Steam Turbine Solutions
Meeting client needs through every stage of project execution
Supplying customised steam solutions for 150 years.

Why choose a Peter Brotherhood steam turbine?

• Highly efficient, maximising power output and profitability
• High reliability, low maintenance, rapid return on capital investment
• World beating delivery times
• World-class project management
• Stringent compliance to customer specifications
  - meet international standards compliance
  - excellent after sales care
• Global reputation of delivering energy efficient solutions for land and marine based application
• Reliable, long service life (25+ years)
• Specialist application engineering capabilities

Powering customer profits in over 100 countries

40 MW
UK’s only producer of steam turbines with outputs up to 40 MW

24/7 customer care and servicing globally

1,000+
steam turbines supplied for marine applications

33 MW
world leader in turbo generators for floating production vessels, including one of the world’s largest of 33 MW

500+
steam turbines installed in the Cane Sugar industry

1,000 MW
installed power in Waste to Energy power plants
Peter Brotherhood are specialists in the design, manufacture, installation and servicing of steam turbine generators up to 40 MW.

We’ve delivered many world-firsts – including the first extraction-condensing Steam Turbine Generator (STG) on an FPSO and two of the largest STGs on an FLNG – that’s why we have a global reputation as the first choice company for specialist steam turbine applications.

Our steam turbines cover a range of applications such as:

- Combined cycle and cogeneration
- District heating
- Industrial processes (Energy from Waste)
- Sugar mills
- Oil and gas production
- Refineries
- Petrochemical plants
- Floating Production Storage & Offloading (FPSO) vessels
- Floating Liquified Natural Gas (FLNG)
- Floating Storage & Regasification Unit (FSRU)
- Waste heat recovery, industrial and marine applications

We don’t just produce steam turbines. We design and manufacture reciprocating gas compressors, gas engine based CHP systems, special purpose machinery and gearboxes. We provide the complete service – from initial concept development to installation and commissioning, as well as after sales support and on-site maintenance.

From design through to commissioning, we work to the highest quality assurance standards, including ISO 9001:2000, ISO 14001:2004 Environmental Management Standard and OHSAS 18001:2007 Health & Safety management.

We combine traditional engineering skills with the latest techniques and equipment and have been providing engineered solutions to global customers since 1867.

Our Markets

- Marine
- Offshore production
- Sugar processing
- Petrochemical
- Waste to Energy power plants
- Combined Heat & Power (CHP)

Steam Turbine Types

- Condensing
- Extraction condensing
- Back pressure
- Extraction back pressure
- Induction (mixed pressure)

Standards

- API 611, 612, 613, 614
- NEMA SM23, SM24
- IEC 45-1
- ATEX
- IEC 60034

Third Party Classifications

- Lloyd’s
- DNV GL
- ABS
- BV
- RINA

We have supplied steam solutions for a variety of applications not listed above. Please contact us with your individual application requirements.
Customised steam turbines to answer business and environmental challenges

Peter Brotherhood has a global reputation for delivering practical and economic engineering solutions. Our team of world-class engineers has experience in designing products and systems for many different industries.

Design Capabilities
We are not an ‘off-the-shelf’ supplier that engineers a solution to fit around our turbines. At Peter Brotherhood, each turbine is individually designed to match the customer’s specification. Our design engineers are some of the finest in the world when designing for difficult applications such as remote locations or harsh marine environments.

Our mechanical and electromechanical skills are complemented by expertise in sophisticated control systems and software to ensure the optimum product performance.

We use a modular form of construction to enable standardisation of service-proven components. All our turbines and systems are customised to the client’s exacting standards, international industry standards and regulations. We can help at every stage of development, from initial concept design through to production of detailed manufacturing drawings.

The service is totally flexible, enabling our skills to be utilised wherever appropriate. Designs can be produced to conform to any international, national or industry standard required.

ADVANTAGES OF CHOOSING A PETER BROTHERHOOD STEAM TURBINE
- Highly efficient, maximising power output and profitability
- Customised steam turbines answering customers individual requirements
- Best in class delivery times
- Design and manufacturer of steam turbines since 1907
- Global reputation of delivering energy efficient solutions for land and marine based applications
- Range from 1 MW to 40 MW
- Reliable, long service life (25+ years)
- Low maintenance (5+ years service intervals)

Reputation for Reliability
Peter Brotherhood has a “right first time” culture that has given us a global reputation for delivering practical and economic engineered solutions. Our world-class engineers are highly experienced in designing products and systems for many different industries, producing highly efficient machines for maximising power output and profitability, wherever they operate.

Committed to steam turbine efficiency and performance Peter Brotherhood minimise their impact on the environment through an environmental management system approved to ISO 14001.

We provide a complete service from initial concept development to installation and commissioning, as well as after sales support and on-site maintenance.
Customised steam turbine generator sets
Solutions built to deliver a competitive advantage

For power generation applications Peter Brotherhood provide a complete package comprising the turbine, gearbox, generator, instrumentation, control and monitoring systems and associated auxiliary equipment. These units are normally mounted on a fabricated baseplate so that they can be transported to site in their assembled form, reducing site installation time.

1. Steam Turbine
   Oil operated fail safe isolation valve with steam regulation through single or multi-valve control. The rotor and discs are manufactured from a single piece forging. Bearing pedestals are separate from the steam casings and exhaust orientation can be up, down or axial.

2. Condensers
   Water-cooled multi-pass shell and tube condensers can be provided together with vacuum-raising equipment and condensate extraction pumps.

3. Lubrication
   Forced lubrication is normally provided by an oil pump driven from the gearbox. The oil is contained in the turbine base-plate and is passed through a heat exchanger and duplex cartridge type filters to the bearings and gearbox. A completely separate lubrication oil console can be supplied in accordance with the customer’s specification and/or to API 614 standard.

4. Gearing
   Peter Brotherhood turbine frames operate in the speed range 4,000 – 15,000 rpm. They are geared to the driven equipment’s speed using a reduction gearbox.

5. Instrumentation
   The level of instrumentation can be tailored to suit customers’ needs and ranges from a simple local control panel to a sophisticated monitoring system remote from the turbine.

6. Control & Monitoring System
   Electronic speed governing devices are fitted to provide either remote or local regulation of the turbine. Monitoring of vibration and the axial displacement of the rotor shaft can also be incorporated. Remote or local push-button starting using a PLC-based control system can be provided, as can systems to provide full remote control of the turbine.

7. Security Trip Systems
   An emergency trip is fitted on each turbine to trip it in the event of any fault condition arising. A SIL 3 electronic overspeed trip system is fitted as standard. Programmable control systems can be provided which initiate shutdown of the turbine in response to a variety of conditions, ranging from excessive vibration to low oil pressure.

8. Generators
   Well-established relationships have been built with a number of leading generator suppliers to allow the company to supply the optimum unit for any application.
Marine & Offshore Production
Peter Brotherhood has been supplying steam turbines to the marine industry for over 100 years.
Having considerable experience of marine standards, classification society requirements and petroleum industry standards, Peter Brotherhood has found itself in a unique position to provide steam turbines for FPSO (Floating Production Storage & Offloading) vessels, FLNG (Floating Liquified Natural Gas), and FSRU’s (Floating Storage Regasification Unit).
The use of such vessels for the recovery of offshore oil and gas is growing and Peter Brotherhood has supplied over 40 steam turbines that ensure reliable and efficient power supplies.
Our steam turbine packages are specifically designed to fully integrate within the confined spaces available on marine vessels. We even help layout the turbine machine space and engine room to ensure that our turbine fits and that there is enough room for disassembly and laydown areas for equipment. Peter Brotherhood will work with you to fully understand your needs and to develop solutions to the problem.
Efficiently designing a turbine’s footprint is not done at the compromise of maintenance – all equipment that requires planned maintenance such as oil filters are positioned so that ease of access is maximised.

Specialist application design – powering business across a range of industries

OFFSHORE EXPERTISE
Our machines are designed to withstand the harshest environmental conditions the oceans can produce. We accommodate the pitch, roll, yaw, sway, heave and surge of the vessels, along with the wave induced deflections. If our turbines can run in these conditions, they can run anywhere.

We have developed many world-firsts for the marine industry:
• First Turbo Compound System (TCS) for container ships
• First steam turbine waste heat recovery on a vessel
• First controlled extraction condensing STG on an FPSO
• Largest deck mounted turbine generator sets on an FPSO

We have also been a trusted supplier to the Royal Navy for over 140 years, including supplying turbines for the Astute class of submarine.

Delivering power to recover “marginal oil”

Location: Offshore Brazil
Market: Marine
The FPSO required steam turbine generators to provide process power to the vessel which is capable of producing 100,000 barrels of oil per day. Peter Brotherhood supplied 3 x 24 MW steam turbine generators to fulfil the vessel’s power consumption requirements.
Peter Brotherhood’s reliable and robust design ensures that process power is constantly available to achieve this target. Due to vessel space constraints the steam turbine generators are located on the topside of the vessel exposed to the offshore environment – the harshest location for any equipment.
Topside, the forces, moment and accelerations transferred from the vessel motion to the steam turbine generator have to be considered during the design phase of the machine to ensure that tight clearance and alignments are not exceeded. Peter Brotherhood’s considerable experience in this industry means we know and understand the rigours of topside operation to ensure the reliability of this process critical application.

Peter Brotherhood has supplied equipment up to 27 MW to many of the world’s leading FPSO operators including: Woodside, Single Buoy Moorings (SBM), BW Offshore, Bluewater, Saipem, Aker Floating Production, Fred Olsen Production and Maersk.
Oil & Gas Process Industries
The oil, gas and petrochemical industries are large users of steam turbines for driving pumps, compressors and generators. Peter Brotherhood has supplied many steam turbines for use in these industries both on land and offshore. This industry has stringent specifications for both equipment safety and application. Peter Brotherhood has a highly experienced team who can work with customers to meet these exacting standards. Through this close relationship with our clients, Peter Brotherhood are able to deliver exactly what the client wants.

The Peter Brotherhood advantage

Open Cycle Diesel Power Plant

Combined Cycle Diesel Power Plant

Reduction of energy costs and improved efficiency

Location: Europe
Market: Power Generation
Peter Brotherhood was approached by a newly constructed diesel engine power station in Malta to increase its overall efficiency. A steam turbine generator was required to convert the heat generated from the diesel engine exhaust gases into additional energy to the grid.

• Our steam turbine design proved invaluable as we had previously supplied the same customer with a similar solution for the same application in Kenya
• Diesel engine exhaust gas heat converted into free energy
• Power output of plant increased by 10%

WE DO MORE
Our world-class engineering and project management teams frequently take on additional scope of supply for projects such as:

• Foundation design
• Steam inlet & exhaust piping design
• Safe area segregation enclosures
• Steam by-pass system & dump condensors
• Incoterm (Extended delivery)
DECADES OF ENGINEERING EXCELLENCE ENABLE US TO DESIGN AND MANUFACTURE STEAM TURBINES SPECIFIC TO YOUR UNIQUE APPLICATION AND PROJECT NEEDS.

Specialist application design – powering business across a range of industries

Energy from Waste
Peter Brotherhood has been engineering energy from waste systems globally since the 1950’s. Our solutions are used across a vast spectrum of applications where waste can be used as a fuel to heat steam and drive a turbine generator set to produce power. A Peter Brotherhood condensing steam turbine in a UK energy from waste plant generates power from steam raised by the incineration of meat and bone meal. In addition to the 9.1 MW turbine generator set and water-cooled condenser, the company was also responsible for the supply of a weatherproof acoustic enclosure over the complete unit.

A client in Spain has installed an 8 MW condensing steam turbine generator set in an olive waste fired power plant. The turbine is used to supply the plant’s steam requirements and the electricity generated is sold to the Spanish grid.

OPPORTUNITIES TO PRODUCE ENERGY
- Biomass
- Landfill gas
- Sewage digester gas
- Mines gas
- Coke oven gas
- Refinery flare gas
- Bagasse & other agrifibres
- Clinical waste
- Sewage sludge
- Coppiced wood
- Sawmill / wood processing waste
- Forest residues
- Municipal solid waste (MSW)
- Refuse-derived fuel (RDF)
- Meat and bone meal (MBM)
- Used vehicle tyres
- Olive-milling waste (OMW)

Generating power and revenue from waste

Location: UK
Market: Waste-to-Energy
Meat & Bone Meal (MBM) fired waste-to-energy plant harnessing a Peter Brotherhood steam turbine to generate 14 MW of green energy.

- Local waste is used to provide power back to local homes and industries
- Our extensive experience in the waste-to-energy market ensures an efficient, reliable grid compliant machine to maximise up-time
- Another repeat customer, which endorses the equipment and overall service that we supply

Peter Brotherhood has considerable experience in waste heat recovery and combined heat and power projects. We are able to deliver to extremely short delivery deadlines.
Sugar Industry Expertise
Peter Brotherhood has been supplying steam turbines to sugar mills all over the world with proven reliability of 60 years. We have in excess of 500 steam turbines installed in the sugar cane industry. Cane sugar mills are often sited in remote locations and therefore need to generate their own power. The vast majority burn bagasse, the waste product left after processing sugar cane, to raise steam to drive turbines.

Steam turbines can export energy to the grid to provide an additional revenue stream for the sugar mill as well as providing a secure electricity supply to the local area, bringing vital energy to the local hospital, schools and community.

Single stage machines are used for mill and cane shredder drives; multi-stage machines are normally used for the generation of electrical power.

Using Bagasse to generate profits

WASTE-TO-ENERGY
Steam turbines produce energy from a waste product providing a self-sufficient power supply to the plant:

• Helping to reduce its running costs
• Making it self-sufficient
• Providing reliable power
• Surplus power can be used to power local villages and communities - benefiting the local community that otherwise would not have power or certainly an unreliable source of power due to the remote location

Powering sugar mills and the local community

Location: Zimbabwe & Mozambique
In Southern Africa our customer installed what is believed to be the largest back pressure steam turbines operating in an African sugar mill – almost 50 per cent bigger than any similar machine. The 20 MW back pressure turbines use steam raised from burning bagasse to generate the mill’s electrical power and the exhaust steam is used in the sugar production process. In addition to providing the mill’s electrical power, the turbines also export power to the national grid.

Location: South Africa
The Komati sugar mill in South Africa processes 2.6 million tonnes of sugar cane in 38 weeks at a rate of 500 tonnes per hour. In a world beating delivery time we installed a multi-stage steam turbine, gearbox and AC generator to fit a very unconventional layout. Working across the entire sugar mill process we optimised the system to give our customer the flexibility of power and process steam capabilities which allowed them to optimise the use of the mill’s energy so it could sell the excess power to the grid at any time. Through burning bagasse the mill has a self sufficient power supply, is environmentally friendly and carbon neutral at the same time.
Our reputation for engineering is driven by our commitment to quality and client needs

**Project Management**
All customer projects are managed carefully through our manufacturing facilities by experienced teams of project managers, supported by production control and procurement staff. Our purchasing teams include commercial specialists and engineers who source components from companies across the world. We select suppliers carefully in order to maintain high quality product standards and reliable service in-line with project requirements. Our project managers are the focal point of customer orders during production. They use the latest software and systems to track every aspect of a customer order to ensure its smooth transition through our factory.

The project management team all possess extensive experience of working within a global market and cultures, and provide all of our clients continuous communication throughout the project lifecycle, from pre-award to handover.

**Blades**
The quality of our blading meets the highest standards. Where blading has been redesigned, improved efficiency has been proven when the turbines are returned to service. The company’s sophisticated machine tools enable us to manufacture straight or tapered and twisted blades, machined from solid metal billets to ensure the material integrity of the blade during operation. Materials are carefully selected by the company’s design engineers to meet the demands of the unique operating conditions of each machine. Blades can be manufactured and delivered to the customer within a very short timescale thus reducing machine downtime.

Peter Brotherhood manufactures, supplies and fits rotor blades for many makes of turbine and can reproduce any blade profile and root section, making allowances for wear and damage. Component drawings can automatically be produced or the data transferred direct to the machine tools. This process reduces manufacturing lead times significantly. A full fitting and balancing service providing certification to meet every safety and insurance requirement backs up the blading facility. The service engineers can provide onsite re-assembly and re-commissioning to ensure safe and efficient operation of the customer’s turbine.

**LIVE STEAM TESTING CAPABILITY**
Peter Brotherhood test all of our products on live steam. We can produce 400°C 40 bar steam with a maximum flow rate of 12 tonnes per hour allowing us to test the whole range of products at full speed with no load. This capability allows Peter Brotherhood to mechanically test the entire steam turbine package complete with contract control system, to rectify any issues within the factory environment with the right personnel, equipment and support to hand.

The quality of our blading meets the highest standards – we believe it is second to none. This is achieved by state of the art machining, measurement and quality control techniques.
Engineering Excellence
Peter Brotherhood’s purpose-built world-class facility has first-class design and manufacturing facilities and a highly skilled workforce. Peter Brotherhood offers a complete “one stop shop” from development of an initial concept through to site installation and commissioning, with a service tailored to meet client requirements. Peter Brotherhood works to ISO 9001:2000 quality assurance standard, ISO 14001:2004 Environmental Management standard and OHSAS 18001:2007 Health & Safety management.

Skilled Workforce
We are a highly skilled, multi-disciplinary team of professional engineers dedicated to fulfilling customer needs worldwide. The company’s analytical and design facilities include CAD/CAM, finite element analysis (linear, non-linear and multi-physics), computational fluid dynamics (CFD), and programs for rotor dynamics, heat transfer, control system design and materials science. These are complemented by advanced manufacturing, monitoring and test facilities.

Our steam turbines are the result of continuous, evolutionary development, to maximise efficiency for lower fuel consumption and carbon emissions.

The complete service - from initial concept development to installation and commissioning, as well as after sales support and on-site maintenance.

Installation & Commissioning
World-class project management ensures that globally sourced components arrive on-site, on-time to start a seamless installation and commissioning process. Our team of experienced field service engineers are able to coordinate and conduct activities from the inspection of the turbine foundations to the commissioning and hand-over of the machine to the customer on land and marine based packages.

Servicing & Peace of mind
Peter Brotherhood offer repairs and re-rating to any make of reciprocating compressor or steam turbine. A highly skilled team of engineers provide round the clock worldwide services. Often working under extreme conditions, the engineers are dedicated to solving customers’ problems and reducing down time. The engineers are supported by design and technical staffed based at Peter Brotherhood’s head office in the UK and if required, can be sent to the customers facility. This, together with an international network of partner companies that offer local support and assistance, ensures we have the right personnel to provide solutions in the shortest time possible.

Continuous R&D
Our ongoing R&D, combined with the feedback from many hundreds of products in the field allows the company to continuously develop designs and manufacturing procedures, improving product capability, reliability and performance. This minimises the time taken to implement new developments and maximises the company’s responsiveness to customers’ needs.

The 11,000m² manufacturing area includes:
- Assembly
- Machining
- Welding and fabrication
- Test bed with live steam
- Heat treatment
- Acid plant
- Pipe fabrication
- Warehouse and stores
- Radiography booth
- NDT – ultrasonic, dye penetrant, magnetic particle

In-house capabilities include:
- Assembly / testing of machines weighing up to 100 tonnes
- Overhead crane capacity of 50 tonnes
- Gas, metal arc, MIG, and TIG welding
- Paint and blasting
- CNC and conventional machining
- Turbine blade manufacture
- Non-destructive testing
- Hydro testing
- Balancing

Manufacturing to quality standards including:
- NEMA SM24
- IEC 45-1
- API 611, API 612
- API 613
- API 614
- ISO 9001:2000
- ISO 14001:2004
- OHSAS 18001:2007
- International Standards
- National Standards, CE Norms, European Directives
- Client and / or Industry Standards

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Peter Brotherhood - a proud history of steam turbine innovation

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
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<tbody>
<tr>
<td>1838</td>
<td>Peter Brotherhood born (1838-1902)</td>
</tr>
<tr>
<td>1861</td>
<td>Peter Brotherhood supervises installation of new rudder post and paddle wheels on Isambard Kingdom Brunel's vessel The Great Eastern - the largest ship in the world at the time</td>
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<tr>
<td>1867</td>
<td>Peter Brotherhood company founded</td>
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<tr>
<td>1872</td>
<td>Invented the three cylinder radial steam engine - the first steam engine to be coupled directly to a dynamo</td>
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<tr>
<td>1875</td>
<td>Installed steam driven generator sets on the French warship Richelieu - the first major vessel in the world to have electricity</td>
</tr>
<tr>
<td>1876</td>
<td>Installed steam driven generator sets on HMS Invincible - the Royal Navy’s first vessel to have electricity</td>
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<tr>
<td>1879</td>
<td>Supplied 18,000 kW condensing machines to coal fired power stations in the UK</td>
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<tr>
<td>1894</td>
<td>Supplied the first Peter Brotherhood steam turbine to the cane sugar industry</td>
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<tr>
<td>1924</td>
<td>Supplied the world’s first marine waste heat recovery steam turbine</td>
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<tr>
<td>1926</td>
<td>Supplied 10,000 kW back pressure turbine generator set to the Australian sugar industry</td>
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<tr>
<td>1994</td>
<td>Moved to existing location in Peterborough</td>
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<tr>
<td>2001</td>
<td>Supplied 20,000 kW back pressure turbine generator set to a sugar factory in Zimbabwe - the largest in Africa</td>
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<tr>
<td>2003</td>
<td>Supplied 27,000 kW turbine generators, the largest in the world on an FPSO</td>
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<tr>
<td>2005</td>
<td>Supplied 24,000 kW turbine generators, the largest in the world on an FPSO</td>
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<tr>
<td>2006</td>
<td>Supplied 8,500 kW turbine generator set to Emma Maersk, the world’s largest container ship</td>
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<tr>
<td>2007</td>
<td>Supplied 27,000 kW turbine generators, the largest in the world on an FPSO</td>
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<tr>
<td>2008</td>
<td>Supplied 17,650 kW turbine generator in a diesel engine combined cycle - the largest in the world at this time</td>
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<tr>
<td></td>
<td>Installed three 24,000 kW turbine generators on an FPSO, the largest amount of steam produced electrical power output at sea</td>
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<tr>
<td>2012</td>
<td>Supplied two 16,000 kW extraction turbine generator sets to FPSO for the North Sea, the world’s first extraction condensing machines on an FPSO, and the largest in the North Sea</td>
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<tr>
<td>2013</td>
<td>Supplied 38,000 kW back pressure turbine generator set - the largest in the world to the Mexican sugar industry</td>
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<tr>
<td>2015</td>
<td>Supplied two 33,000 kW turbine generator sets to the world’s first converted FLNG vessel</td>
</tr>
<tr>
<td>2016</td>
<td>Supplied steam turbine generator sets to the Royal Navy - 140 years of continuous supply to the same customer</td>
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For your next steam turbine solution please contact our sales team on: +44 (0)1733 292200 or sales@peterbrotherhood.com