



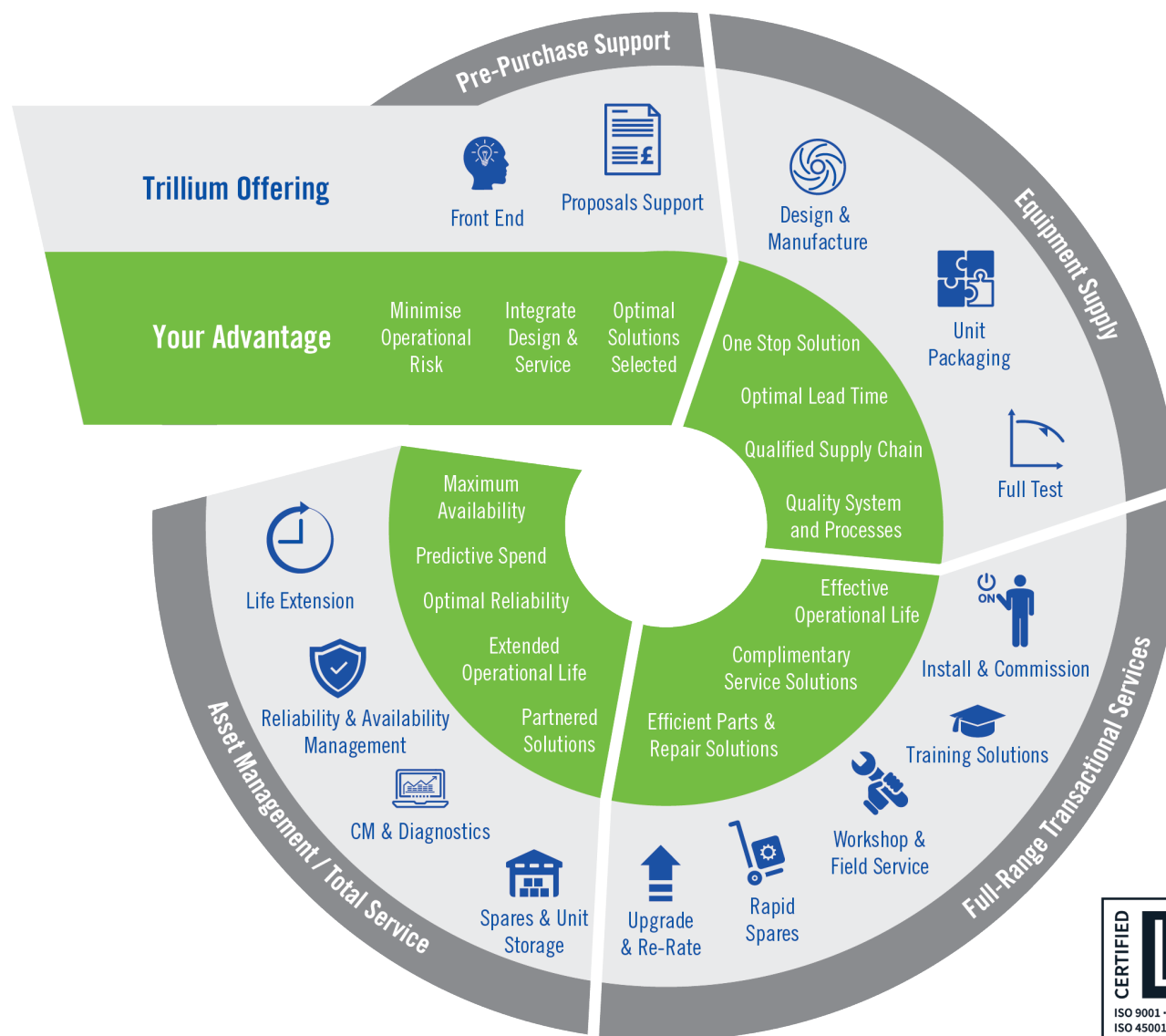
ENGINEERED SERVICE SOLUTIONS  
HIGH INTEGRITY PUMP SERVICE

# YOUR TRUSTED PARTNER

Trillium Flow Technologies is an established pioneer of flow control technology across many industries worldwide.

Our OEM knowledge and project management skills enable our delivery of a complete service. This covers the conceptual support, equipment supply and through life repair, overhaul and optimisation of both Trillium Flow Technologies pumps, valves, and critical equipment together with similar equipment from other OEM's.

We're here to support you through the lifetime of your product and project lifecycle.



# INTEGRATED SERVICE OFFERING

## Integrated Service Solutions / Total Value Maintenance Support

- Comprehensive project and overhaul management
- Embedded Engineering resource under contract
- Managed Service Engineers & Augmented reality specialist support
- Outage Management

## Inspection and Monitoring

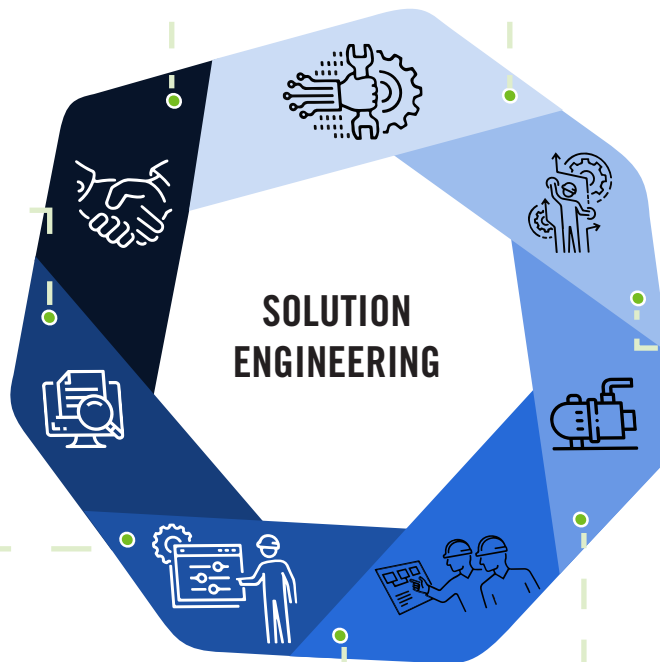
- Condition Monitoring
- NDT and Investigative Analysis
- Operational Performance and Vibration Testing
- Advanced Analytics

## Product Service Training

- Collaborative classroom and workshop training
- Pumping systems and theory
- Application and Issues encountered
- Augmented and Virtual Reality Solutions

## Upgrade and Rerates and Advanced parts Solutions

- Mechanical and Hydraulic Upgrades
- Life Extensions
- Material Upgrades
- Full data capture operational parts including engineering by OE engineering team



## Key workshop service elements OH & Auxiliaries

- Unit Strip Inspect and complete overhaul to Quality Programs
- OE Pump Qualified Service Technicians/Operatives
- Extensive Assembly and alignment jigs/fixtures
- Dynamic balance & performance test capability

## Key Field service elements / Major refit / Overhaul / Outage Programs

- OE Pump Trained and Skilled Field Service Technicians
- Install commission and performance expertise full drive train and auxiliaries
- Activities undertaken at site: NDT, performance testing, strip overhauls and repair
- Augmented reality support by remote specialist and Engineering Hub

## Engineering Hub

- OE Pump Qualified Engineering Team
- Computational Fluid Dynamics and Finite element Analysis
- RCA and Reliability Analysis
- Mechanical, Hydraulic, Electrical Engineering
- Site diagnosis and data analysis

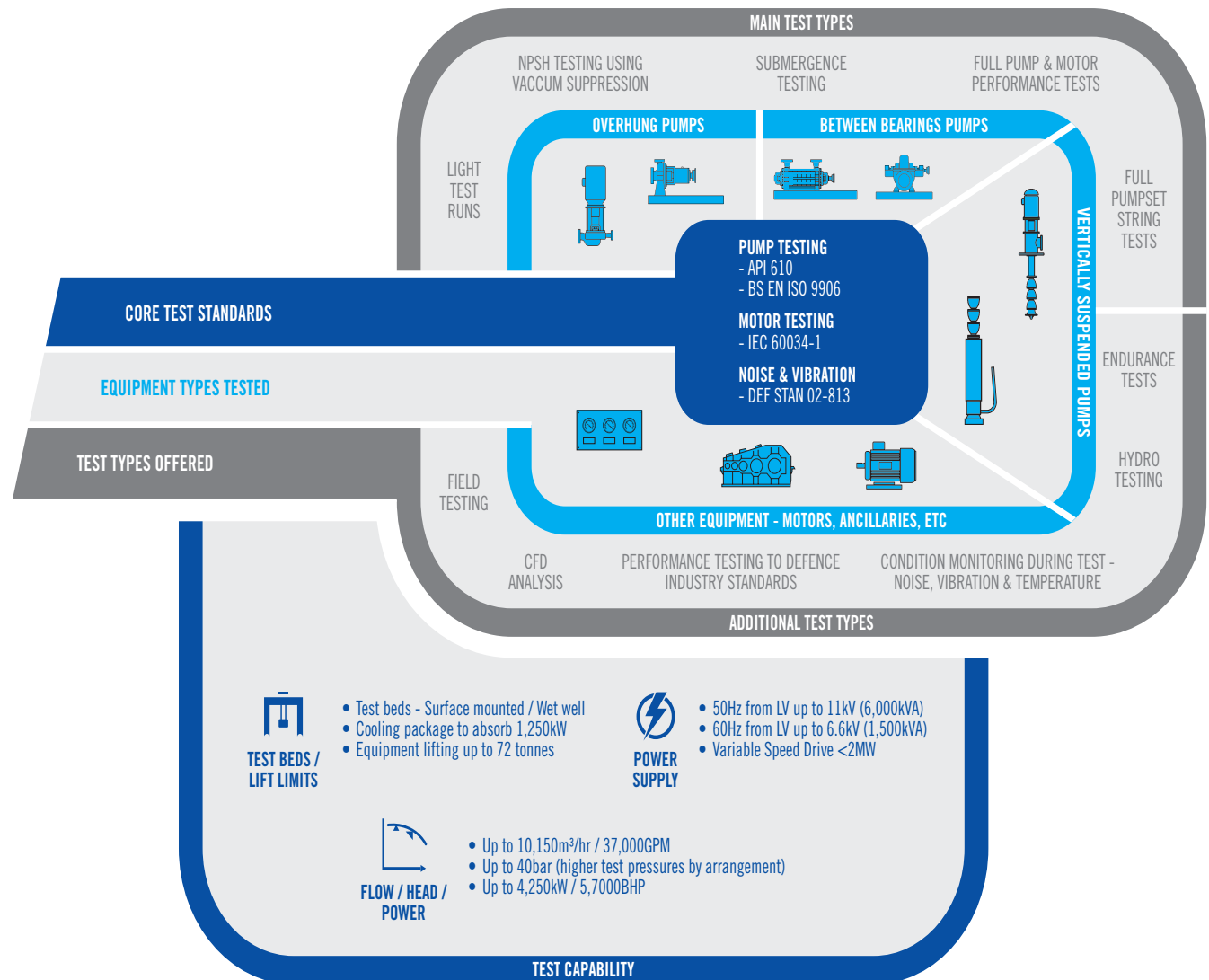
# COMPREHENSIVE TESTING

Our comprehensive test capability provides ultimate peace of mind your pumping equipment will operate first time.

We can conduct a wide range of tests either post service or after upgrade or overhaul. We test across all major pump types, performed to the highest of standards.

Trillium Flow Technologies has a flexible test facility to handle a wide range of equipment. We utilise highly trained technicians to conduct your test and this can be witnessed in person, by your inspector or remotely via our camera and data delivery system.

We test new or repaired equipment from all the major pump brands to the same high standards. This is backed up by our in-house engineering team and global network of pump and valve engineers.



## Material Upgrades Increase Pump Service Life by a Factor of Ten

### Customer / Site

Oil Major / North Slope,  
Alaska, USA

### Applications

Water Injection Pump

### Trillium Offering

Material Upgrades

### Customer Challenge

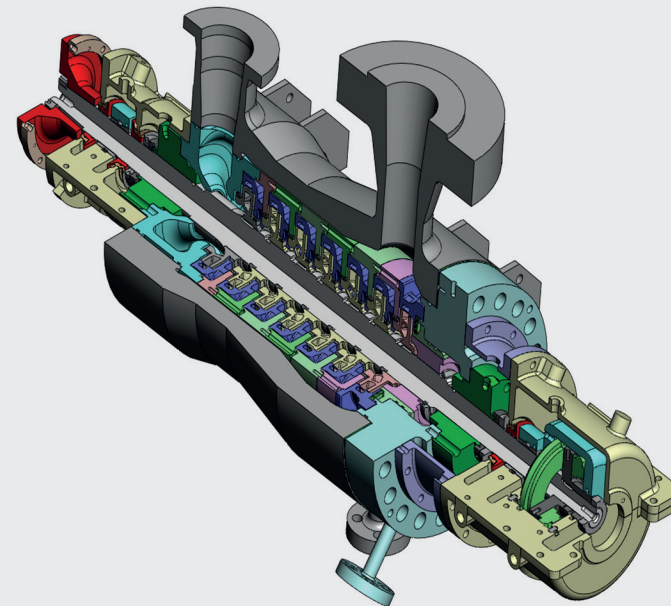
- The customer's multistage pump was pumping produced water with sand and particles present
- This was leading to rapid wear of critical components with some units only lasting 8 weeks in service but typically 6-8 months
- Planned maintenance could not be adopted due to rapid unit failures

### Customer Benefit

- After the Trillium upgrades service life was increased to 4 years between overhaul - typically a factor of 10 over previous average lifespan
- Planned maintenance could be implemented to avoid sudden failures and associated loss of revenue

### Trillium Solution

- Trillium stripped down the unit and conducted a detailed analysis of all wear parts - mainly impellers, diffusers, seals and balance drum bush
- Seals were upgraded to stellite and impellers upgraded to a special grade of duplex SS with Boart/tungsten carbide wear surfaces
- Balance drum bush was also coated with Boart S6 to increase wear rate
- Pump was reassembled and put back into operation. Wear rates on previously worn parts were checked after 9 months with minimal damage seen



Material upgrades matched to duty conditions can frequently offer significant wear life extension



# CASE STUDY

## MBFP Booster pump overhaul and Design Improvement

### Customer / Site

UK Power Generation

### Applications

Main Boiler Feed System –  
Suction Booster unit

### Trillium Offering

Overhaul was part of a series of feed pump overhauls carried out for EDF Energy around their UK nuclear generation fleet

### Customer Challenge

- Unit had been in service for an extended period of time
- Thrust collar had become slack on the pump shaft causing vibration and reliability issues
- Leaks present at suction cover from main gasket

### Customer Benefit

- Reduced overhaul interventions
- Cost and lead-time reduction by recovering ex-service shaft instead of new supply

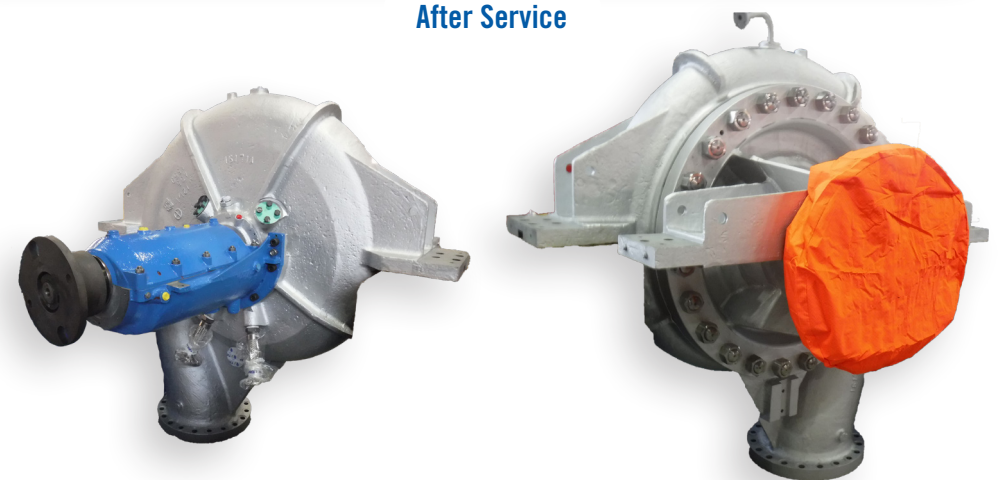
### Trillium Solution

- Full Strip, Inspect and report carried out detailing scope of work for rebuild
- Re-designed thrust collar and collar locking arrangement
- Shaft repairs via chrome and nickel coating to remove fretting and journal bearing operational damage
- New design 'metaflex' controlled gasket arrangement fitted in place of original copper backed gasket design
- Unit dynamically balanced, fully assembled and preserved for long term storage

**MBFP Booster pump overhaul incorporating design upgrades to reduce future overhaul interventions and reduce cost of overhaul to client**



Before Service



After Service

## Re-Engineered Problematic Sea water lift pump

### Customer / Site

UK North Sea FPSO

### Applications

Sea water lift pumps  
on FPSO

### Trillium Offering

Review installed units, develop  
cost effective solution and  
undertake unit upgrades

### Customer Challenge

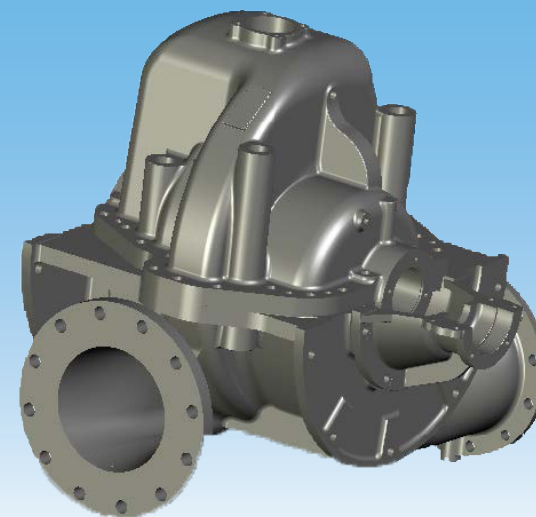
- Installed sea water lift pumps required high frequency of overhaul
- OEM for installed units unavailable for product support
- Trillium Flow study confirmed existing units were not API 610 compliant
- Space envelope limited to installed units

### Customer Benefit

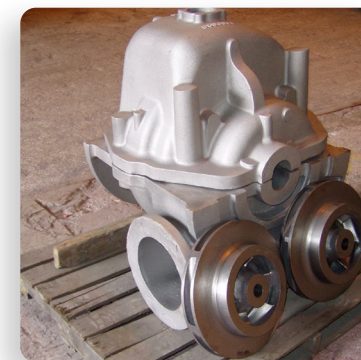
- Reduced overhaul interventions
- Improved unit installed within existing envelope

### Trillium Solution

- Full investigation and RCA undertaken
- Existing unit geometry captured and 3 dimensional computer model generated
- Trillium Flow design engineers incorporate API 610 design features in computer model together with modifications to casing bolting and sealing
- Unit rebuilt with redesigned casings within original design envelope including improved hydraulics
- Unit performance tested and witnessed prior to reinstallation on FPSO



Zeron Castings and casing at qualified  
supply Foundry



Previously problematic sea water lift pump upgraded and reinstalled within limited existing FPSO pipework system

# CASE STUDY

## Critical MOL Pump Rerate

### Customer / Site

Offshore Platform UK

### Applications

Main Oil Line Pumps

### Trillium Offering

Investigation and rerate of hydraulic design to match actual site operating conditions

### Customer Challenge

- Site hydraulic operating conditions differ from original design conditions
- Higher power consumption and units operating inefficiently

### Customer Benefit

- New unit installed designed for optimum performance at revised duty condition
- Replacement cartridge within existing barrel avoiding invasive redesign offshore layout
- Operating costs reduced

### Trillium Solution

- Assessment operating conditions and selection optimum hydraulics for 'as-is' duty
- Design new cartridge for replacement within existing barrel physical envelope
- Supply new main oil line cartridge with redesigned shaft, impellers, diffusers for required duty flow



Custom replacement pump cartridge supplied to meet specific operating conditions



# SERVICE RESOURCES

## Workshop

### Workshop

- Lifting capacity: 70 tonnes, 10m hook lift
- Machine balancing – up to 18 tonnes, 2.55m max dia, 5m max length
- Heavy engineering fitting & machine shops
- High integrity pump workshop
- Electro submersible pump workshop
- Integrated valve & actuator Workshop
- Turbine production & overhaul

### Specialist Services

- Technical solutions via dedicated Engineering Group
- Advanced coatings – repair, high efficiency & anti-corrosion
- Critical part solutions – re-engineering & part manufacturing
- Non-destructive testing & condition monitoring
- Grit blasting & painting
- Long Term Service Agreements (LTSA)
- Asset Management Controller Embedded Engineers.
- In-Situ Valve seat replacement
- Reliability Engineering

## Machining

### Heavy Machining

- Lifting capacity: 70 tonnes; 10m hook lift
- Turning capacity: 7.62m length; 1.2m swing dia over saddle
- Horizontal boring: 3m x 7.3m table; 2m spindle height
- Vertical boring: 6.7m table with 7.3m swing
- Hydraulic press: 100 tonnes vertical
- Drilling: 125mm hole dia; 1.2m – 1.5m arm radius; 1.5m height

### Light Machining

- Lifting capacity: 15 tonnes; 7.6m hook lift
- Conventional turning capacity: 4.6m length 0.64m swing
- CNC Turning: 2m length, 300mm swing (600mm at chuck)
- Vertical boring: 1.5m chuck
- Conventional Milling: 1.2m x 0.3m Table – 0.4m height
- CNC Milling: 1.6m x 0.762m table–0.635m height
- Slotter: 75mm key slot width x 1.4m length
- Grinding: 3m length, 0.3m swing

## Test

### Pumps

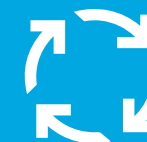
- Up to 10,150m<sup>3</sup>/hr / 37,000GPM
- Up to 40bar / 580psi (higher test pressures by arrangement)
- Up to 4,250kW / 5,700BHP
- Power supply 50Hz up to 11kV / 60Hz up to 6.6kV
- Variable speed drive <2MW

### Valves & Actuators

- All Types/makes of valve overhauls carried out, up to 72" (Safety / control / butterfly / pilot assisted safety / gate etc)
- General valve testing up to 640bar / 9,280psi
- Actuator torque ranges 0-500Nm and 0-2,000Nm
- Torsion bar hysteresis testing



Qualified People



Proven Process



Quality Supply Chain



Delivery as Planned



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