-skill our UK workforce to meet 'Fit For Nuclear' standards and this achievement will carry across into all that we do.

Our manufacturing centre is already certified to ISO 9001 and has been granted both ASME and nuclear accreditation, and we are the only UK provider of industry-specific hotbed testing.

> Our expert knowledge, precision engineering and world-class manufacturing processes enable us to deliver unsurpassed product capabilities, reliability and performance.

NUCLEAR AMRC

F4N Fit For Nuclear



# Next generation engineered submersible solutions for the global energy sector

KEY TECHNICAL FEATURES:

## Topside

| Motor Designation | Power | Voltage | Speed | Efficiency | Power Factor |
|---|---|---|---|---|---|
| | kW | kV | rpm | Typical at 100% Load | Typical at 100% Load |
| **800 Y 453 6600** | 600-800 | 6.6kV | 1459 | 89% | 0.78 |
| **1000 Y 453 6600** | 801-1000 | 6.6kV | 1455 | 90% | 0.79 |
| **1001-1500 6600** | 1001-1500 | 6.6kV | 1468 | 90% | 0.82 |
| **2000 Z 453 6600** | 1501-2000 | 6.6kV | 1463 | 92% | 0.82 |
| **800 Y 463 6600** | 600-800 | 6.6kV | 1757 | 88% | 0.77 |
| **1000 Y 463 6600** | 801-1000 | 6.6kV | 1755 | 89% | 0.77 |
| **1500 Z 463 6600** | 1001-1500 | 6.6kV | 1769 | 89% | 0.81 |
| **2000 Y 463 6600** | 1501-2000 | 6.6kV | 1762 | 91% | 0.81 |
| **1500 Z 453 11000** | 1001-1500 | 11kV | 1458 | 92% | 0.76 |
| **2000 EA 453 11000** | 1501-2000 | 11kV | 1477 | 92% | 0.84 |
| **2500 EA 453 11000** | 2001-2500 | 11kV | 1473 | 92% | 0.84 |
| **1500 Z 463 11000** | 1001-1500 | 11kV | 1756 | 91% | 0.77 |
| **2000 EA 463 11000** | 1501-2000 | 11kV | 1771 | 90% | 0.84 |
| **2500 EA 463 11000** | 2001-2500 | 11kV | 1767 | 91% | 0.84 |

## Subsea

| Power | Voltage | Speed (VSD Driven) | Depths | Design Life |
|---|---|---|---|---|
| Up to 6,000kW | 6.6kV-11kV | Up to 6,000rpm | Up to 3,000m | 25+ years |

For further information on Hayward Tyler's next generation of performance-critical motors for submersible and subsea applications, please contact us or visit **www.haywardtyler.com/oilandgas**

HAYWARD TYLER

Engineered solutions for the global energy sector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