



TWIND Summer School

The use of project management to reduce costs

Amorina González Armayor

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Defining the Supply Chain for OFFSHORE WIND in Portugal



<https://twindproject.eu/news-and-events/>

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Defining the Supply Chain for OFFSHORE WIND in Portugal

Country	Name of the company	Development & Consent							
		Surveys	Met Masts / Wind Monitoring	Planning / Consenting	Engineering & Design Studies	Consultants	Human Impact Studies & Stakeholder Engagement	Certifications	Other services
									Website
PT	AICEP Portugal Global								http://www.portugalglobal.pt
ES	Aquatera	✓		✓	✓	✓			https://www.aquatera.co.uk
PT	AREAM - Regional Energy and Environmental Agency of Madeira Autonomous Region	✓			✓	✓	✓		https://aream.pt
PT	ASM Industries								https://asm-industries.com
NL	Bluewater Energy Services BV								https://www.bluewater.com
PT	BNP Paribas								https://www.bnpparibas.pt
ES	Bosch Rexroth				✓	✓			https://www.boschrexroth.com
FR	Bourbon Subsea Services				✓			(1)	https://www.bourbonoffshore.com
UK	Carbon Trust			✓	✓	✓			https://www.carbontrust.com
ES	Casco Antiguo					✓			https://www.cascoantiguo.com

https://twindproject.eu/wp-content/uploads/2020/06/TWIND-Matrix_v1.0_17062020.pdf



Development & Consent

Surveys
Met Masts / Wind Monitoring
Planning / Consenting
Engineering & Design Studies
Consultants
Human Impact Studies & Stakeholder Engagement
Certifications
Other services

Infrastructure

Manufacture / Supply / Installation of Cables
Cable Protection / Scour Protection
Diving Services / ROVs
Structural Components
Engineering Services / Components
Electrical Services / Components
Vessel Construction and Maintenance
Facilities & Structure
Other services

Installation & Commissioning

Foundation / Station Keeping installation
Logistics / Warehousing
Lifting / Cranage
Lighting / Navigation
Sea Based Support
Turbine / Substation Installation
Other services

Professional Services

Legal / Financial Services
Professional Body / Membership Group
IT / Specialist Software
Project Management
PPE / Health & Safety / Equipment
Training / Education
Hire Services
Ancillary Services / Supply Chain Services
Other services

Operation & Maintenance

Port & Support Services
After Warranty Period
Personnel Services
Condition Monitoring
Access Services / Slings / Working at Height
Commercial Marine Services
Emergency Response / Crisis Management
Vessel Hire / Commissioning
Technician & Equipment Transfer
Coatings / Protection / Cleaning
Offshore Accommodation / Servicing & Supplies
Plant, Tools & Equipment Provision & Servicing
Other services



What are the main sources of our costs?

- Studies/Reports/Certifications
- Materials/Infrastructure/Construction
- Human resources



TIME IS
MONEY



Defining the problem

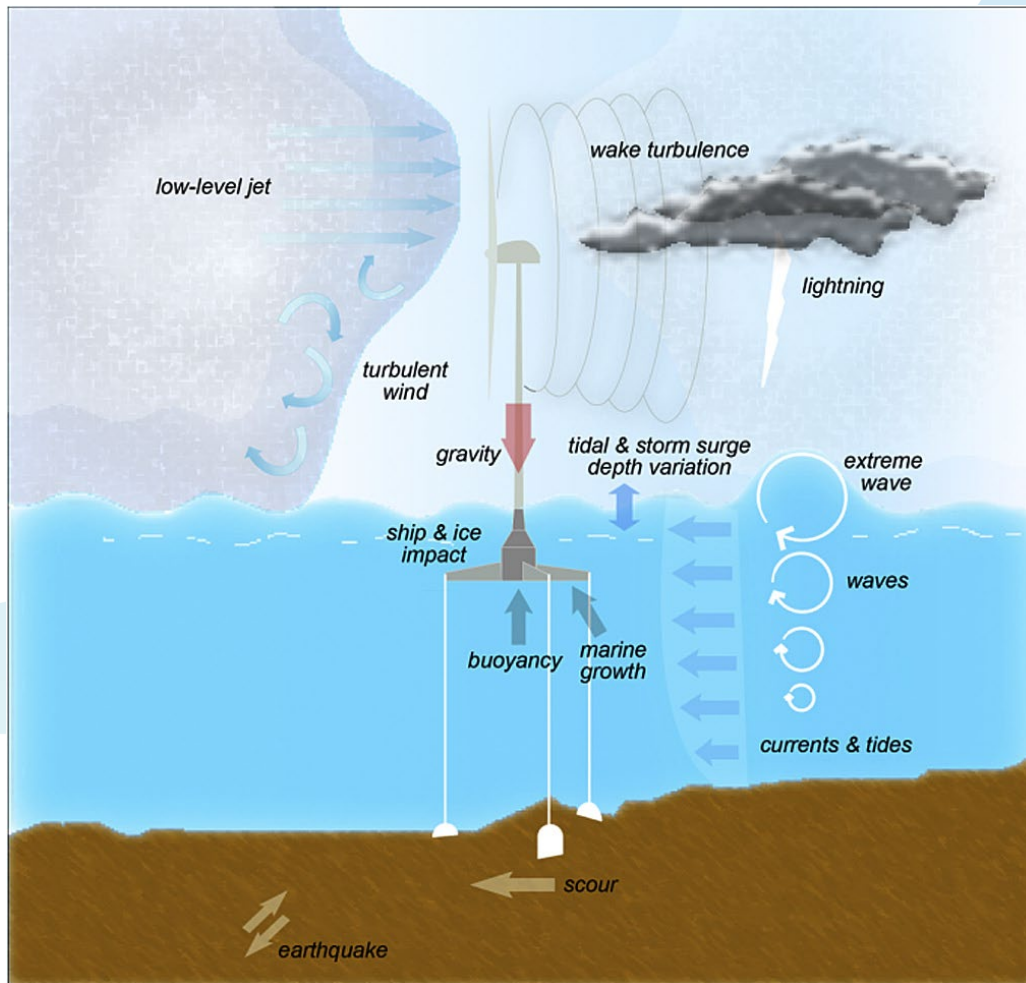


Fig. 2. Illustration of the various metocean factors influencing a floating offshore wind turbine (adapted from the US National Renewable Energy Laboratory).

https://www.researchgate.net/publication/316673231_A_n_evaluation_of_offshore_wind_power_production_by_floatable_systems_A_case_study_from_SW_Portugal




And these are ONLY the metocean factors!



We need to add certifications, surveys, etc.



What tools are available?
Which is my audience?
Where is my audience?



Status	Legend
	PRIORITY
	When available
	Done

Status	Activity	Start Date	End Date	Person in charge	Comments
	Presentation in Summer School	9/7/21	9/7/21	Amorina	Upload ppt
	Reports on registrations	5/7/21	9/7/21	Pranav	At the end of the session
	Hosting the session on Energy Storage and Hydrogen	7/7/21	7/7/21	Amorina	



Multidisciplinary Human Resources

- Be MacGyver

A large blue circle with a gradient, containing the text "Learn new skills" in white. The circle is surrounded by several light blue, elongated, teardrop-shaped elements that radiate outwards, resembling stylized wind turbine blades or a sunburst. The background features a white sky with a blue horizon line at the bottom and two small blue birds flying in the distance.

Learn
new
skills

Job Roles in Offshore Wind



Development surveys and studies

For consent applications, surveys and studies are needed to analyse environmental impacts and to inform early wind farm design. These include meteorological and oceanographic studies, wildlife surveys, geotechnical and geophysical surveys, port studies, visual studies, economic studies and onshore studies.

Planning approval bodies recommend at least two years' environmental data collection.

The services are typically contracted to specialist onshore and offshore survey companies.



Port studies

Port studies assess how specific ports could support the installation and maintenance of an offshore wind farm. They cover environmental, economic and engineering analysis. The worker location is not significant. Someone living in the Hull and East Riding of Yorkshire area could work for a non-local company offering port studies.

Current suppliers include AMEC Foster Wheeler, GVA Bilfinger and Marine Energy 6 Consultants. The client can be the developer of the offshore wind farm, a marine contractor or the port owners.

Project director: The director is responsible for the delivery of the project, approving project deliverables and managing finances. The director works onshore. Degree level qualifications are required in a relevant field, such as environmental sciences, economics or engineering. Project management qualifications are also desirable. The salary ranges between £55,000 and £70,000.

Project manager: The manager is responsible for the day-to-day operations, including project planning, staff management, financial reporting and client engagement. One manager is typically required to deliver a contract. The manager works onshore. Degree level qualifications are required in a relevant field, such as environmental sciences, economics or engineering. Project management qualifications are also desirable. The salary ranges between £40,000 and £50,000.

Principal consultant: The principal consultant is responsible for writing of the port studies and client contact on a technical level. Two to three principal consultants are typically required to deliver a contract. The principal consultant works onshore. Degree level qualifications are required in a relevant field, such as environmental sciences, economics or engineering. The salary ranges between £30,000 to £35,000.

Consultant: The consultant is responsible for data collection and analysis. Four to six consultants are typically required to deliver a contract. The consultant works onshore. Degree level qualifications are required in a relevant field, such as environmental sciences, economics or engineering. The salary ranges between £20,000 and £28,000.

Graphic design assistant: The graphic design assistant is responsible for completing drawings using geographical information systems (GIS) or computer-aided drafting software to support the written studies. One graphic design assistant is typically required to deliver a contract. Graphic design qualifications are needed. The salary ranges between £18,000 and £23,000.

Geotechnical and geophysical surveys

Geophysical surveys include bathymetric, cable route and unexploded ordnance (UXO) surveys. Geotechnical investigation is generally the most costly part of survey work, making it a significant at-risk investment for developers. The worker location is not significant because much of the work is completed offshore. Someone living in the Hull and East Riding of Yorkshire area could work for a non-local company offering geotechnical and geophysical studies.

Current suppliers include Fugro, Gardline, GPMC, Mainprize Offshore and Latitude Surveys. The client is normally the developer of the offshore wind farm.

Oceanographer: The oceanographer analyses physical and chemical interactions in the marine environment by looking at waves, tides and currents, and the chemicals in seawater and sediments. Two oceanographers are typically required to deliver a contract. Degree level qualifications are required in environmental sciences and a master's degree in oceanography is desirable. The oceanographer works offshore. The salary ranges between £20,000 for a junior position and £40,000 for a senior position, with an additional offshore allowance of about £120 per day.

Hydrographer: The hydrographer maps the marine environment by looking at the shape of the seabed and depth of the ocean. Two hydrographers are typically required to deliver a contract. Degree level qualifications are required in environmental sciences and a master's degree in hydrography is desirable. The hydrographer works offshore. The salary ranges between £20,000 for a junior position and £40,000 for a senior position, with an additional offshore allowance of about £120 per day.

Geophysicist: The geophysicist maps the marine environment by looking at the different types and depth of rocks which make up the seabed. Two geophysicists are typically required to deliver a contract. Degree level qualifications are required in environmental science and a master's degree in geophysics is desirable. The geophysicist works offshore. The salary ranges between £20,000 for a junior position and £40,000 for a senior position, with an additional offshore allowance of about £120 per day.

Offshore processor: The offshore processor checks data quality as it is collected offshore and then analyses it. Two to four offshore processors are typically required to deliver a contract. Degree level qualifications are required in environmental sciences. The offshore processor works offshore. The salary ranges between £20,000 for a junior position and £40,000 for a senior position, with an additional offshore allowance of about £120 per day.

Onshore processor: The onshore processor analyses data once information is taken back to shore. Two to three onshore processors are typically required to deliver a contract. Degree level qualifications are required in a relevant field, such as environmental sciences. The onshore processor works onshore. The salary ranges between £20,000 for a junior position and between £30,000 and £40,000 for a senior position.

Wildlife surveys

Wildlife surveys include seabed organism, fish, bird and marine mammal surveys. Surveys are undertaken mainly from survey vessels, with some bird surveys using aircraft. Current suppliers include Benthic Pelagic Solutions, Fugro, Gardline, Hi Def and Precision Marine Surveys. The client is normally the developer of the offshore wind farm.

Marine mammal observer: The marine mammal observer monitors and records observational data. Three to six observers are typically required to deliver a contract. The role requires a marine mammal observer qualification (one-day course). A degree or higher national diploma in marine biology or environmental monitoring is desirable. The marine mammal observer works offshore. The salary ranges £20,000 for a new graduate and £40,000 for a senior.

Marine ecologist: The marine ecologist collects survey data and analyses the results. Five or six positions are typically required to deliver a contract. Relevant degree level qualifications are required. The marine ecologist works both onshore and offshore. The salary ranges between £20,000 for a new graduate and £40,000 for a senior.

Turbine tower supply

Towers are welded conical structures made from steel. Towers are manufactured by cutting and rolling steel plate and then welding to make 'cans'. These cans are then welded into three sections, which are bolted together as part of the installation process. Towers are painted before fit-out with internal components, and are then prepared for transport and storage.

Towers are always fitted-out with internal ladders, and in the case of offshore turbines also a lift. Offshore turbines are equipped with offshore survival equipment

in case weather conditions stop the crew leaving the turbine as planned. The towers also need lighting for safe personnel access.

Key suppliers of turbine towers are Ambau, Titan Wind Energy, Valmont SM and Windar. CS Wind will develop a manufacturing facility in Scotland in 2017. Turbine towers are contracted by the turbine supplier because they are an integral part of the turbine design and contain turbine electrical components.

Ladders

Ladders inside the tower provide access from the base of the tower to the turbine nacelle. Ladders are fabricated off-site from the location of turbine tower manufacturing. Because of the volumes needed for an offshore wind farm, suppliers tend to be specialist. Workers are typically employed locally to a ladder manufacturer. The client is the turbine tower manufacturer. There are currently no UK suppliers of turbine tower ladders.

NDT inspector: The non-destructive testing (NDT) inspector investigates structural materials to find cracks, flaws and other imperfections using a range of inspection methods. Typically, there are two in-house NDT inspectors across all projects. Entry into the profession may be through an apprenticeship or technical qualification such as a Certification Scheme for Personnel (CSWIP) certificate. The NDT inspector works onshore. The salary ranges between £23,000 and £35,000

Welder: Welders fabricate structures through cutting, shaping and joining sections of metal plate and pipes. Large contracts involve many skilled welders. A career in welding may start with an apprenticeship that will include obtaining qualifications such as a CSWIP or Construction Skills Certification Scheme (CSCS) technical certificate. The welder works onshore. The salary ranges between £17,000 and £30,000 for an experienced welder.

Plater: The plater sets up, operates and tends plating machines used to coat metal components. Large projects can involve many platers. Platers may also have skills to carry out other fabrication roles such as welding. No formal qualification is required and entry to plating may be through an apprenticeship or a background in fabrication. The plater works onshore. The salary ranges between £17,000 and £30,000 for an experienced plater.

Quality controller: The quality controller checks and reports on fabrication quality and processes to meet recognised standards. One quality controller is required to deliver a contract. No formal qualifications are required but previous experience in a technical role may be necessary. The quality controller works onshore. The salary ranges between £18,000 and £25,000.

Cross cutting: Coatings

Coatings, such as metal sprays and paints, are required on several components including turbine blades, towers, foundations, gearboxes, bearings and hydraulic components. Coatings help to prevent damage and corrosion from the marine environment. Coatings are applied before initial installation but may be re-applied during operations, maintenance and service if required.

Current suppliers include Industrial Paint Supplies, International Paint and Witham Paint & Oil. Key applicators include Barrier Group, Offshore Painting Services, and Universal Coatings and Services.

Specialist coating technician (applier): A coating technician selects, mixes and applies coatings to component surfaces. Equipment such as spray guns and automated painting machinery is used to apply the coating. No formal qualifications are required, although an Industrial Coating Applicator Training Scheme (ICATS) qualification is desirable. Forklift operating and rigging qualifications may be required. The specialist coating technician works onshore. The salary ranges between £15,000 and £25,000.

Blasting technician (applier): Blasting technicians prepare the surfaces, for example by abrasive blasting and chemical stripping, of components before coatings are applied. No formal qualifications are required, although an ICATS qualification is desirable. Forklift operating and rigging qualifications may be required. The blasting technician works onshore. The salary ranges between £15,000 and £25,000.

Cross cutting: Health and safety equipment

Health and safety equipment for offshore wind personnel includes overalls, safety footwear, safety vests, full body harness and lanyards, safety glasses, helmets, personal lighting (such as a head torch) and fall-arrest systems. Many equipment manufacturers sell equipment through third parties. For a manufacturer, workers are normally local. For a vendor, the worker location is not as significant. Someone living in Hull and East Riding of Yorkshire could work for a non-local company.

Current manufacturers include Ballyclare, Marine Rescue Technologies, Mullion and Latchways. Current third party distributors include AP Workwear, Arco and Oaasis.

Account manager (distributor): The account manager negotiates contracts with clients and engages with distributors to improve and develop new products. No formal qualifications are required, but account managers require National Examination Board in Occupations Safety and Health (NEBOSH) training. The account manager works onshore. The salary ranges between £30,000 and £40,000.

Garment technologist (manufacturer): The garment technologist works as part of a design team to develop product specifications and ensure the quality and performance of the finished clothing. Travelling to factories to supervise production is required. The technologist also identifies and reports manufacturing or design faults. A degree in textile technologies or manufacturing and production engineering is required. Experience with computer design software is desirable. The garment technologist works onshore. The salary ranges between £15,000 and £30,000.

Technical sales specialist (distributor): The technical sales specialist meets with clients to promote the sale of products and to identify additional products the client may require. No formal qualifications are required, but previous experience in sales is desirable. The technical sales specialist works onshore. The salary ranges between £18,000 and £25,000.

Product data controller (distributor): The product data controller ensures that a company's product and purchasing information is industry compliant and up-to-date. No formal qualifications are required, but experience with computer management software is desirable. The product data controller works onshore. The salary ranges between £17,000 and £20,500.

Foundation supply

The turbine foundation provides structural support for the wind turbine and provides a means for personnel access.

Developers select a foundation technology depending on the water depth, seabed conditions, turbine loading, turbine mass and rotor speed. Most offshore wind farms have used monopiles which are driven into the sea bed. For larger turbines and in deeper water, the cost of monopiles rises significantly and lattice foundations ('jackets') are the most common alternative.

Steel plate is used for the manufacture of monopile and jacket foundations.



Manufacturing monopiles is a relatively simple process but uses highly specialist equipment. Manufacturing jacket foundations is significantly increased because of the complexity of the structure and the number of welds.

Current suppliers of this service include Ambau, Bladt Industries, BiFab, EEW Special Pipe Constructions, Navantia, Sif Group, Smulders Projects and Steelwind Nordenham. Foundation supply may be contracted separately by the developer or as part of a contract including foundation installation.

Platforms

Both monopile and jacket foundations have a work platform at the top of the structure, a smaller intermediate platform along the ladder access route and internal platforms in the transition piece. The work platform usually supports a crane and provides a lay down area for equipment. Platforms are likely to be fabricated in a different location to the foundation manufacturing. Someone living in the Hull and East Riding of Yorkshire area could work for a local company offering platform fabrication. The client is the foundation supplier. Current suppliers include Hutchinson Engineering, MTL and Wilton Engineering.

Structural engineer: The structural engineer designs large structures and has an advanced understanding of materials and manufacturing processes. A degree or postgraduate qualification in structural or civil engineering is required. The structural engineer works onshore. The salary ranges between £30,000 and £50,000.

Rigger: The rigger is responsible for planning and implementing safe lifting and the movement of large structures that may involve crane operation. Several riggers may be involved in delivering a contract. A rigger will require formal training and certification such as a Construction Skills Certification Scheme (CSCS) or National Vocational Qualification (NVQ) certificate from an accredited industry body. Knowledge of current Lifting Operations and Lifting Equipment Regulations (LOLER) and Provision and Use of Work Equipment Regulations (PUWER) is also desirable. The rigger works onshore. The salary ranges between £18,000 and £30,000.

Secondary steel

Secondary steel on offshore wind foundations can include plate beams, railings, barriers, rescue support frames, J-tubes (steel tubes protecting array cables) and boat landing systems. Secondary steelwork can be designed and fabricated off-site from the location of foundation manufacturing. Someone living in the Hull and East Riding of Yorkshire area could work for a local company offering fabrication of secondary steel. The client is the foundation supplier.

Current suppliers include Hutchinson Engineering, MTL and Wilton Engineering.

Draughtsman: The draughtsman creates detailed technical drawings and plans of structures before they go into fabrication. These are drawn using computer-aided design software. One draughtsman is required to deliver a contract. A degree in an engineering or design discipline and experience with computer-aided design software is required. The draughtsman works onshore. The salary ranges between £35,000 and £45,000.

Manufacturing manager: The manufacturing manager ensures fabrication runs smoothly, to budget and on time. One manager is required to deliver a contract. Managers will have experience in project management and are likely to have a technical background in mechanical or fabrication engineering. The manufacturing manager works onshore. The salary ranges between £25,000 and £35,000.

Production supervisor: The production supervisor leads the team of fabrication staff and organises their workload. One supervisor is required to deliver a contract. Supervisors are experienced members of the fabrication team. The production supervisor works onshore. The salary ranges between £23,000 and £27,000.

CNC machinist: The computer numerical controlled (CNC) machinist operates machinery to make precision components. Several machinists may be required to deliver a contract. This role does not require a formal qualification and entry may be through an apprenticeship or an engineering-related college course. The CNC machinist works onshore. The salary ranges between £18,000 and £27,000 for an experienced machinist.

Press brake operator: The press brake operator runs the industrial machine equipment that makes and processes metal sheeting and parts. Several machine operators may be required to deliver a contract. This role does not require a formal qualification and entry may be through an apprenticeship. The press brake operator works onshore. The salary ranges between £17,000 and £22,000.

Cross cutting: Training services

Personnel need specific skills and deep technical knowledge about the wind farm. Training of personnel is therefore essential for the safe and efficient installation and operation, maintenance and service of the wind farm. Training courses include fire awareness, first aid, manual handling, rope access, sea survival and working at heights. Current suppliers include 3Sun Group, Advanced Industrial Solutions (AIS) Training, Complete Training Solutions, HETA and HOTA. There is no typical client, as all areas of the supply chain require different training services.

Training and resource manager: The training and resource manager manages a team of instructors for internal and external training requirements. They also develop future training packages. The training and resource manager works onshore. The salary ranges between £30,000 and £45,000.

Instructor: The instructor delivers commercial training courses in a specialist area such as in electrical engineering, mechanical engineering, fabrication and welding, renewable energy and health and safety. Typically, five years experience in the specialist field is required to become an instructor, alongside relevant qualifications to at least higher national certificate level. Previous teaching qualifications are also desirable. For example, a working at height instructor would require certification from RenewableUK or Global Wind Organisation for working at height, alongside appropriate health and safety qualifications, such as from the Institution of Occupational Safety and Health (IOSH). One working at height instructor is likely to be part of a four-person team of instructors, each instructing four to six delegates during a training course. The instructor works onshore. The salary ranges between £25,000 and £40,000.

Cable supply

Cables deliver the power output from the wind turbines to shore. Array cables connect the turbines to each other and the offshore substation. Export cables connect the onshore and offshore substations.

Array cables are manufactured using copper or aluminium cores and include fibre optic cables for data communications. Each turbine has about 1 km of array cable associated with it, depending on turbine size and spacing. Most projects have two or more export cables, but small projects can have just one.

Cable protection is required to protect cables at vulnerable locations, such as close to shore from wave and tidal action.

Key suppliers of cables are JDR Cable Systems (array cables only), Nexans, NKT Cables, NSW (General Cable) and Prysmian. Most cable suppliers also have the capability to install. Cable supply may be contracted separately by the developer or as part of a contract including cable installation.



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Splicing

To achieve the length of cable required, smaller manufactured sections of cable may need to be spliced together before cable installation. Cable splicing is most commonly applied at the cable assembly ('lay-up') stage of manufacture although in some cases, such as during repair, splicing takes place after lay-up and off-site from manufacturing. Someone living in the Hull and East Riding of Yorkshire area could work for a local company offering cable splicing. The client is the cable supplier.

Current suppliers include Nexans, PCSL and Prysmian.

Jointing supervisor: The supervisor oversees the work and ensures it is carried out in accordance with health and safety requirements. Several supervisors are employed in-house across all contracts. This role would require a Higher National Diploma (HND) in electrical engineering or equivalent although a position may also be attained through experience as a cable jointer. The jointing supervisor works onshore. The salary ranges between £35,000 and £50,000.

Cable testing engineer: The cable test engineer performs mechanical, electrical, material and dimensional testing of cables. Several engineers are employed in-house across all contracts. A HND or higher in electrical engineering, quality management or other relevant field is desirable. The cable testing engineer works onshore. The salary ranges between £30,000 and £45,000.

Cable jointer: The cable jointer carries out the cable splicing and ensures the joints match the diameter and flexibility of the power cable. Several jointers are employed in-house across all contracts. Academic qualifications are not essential and entry may be through an apprenticeship. Vocational training, such as a City & Guilds qualification in electrical engineering or similar, is an advantage. Training is usually provided by the employer. The cable jointer works onshore. The salary ranges between £29,000 and £40,000.

Ancillaries

To install and maintain subsea cables, a number of specialised ancillaries are necessary, including pulling heads, armour clamps, repair joints, hang-offs and terminations. Cable ancillaries can be designed and manufactured away from the site of cable manufacturing. Someone living in the Hull and East Riding of Yorkshire area could work for a local company offering design and manufacture of cable ancillaries. The client is the cable supplier.

Current suppliers include Prysmian and WT Henley.

Design engineer: Design engineers research and develop components. They also work to improve performance of existing products. Several design engineers may be employed in-house. This role requires a degree in product design engineering or similar. The design engineer works onshore. The salary ranges between £30,000 and £40,000.

Test engineer: The test engineer is responsible for designing and carrying out the quality assurance of manufactured components. Up to two test engineers are required in-house. This role requires a degree or equivalent in design engineering. The test engineer works onshore. The salary ranges between £30,000 and £40,000.

Storage

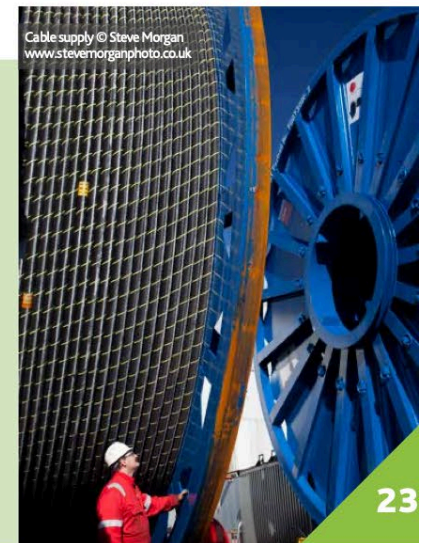
Storage of cables and related components is generally carried out near to the port before installation. Specialist equipment is required for the storage and handling of cables. Someone living in the Hull and East Riding of Yorkshire area could work for a local company offering cable storage. The client is the wind farm developer or installation contractor.

Current suppliers include ABLE and Manor Renewable Energy.

Facilities manager: The facilities manager supervises staff, oversees operations and ensures health and safety practices are followed. No formal qualifications are required, but several years experience in management and warehouse operations is necessary. The facilities manager works onshore. The salary ranges between £30,000 to £40,000.

Storeperson: The storeperson operates forklift and reach trucks as well as overhead cranes and gantries. Several storepersons may be employed in a storage facility. The role requires licences for each type of lifting equipment as well as a Construction Plant Competence Scheme (CPCS) certificate for the operation of cranes. The storeperson works onshore. The salary ranges between £20,000 and £28,000.

Carousel and tensioner operator: The carousel and tensioner operator is responsible for the operation, maintenance and repair of the specialist cable storage and handling equipment. A team of three operators are required to deliver a contract. This role requires an HNC in electrical engineering or equivalent. The carousel and tensioner operator works onshore. The salary ranges between £20,000 and £30,000.



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Substation supply

The offshore substation transforms and transfers the energy collected by the wind turbines. Offshore substations are usually alternating current (AC) but direct current (DC) is considered for projects further from shore. Depending on the wind farm size, there may be more than one offshore substation.

A substation platform weighs up to 2,000t and may include a helipad. The substation has electrical components such as the back-up generator, reactive compensation system, switchgear, transformer and, in the case of DC substations, converters. It will also have other facilities such as fire and blast protection systems,

a control room and refuge accommodation.

Current suppliers of the electrical components include ABB, GE Grid Solutions and Siemens Energy Transmission. Current suppliers of the topside are Babcock, Blatt, Fabricom, Harland & Wolff, Hollandia and Navantia. Substation supply may be contracted separately by the owner or as part of a contract including substation installation. Substation foundations are often contracted with the turbine foundations.

Architectural steel

Substation platforms are large complex structures that require a range of steelwork. Architectural steel, for example railings and walkways, can be designed and fabricated off-site from the location of substation topside manufacturing. Someone living in the Hull and East Riding of Yorkshire area could work for a local company offering fabrication of architectural steel. The client is the substation platform supplier.

Current suppliers include A G Brown, Allerton Steel and MTL.

Workshop manager: The workshop manager oversees day-to-day operations, making efficient use of the shop floor, managing resources and ensuring safe working. One manager is required to deliver a contract. The manager will have skills in project management and an understanding of the technical fabrication processes. The workshop manager works onshore. The salary ranges between £30,000 to £40,000.

Design engineer: The design engineer leads the design team in developing structures and components for manufacture. Several design engineers may be required to deliver a contract. A degree in engineering design and manufacture is required. The design engineer works onshore. The salary ranges between £30,000 and £45,000.

Design assistant: The design assistant uses computer-aided design software to design structures and components. Several design assistants may be required to deliver a contract. A college course or an apprenticeship is required. The design assistant works onshore. The salary ranges between £20,000 to £30,000 for an experienced designer.

Laser operator: The laser operator programmes and operates laser-cutting machinery. Several machine operators may be required to deliver a contract. This role does not require a formal qualification and entry may be through an apprenticeship or an engineering related college course. The laser operator works onshore. The salary ranges between £18,000 to £25,000 for an experienced operator.

Scaffolder: The scaffolder puts up and takes down scaffolding to allow workers to access external higher levels of structures safely. The role requires carrying a valid Construction Industry Scaffolders Record Scheme (CISRS) card. The scaffolder works onshore. The salary ranges between £15,000 and £18,000.

Navigation lights

Strong lighting is required around offshore wind farm structures to aid navigation. Lighting is also used to enable workers to move safely around the substation. Lighting systems are supplied by specialist companies to the substation supplier. Someone living in the Hull and East Riding of Yorkshire area could work for a local company offering supply of navigation lighting. The client is the substation platform supplier.

Current suppliers include IMT Lighting, Sims Systems and Tideland.

Procurement manager: The procurement manager identifies the suppliers and negotiates the purchase of external products and components. One procurement manager is required to deliver a contract. No formal qualifications are required, but a degree and relevant Chartered Institute of Procurement & Supply certificates are desirable. The procurement manager works onshore. The salary ranges between £30,000 and £40,000.

Sales manager: The sales manager is responsible for understanding industry standards and working alongside the substation supplier to identify appropriate products. One sales manager is required to deliver a contract. This role does not require formal qualifications but experience in sales and the offshore wind sector is desirable. The sales manager works onshore. The salary ranges between £30,000 and £40,000.

Product development engineer: The product development engineer works on designing new and enhancing existing lighting products to meet industry need and technical standards. Several engineers are required for product development. This role requires a degree in product design engineering. The product development engineer works onshore. The salary ranges between £30,000 and £40,000.

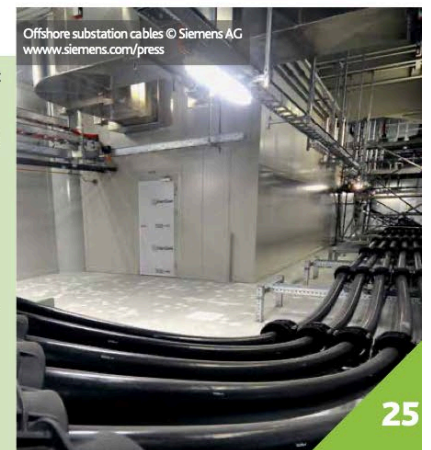
Cables route systems

Storage of cables and related components is generally carried out near to the port before installation. Specialist Substation platforms need cable route systems to provide structural support to the cables that connect the electrical components. These can be supplied by specialist distributors to the substation supplier. Someone living in the Hull and East Riding of Yorkshire area could work for a local company offering cable route systems. The client is the substation supplier.

Current distributors include MacLean Electrical and Thorne & Derrick.

Technical sales manager: The technical sales manager works with the substation supplier to identify appropriate products and supports business development. One manager is required to deliver a contract. This role requires a degree in a technical or business-related subject and experience in the offshore wind sector. The technical sales manager works onshore. The salary ranges between £40,000 and £50,000.

Electrical sales engineer: The electrical sales engineer supports the sales manager and clients with specialist electrical knowledge. Up to two sales engineers are required to deliver a contract. The role requires a university degree or college qualification in electrical engineering. The electrical sales engineer works onshore. The salary ranges between £32,000 and £37,000.



Turbine and foundation installation

Foundation installation is undertaken using a jack-up vessel or a floating heavy lift vessel. Monopile installation is usually undertaken as a two-stage process: the monopile is driven into the seabed and a transition piece is then lowered over the top and bolted or grouted in place. Usually the two stages are undertaken sequentially using the same vessel. Vessels installing monopiles typically need a crane with a capacity of 1,000t or greater. Lattice foundation structures, such as jackets, are installed using similar vessels but a large deck space is an advantage. Usually, the main structure is lowered over piles that have been driven into place using a re-usable template.

Gravity-base foundations have not been used in the UK yet. Future designs will be floated out to site using tugs and ballasted to sink them into position. Rock-dumping follows to secure the foundation's position and stability.

All foundations, but particularly monopiles installed in sandy conditions, may suffer from scour. Scour is the erosion of the seabed by waves and tides and around the base of the foundation or along the cable routes. Rock dumping mitigates the risk but new solutions are still being sought.

Turbine installation always involves a jack-up vessel to minimise the movement of the turbine components during installation lifts. These vessels have been designed specifically for offshore wind use and they typically have an 800t crane or greater. Turbine installation is sensitive to high winds.

Turbines are usually installed using five lifts:

- Tower, fully assembled with internals
- Nacelle and hub, and
- Each blade separately.

Mobilisation

Mobilisation equips the installation vessels with blade racks and sea fastenings to ensure safe storage and transport of components. Mobilisation takes place at the installation port. Someone living in the Hull and East Riding of Yorkshire area could work for a local company offering mobilisation works. The client is the installation contractor.

Current suppliers include A&P, Associated British Ports, MSS and MPI Offshore.

Operations manager: The operations manager is responsible for overseeing mobilisation, from planning to vessel load-out, ensuring works are carried out safely and on schedule. Up to two operations managers may be required to deliver a contract. An academic degree in engineering or project management is desirable but a high level of experience in loading operations and project management can be an alternative. The operations manager works onshore. The salary ranges between £33,000 and £50,000.

Crane operator: The crane operator drives the machinery used to carry out lifting of heavy structures and equipment. The role requires training and experience in using heavy plant machinery, a Construction Plant Competence Scheme (CPCS) certificate and a college qualification in plant operations. The crane operator works onshore. The salary ranges between £20,000 and £30,000 for an experienced crane operator.

Turbine installation at Dan Tysk © Siemens AG
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Crewing services

Crewing for offshore activities is provided by recruitment companies with specialist knowledge of the skilled personnel required by the offshore wind sector. Supplier location is not significant and someone living in the Hull and East Riding of Yorkshire area could work for a local company offering crewing services. The client is usually the installation contractor.

Current suppliers include Advanced Industrial Solutions, Boston Energy, MPI Offshore and Seajacks.

Technical recruiter: The technical recruiter is the company's authority on technical skills, qualifications and competencies and is responsible for ensuring appropriate workers are contracted. One technical recruiter is required to deliver a contract. The role requires experience in offshore wind operations and the recruiter is likely to have obtained a qualification in a technical area. The technical recruiter works onshore. The salary for this role ranges from £35,000 to £60,000.

Logistics coordinator: The logistics coordinator is responsible for arranging the transfer and accommodation of workers travelling nationally and internationally to undertake contracted roles. Two coordinators are required to deliver a contract. No qualifications are required for this role. The logistics coordinator works onshore. The salary ranges between £18,000 and £23,000.

Administrator: Administrators are responsible for organising and executing employment contracts with recruited workers. No qualifications are required for this role but a National Vocational Qualification (NVQ) or similar in business administration is desirable and may be obtained through an apprenticeship. The administrator works onshore. The salary ranges between £16,000 and £23,000.

Vessel maintenance

Vessel maintenance can include engineering and fabrication of new or replacement parts, steelwork and welding, pipefitting, carpentry, deck repair, painting and coating, and electrical repairs. Maintenance is carried out while ships are in a shipyard. Major repairs and service to the vessel hull require a dry dock. Workers usually live close to companies offering vessel maintenance. The client is the vessel owner or operator.

Current suppliers include A&P, Dunston, MMS and Wilton Engineering.

Shipyard manager: The shipyard manager oversees all activities within the shipyard and ensures high levels of safety and efficiency. Two managers are required to deliver a contract. A manager may have a degree in production management or engineering and must have experience in shipyard processes, ship systems and structures. The shipyard manager works onshore. The salary ranges between £50,000 and £65,000.

Naval architect: The naval architect works on issues concerning the vessel design and is primarily concerned with the form and stability of the hull. For major maintenance and repair, several architects may be employed to deliver a contract. The role requires a degree in naval architecture. The naval architect works onshore. The salary ranges between £45,000 and £65,000.

Marine engineer: The marine engineer inspects and designs repairs of vessels and their equipment, with focus on mechanical systems such as propulsion and steering. Several marine engineers may be employed to deliver a contract. The role requires a degree in marine engineering or similar. The marine engineer works onshore. The salary ranges between £30,000 and £40,000.

Shipwright: The shipwright undertakes a variety of marine fitting duties, including metalwork and carpentry to carry about repair and maintenance duties. Several shipwrights are required to deliver a contract. A shipwright will have obtained a City & Guilds Yacht and Boatbuilding qualification or an equivalent technical certificate. The shipwright works onshore. The salary ranges between £25,000 and £33,000.

Pipefitter: A pipefitter installs, maintains and repairs mechanical piping systems. The role includes using techniques such as bending and welding. No formal qualification is required and entry to pipefitting may be through an apprenticeship that may include obtaining a vocational qualification or engineering diploma. The pipefitter works onshore. The salary ranges between £17,000 and £30,000 for an experienced pipefitter.

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Cable installation

Cables are installed using specialist cable vessels equipped with cable-handling equipment. The cables may be laid and buried in a single process using a cable plough or in two stages in which a first vessel lays the cable and a second vessel buries the laid cable using a remotely operated vehicle (ROV). The cable may be carried as long lengths and cut to size at each location or pre-cut onshore. Once the cables are pulled-in to the base of the turbine tower, they are terminated and tested. Although the large cable manufacturers have their own vessels, the work is typically undertaken by specialist contractors. These contractors also work in the

oil and gas and telecommunications market but offshore wind is an increasingly important part of their business.

Current suppliers of this service include DeepOcean, Jan De Nul, Siem Offshore Contractors, Tideway, Van Oord and VBMS. Most cable suppliers also have the capability to install. Cable installation may be contracted separately by the developer or as part of a contract including cable supply.

Termination and testing

Termination provides the mechanical and electrical connection of the array cables to the turbines. Testing verifies that the cables have not been damaged during installation. The worker location is not significant. Someone living in the Hull and East Riding of Yorkshire area could work for a non-local company offering termination and testing.

Current suppliers are EDS Group and H&Askham. These are highly specialist companies. The client is normally the cable installation contractor, although it can be the project developer.

Project manager and project supervisor: The manager is responsible for personnel safety, client interface and team performance. The supervisor manages day-to-day operations, such as material loading, equipment calibration and certification of personal protective equipment. One manager and one to two supervisors are typically required to deliver a contract. Offshore experience is required and project management qualifications are desirable. The manager and supervisor work both onshore and offshore. The salaries range between £50,000 and £75,000.

Cable jointer: The jointer acts as the offshore team leader and terminates and tests the cable cores. Four jointers are generally needed to deliver a contract. Academic qualifications are not essential, but the successful completion of vocational training or an apprenticeship is desirable. Training is usually provided by the employer. The cable jointer works offshore. The salary ranges between £45,000 and £55,000.

Fibre optic technician: The technician terminates and tests the fibre optic communication cables. Four technicians are typically required to deliver a contract. Academic qualifications are not essential, but a vocational qualification or an apprenticeship is desirable. Training is usually provided by the employer. The technician works offshore. The salary ranges between £35,000 and £45,000.

Electrical technician: The technician supports the activities of the jointer and fibre optic technician. Four technicians are generally required to deliver a contract. Academic qualifications are not essential, but a vocational qualification or an apprenticeship is desirable. Training is usually provided by the employer. The technician works offshore. The salary ranges between £30,000 and £40,000.

Top-man: The top-man is responsible for personnel safety in offshore confined spaces, such as inside the turbine tower. Four 'top-mans' are typically required to deliver a contract. A qualification course in working confined spaces is essential. The top-man works offshore. The salary ranges between £30,000 and £40,000.

Remotely operated vehicle services

ROVs may perform pre-lay inspection surveys of the cable route, dig the trench and inspect the trenching equipment as the cable is being laid onto the sea bed. The worker location is not significant. Someone living in the Hull and East Riding of Yorkshire area could work for a non-local company offering ROV services.

Current suppliers include Fugro Subsea, Modus and ROVOP. These are typically highly specialist companies. The client is normally the cable installation contractor.

Project manager: The manager co-ordinates work between the client and the vessel crew. One position is typically required to deliver a contract. No technical knowledge is required, but project management qualifications are desirable. The manager works onshore and offshore. The salary ranges between £65,000 and £75,000.

ROV pilot: The pilot operates the ROV underwater from the vessel. This involves operating cameras and robotic arms and judging site conditions to adjust the dive plan. The pilots complete 12-hour shifts and are rotated on a monthly basis. Two positions are typically required to deliver a contract. No specific qualifications are required and training is provided by the employer. Many pilots have previous experience in the Royal Air Force or Navy. The ROV pilot works offshore. The salary ranges between £40,000 and £50,000.

Vessel supervisor: The vessel supervisor supports the project manager in co-ordinating work between the installation contractor and the vessel crew. Two positions are generally required to deliver a contract. No technical knowledge is required, but project management qualifications are desirable. The vessel supervisor works both onshore and offshore. The salary ranges between £35,000 and £45,000.

ROV sub-engineer: The engineer maintains and repairs equipment on the ROV. Six to eight positions are typically needed to deliver a contract. Degree level engineering qualifications are required. The ROV sub-engineer works offshore. The salary ranges between £25,000 and £45,000.

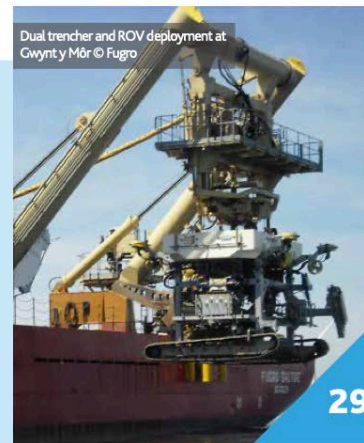
Cable protection systems

Cable protection systems protect subsea cables in offshore wind and oil and gas industries. Protection can include cable burial, rock dumping, bend restrictors and cable mattressing. There is potential for companies offering cable protection systems to establish offices in Hull and East Riding of Yorkshire, which would create future demand for local workers.

Current suppliers are Blue Ocean, First Subsea, Pipex, Tekmar and Trelleborg. These are highly specialist companies. The client is normally the developer or the cable installation contractor.

Senior project engineer: The senior project engineer manages the day-to-day operations to deliver projects on time and on budget. They interface with the client, manage a team of project engineers and work closely with the lead design engineers to identify the cable protection solutions that best meets the client's technical requirements. A degree in engineering is required alongside a higher national certificate or higher national diploma in technical engineering. The senior project engineer works onshore. The salary can range between £30,000 and £40,000.

Lead design engineer: The lead design engineer produces documents, diagrams and layouts in compliance with client's requirements and industry standards. They also use failure mode and effects analysis (FEMA) to evaluate the design of components and assemblies. A degree in mechanical engineering is required, alongside proficiency in computer-aided design software. The design engineer works onshore. The salary ranges between £20,000 and £30,000.



Installation support

During the installation of an offshore wind farm there are many activities which support the developer, the wind turbine manufacturer and main installation contractors to complete installation activities efficiently and safely. Support services include unexploded ordnance (UXO) surveys and removal, the supply of guard

vessels, oil-clean up services, the supply of fuel, waste disposal and insurance. Some functions are provided by local companies, while others are supplied by highly specialist companies that work nationally and internationally.

Unexploded ordnance surveys and removal

UXO are derelict explosives. Usually bathymetric surveys and desktop studies will be completed during project development to identify UXO locations. These early activities may inform front-end engineering and design (FEED) if significant UXO are found. These can often be combined with the geotechnical and geophysical surveys. Further detailed UXO surveys are undertaken at the wind farm site and along the cable route before the installation of turbines and balance of plant. When potential UXO are detected, companies dispose, relocate or remove the items in line with the client's requirements. Remotely operated vehicles (ROVs), offshore divers and underwater electromagnets are used during recovery of UXO. Sometimes UXO are destroyed at sea, but this is a costly and dangerous operation. Sometimes wind farm developers will consider repositioning wind farm components. Processes are put in place during destruction to minimise the impacts on the marine environment, for example, bubble curtains are used to reduce noise impacts on marine mammals and fish. The companies are highly specialised. The client can be the wind farm owner or an installation contractor.

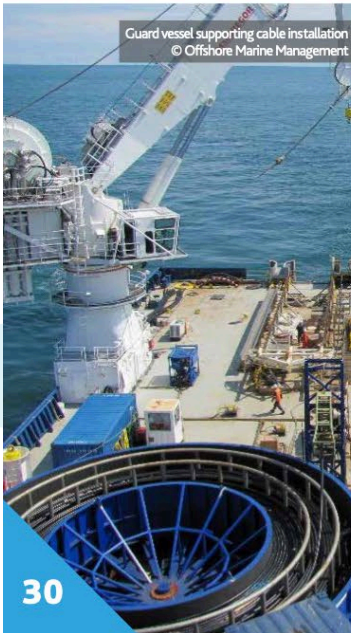
Current suppliers include 6 Alpha Associates, Bactec, DSMC, Fugro, Gardline and James Fisher Subsea.

UXO diver: The UXO diver supports the explosive ordnance disposal (EOD) engineers during on-site surveys to identify and confirm UXO locations. As well as a qualification in EOD, the diver must also have a valid dive ticket and Global Wind Organisation (GWO) module certificates. The UXO diver works offshore. The salary ranges between £60,000 and £90,000.

EOD site manager: The EOD site manager is responsible for the team of EOD engineers and divers during on-site surveys. The manager also reports on health and safety, interfaces with clients and organises the maintenance and repair of survey and disposal equipment. An advanced qualification in EOD is required. Typically, this qualification is gained through experience in the military, or can be gained through an International School for Security and Explosives Education (ISSEE) course. The EOD site manager works offshore. The salary ranges between £40,000 and £50,000.

EOD engineer: The EOD engineer undertakes non-intrusive and intrusive on-site surveys. The engineer will check and prepare the area before planned explosions. They may also assist in preparing health and safety plans before operations. An advanced qualification in EOD is required. Typically, this qualification is gained through experience in the military, or can be gained through an ISSEE course. The EOD engineer works offshore. The salary ranges between £25,000 and £45,000.

UXO consultant: The UXO consultant analyses historical data on sunken ships and firing ranges to determine the likelihood of UXO being present at the wind farm site. A degree in a relevant environmental field, such as geophysics is required. The UXO consultant works onshore. The salary ranges between £20,000 and £50,000, depending on experience.



Guard vessel supporting cable installation
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Guard vessels

Guard vessels provide a safety function during offshore installation. This includes ensuring safe navigation and recording traffic data. Low cost vessels are often used and they often work across other sectors, for example fishing, oil and gas, or dredging. Crew transfer vessels (CTVs) can also be used and they will often perform more than one role at the wind farm. Typically, local contractors are used. A minimum of three crew members are on board the guard vessel. The vessel provides service 24/7, usually with a monthly crew rotation. The client can be the wind farm owner or an installation contractor.

Current suppliers include Eastern Marine Services, Gardline, Mainprize Offshore, Offshore Marine Management and Windpower Support.

Master: The master is in command of the vessel and crew. They perform safety checks and complete the necessary paperwork. The master needs to have certifications in Standards of Training, Certification and Watch Keeping for Seafarers (STCW) to at least Master 200GT (STCW II/3), alongside an ENG 1 medical, STCW95 basic training and a radio communication certificate, for example Global Maritime Distress and Safety System (GMDSS) General Operators Certificate (GOC). The master is also required to complete a stability course, a Maritime and Coastguard Agency (MCA) Approved Engine Course (AEC) or Marine Engine Operator Licence (MEOL). The master works offshore. The salary ranges between £35,000 and £50,000.

Mate: The mate safely navigates the vessel. The mate reports to the master and works with the deckhand to ensure duties on board are completed. The mate requires an ENG 1 medical and STCW95 basic training, alongside an MCA AEC or MEOL. Certification in STCW III/3 is desirable. The mate works offshore. The salary ranges between £30,000 and £35,000.

Deckhand: The deckhand performs regular duties on board the vessel, for example maintenance of equipment and preparing reports. The deckhand also plays a large role in ensuring the safety aboard the vessel. The deckhand requires an ENG 1 medical and STCW95 basic training, alongside an MCA AEC or MEOL. Certification in STCW III/3 is desirable. The deckhand works offshore. The salary ranges between £25,000 and £35,000.

These job roles are also required for CTV and service operation vessel (SOV) operations.

Oil spill clean-up

During installation, oil spills can occur from vessels themselves, or during the change of oil for turbine components. Spills can also occur within ports and harbours during installation and operations, maintenance & service (OMS). Specialist oil spill clean-up companies put in place measures to limit the amount of pollution entering the sea. They must typically to respond within 24 hours. Responding to oil spills at sea usually uses one of three techniques: burning, dispersion or skimming. Burning, where the floating oil is set alight, can be used to prevent a fresh spill from spreading. In dispersal, chemicals are applied to the oil spill, which break up the oil into small droplets. Skimming uses boats and equipment to remove layers of oil from the surface. The method used depends on the weather conditions, the extent of the spill and the type of oil. The client can be any company involved in the development, installation or operation of the wind farm, for example the developer, an installation contractor or a port authority.

Current suppliers include Briggs Marine and Environmental Services, and SMIT Salvage.

Oil spill team leader: The oil spill team leader interfaces with the client and manages a team of oil spill responders. They ensure the team has the correct equipment and carries out procedures in line with current legislation. One team leader is required per oil spill response. As the job is providing an emergency response, the responder must be on-call for out-of-hours work. Maritime and Coastguard Agency (MCA) certification is required. In-house training is also provided by employers. An oil spill team leader is expected to have 5 to 10 years experience as an oil spill responder. The oil spill team leader works offshore. The salary ranges between £35,000 and £40,000.

Oil spill responder: The oil spill responder uses tools, such as boom containers and skimming equipment, to clean up oil spills offshore. The responder may also write end-of response reports for the client. As the job is providing an emergency response, the responder must be on-call for out-of-hours work. For a small oil spill, a team of four responders would typically be required. For larger oil spills, teams of up to 40 responders may be needed. MCA certification is required. In-house training is also provided by employers. The oil spill responder works offshore. The salary ranges between £25,000 and £35,000.

Oil spill consultant: The oil spill consultant advises clients of the potential risks of oil spills and writes contingency plans so that in the event of an oil spill, procedures are in line with current legislation. A team of one or two consultants is typically required to deliver a contract. A degree in environmental science is required. The oil spill consultant works onshore. The salary ranges between £20,000 and £50,000 depending on experience.

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Wind farm operations

Operations are the actions of providing support during the lifetime of the wind farm to ensure maximum energy production. Wind farms typically have an operating lifetime of 20 to 25 years.

The operation of a wind farm is managed from an onshore base. Typically, wind farm operators will look to use the nearest port that meets its specifications, which may not be the closest port to the wind farm. The port needs 24/7, 365 days a year waterway vessel access.

Wind farm operations include day-to-day workflow management and the use of systems to store and analyse data, such as supervisory control and data acquisition (SCADA) and condition monitoring systems (CMS). This allows the owners to

respond efficiently to failures after they occur and, where possible, to identify potential failures before they occur. Advanced warning systems allow the owner to organise the necessary spares, tools and technicians before the failure occurs, resulting in more efficient use of resources and reduced loss of energy production. Some owners pay specialist contractors to provide this advanced warning service, while others have developed in-house tools.

The management of logistics (vessels, helicopters, personnel, specialist tooling and spare parts) is also an important part of the operations roles. One or more specialist software systems are needed to make sure that all the elements are available at the right time for effective proactive maintenance or reactive service or repair.

Operations

Where a wind farm has more than one owner, the owner with the largest share in the project usually takes responsibility for operating the wind farm. Operators are typically utility companies, such as DONG Energy, rather than equity investors, such as sovereign wealth funds, pension funds and infrastructure funds.

Current owners with operation bases located within the Humber region include DONG Energy, EDF and E.ON.

Operations and maintenance manager: The operations and maintenance manager gives technical and commercial support to the project to ensure successful operations of the wind farm. The manager is based onshore. An academic degree in an engineering subject is required. The salary ranges between £55,000 and £65,000.

Asset integrity manager: The asset integrity manager plans, budgets and forecasts costs associated with the maintenance and service of the turbine and balance of plant. They work closely with the operations and maintenance manager and work onshore. An academic degree in an engineering subject is desirable. The asset integrity manager works onshore. The salary ranges between £40,000 and £50,000.

Operations controller: The operations controller manages a team of control room technicians who remotely monitor the wind farm 24/7, 365 days of the year. The controller manages the day-to-day work of the team and ensures they follow processes and procedures correctly. An academic degree in an engineering subject is desirable. The operations manager works onshore. The salary ranges between £35,000 and £45,000.

Control room technician: The technician remotely monitors the wind farm 24/7, 365 days of the year, responds to system faults and communicates with personnel and contractors undertaking maintenance and service work at the wind farm. Around five technicians are required to operate a wind farm. The technicians work onshore in shifts. An academic degree in electrical engineering is desirable, but in many cases a lower technical qualification combined with practical experience working as a wind turbine technician, onshore or offshore, are an acceptable alternative. The control room technician works onshore. The salary ranges between £25,000 and £35,000.

Wind farm supervisory control and data acquisition and network communications

SCADA is a computer system used to monitor and control the wind farm during operation, maintenance and services. The services can be provided by the wind farm owner, the turbine manufacturer or a third-party service provider. If the service is provided by the turbine manufacturer or third party service provider, the client is the wind farm owner.

Data communications, for example through fibre optic cables, enable data to be transferred from the operating wind farm components (for example, from the wind turbines and offshore substation) to the onshore control room for processing.

Current turbine manufacturer suppliers of SCADA include MHI Vestas and Siemens Wind Power. Current third party service providers of SCADA include ABB, Bachmann, DEIF, DNV GL, KK Systems and SCADA International. Wind farm communications networks are supplied and supported by a wide range of different organisations which include multi-nationals such as ABB, Schneider and Siemens, and SMEs such as ACEDA, Cobham Wireless, Computer Service Centre (Norwich), Colchester Communications and SCADA International.

SCADA software developer: The SCADA software developer adds functionality to the existing SCADA software to improve its ability to monitor and control the wind farm. A degree in computer systems, control or software engineering or similar is required. The SCADA software developer works onshore. The salary ranges between £30,000 and £50,000.

SCADA technician: The SCADA technician installs SCADA software onsite and ensures that the control system functions properly. This includes configuration of equipment, performing routine maintenance and back-ups, and responding promptly to failures in the systems. A Higher National Certificate (HNC) in computer systems, software engineering or similar is required and specific wind turbines SCADA experience is desirable. The SCADA technician works onshore and offshore. The salary ranges between £25,000 and £35,000.

Communications network technician: The communications network technician installs and maintains the communications network infrastructure. These networks operate over a range of media including fibre optics, satellite, point-to-point wireless, mesh radio networks and virtual private networks delivered by other third-party companies. An HNC in computer systems, network support or similar is required. Manufacturer-specific training, such as a Cisco Certified Internetwork Expert (CCIE) certification, may be needed. The communication network technician works onshore and offshore. The salary ranges between £25,000 and £45,000.

Cross cutting: Communications

Communication tools, for example satellites and radios, connect offshore workers with each other and those onshore. They are required for two main reasons, first for health and safety, and second to increase the efficiency of those working on the wind farm.

Current suppliers of communication tools include Cobham Wireless, Force55 and Semco Maritime.

Electronic or mechanical design engineer: The electronic or mechanical design engineer researches, designs and develops electronic components for communication tools. This includes using computer-aided design software to prepare technical drawings of innovative ideas. Typically, a degree in electronic, electrical or mechanical engineering is required. The electronic or mechanical design engineer works onshore. The salary ranges between £20,000 and £45,000.



Turbine maintenance

Turbine planned maintenance typically involves a planned visit to each turbine once or twice a year. During these visits, technicians carry out inspection and maintenance activities including checks on oil and grease levels, instruments, electrical terminations the tightness of bolts, and a change of filters.

Unplanned service involves technician visits to a turbine in response to an alarm reported on the wind farm supervisory control and data acquisition (SCADA) system. Such visits can require the simple resetting of a circuit breaker on a piece of

auxiliary plant such as a cooling fan, or as serious as replacing the main gearbox or generator following a failure that cannot be repaired offshore.

Typically, wind turbines are supplied with a five-year service agreement and wind turbine manufacturers provide full turbine maintenance services during this period. Sometimes the service agreement can be for as long as 15 years. At the end of the service agreement, the wind farm owner may negotiate an extension, undertake the wind turbine maintenance itself or contract to a third-party services company.

Blade inspection and repair

Blades need to be kept in good condition in order to continue producing energy efficiently. Blades experience physical damage such as through fatigue loading (if there is an underlying fault in the blade) and lightning strikes during operations. Blades also experience chemical and biological damage from the marine environment, for example abrasion from high-speed water droplets and other airborne particles, and salt corrosion. Technicians, and increasingly unmanned aerial vehicles, inspect blades offshore. Technicians use rope access to inspect the blades and determine the type of damage and the best approach to repairing it. Repairs are usually done on site but in some cases the blade is taken down and repaired onshore. Worker location is not significant. Someone living in Hull and East Riding of Yorkshire could work for a non-local company.

Current suppliers include GEV Group, Humber Access, Offshore Painting Services and Total Wind. Many rope access technicians are self-employed contractors. They may work a two week on/off rotation for a 40-week season when weather conditions are most suitable to undertake blade inspection and repair.

Rope access and blade repair manager: The rope access manager ensures that technicians adhere to health and safety practices. The manager will complete a risk assessment and then select the personnel and the appropriate equipment required. Industrial Rope Access Trade Association (IRATA) Level 3 Certification is required along with industry specific training on blade inspection and repair, and at least one year of hands on experience. The salary ranges between £50,000 and £70,000.

Rope access and blade repair supervisor: The rope access supervisor ensures the inspection and repair work is completed to IRATA International Code of Practice (ICOP) specifications. They supervise rope access and blade repair technicians. Supervisors need IRATA Level 3 certification, industry specific training on blade inspection and repair, and at least one year of hands on experience. The supervisor works offshore. The salary ranges between £30,000 and £50,000.

Rope access and blade repair technician: The rope access and blade repair technician performs repairs on internal and external blade surfaces. They take photographs of damage and repairs to provide documentation for quality control. Technicians require IRATA Level 1 or 2 Certification along with industry specific training on blade inspection and repair. The technician works offshore. The salary ranges between £25,000 and £35,000.

Turbine electrical and mechanical maintenance

Wind turbine technicians oversee planned and unplanned maintenance of the wind turbines. Two technicians work on each turbine as a minimum. Teams of 12 technicians are typically transported to the wind farm turbines by crew transfer vessels (CTVs) and work 10-hour shifts. If a service operation vessel (SOV) is used on the wind farm and weather conditions are favourable, technicians may 'walk-to-work' from the SOV to the turbine on a motion-compensated gangway or transfer onto a smaller vessel and transported to the turbines. They usually work 12-hours shifts. Technicians fix both mechanical and electrical faults. Technicians may work on a single wind farm or across different wind farms. Some technicians are brought in for specific maintenance campaigns.

Under a turbine service agreement, technicians are supplied by the wind turbine manufacturer. On expiry of the turbine service agreement, technicians may be employed by the wind farm owner or operator, or supplied through third party service providers that include 3Sun Group, Boston Energy, CWind, GEV Group and CLS Global Solutions.

Site supervisor: The site supervisor manages the day-to-day activities of a team of wind turbine technicians. They ensure work is completed in line with health and safety procedures, prepare daily reports and plan annual service and maintenance schedules. A degree, Higher National Certificate (HNC) or Higher National Diploma (HND) in electrical or mechanical engineering is required, although an apprenticeship may be sufficient, for example a modern apprenticeship in wind turbine operation and maintenance. The technician will also need offshore certificates, such as working at height and sea survival. Five years' supervisory experience is desirable. The site supervisor works both onshore and offshore. The salary ranges between £30,000 and £50,000.

Wind turbine technician: The wind turbine technician maintains electrical and mechanical components on the wind turbine. They complete regular check-ups on components to ensure they are working correctly and respond quickly to faults. A degree, HNC or HND in electrical or mechanical engineering is required, although an apprenticeship may be sufficient, for example a modern apprenticeship in wind turbine operation and maintenance. The technician will also need offshore certificates, such as working at height and sea survival. A combination of generic, manufacturer-specific and turbine-type specific training is required. The technician works offshore. The salary ranges between £20,000 and £40,000 depending on experience and level.

Statutory inspections

Statutory inspections includes the checking, maintenance and repair of personnel lifts, cranes, lifting equipment and fire safety equipment housed inside the turbine. The inspections are completed on a regular basis, for example personnel lifts are checked once every six months, fire safety equipment once a year and lifting equipment once every two years. In some wind farms, the workers carrying out the inspections are supervised by a qualified wind turbine technician, but in other wind farms the inspection team will have the necessary safety and turbine type training to allow them to work independently. During the turbine service agreement, the client is the wind turbine manufacturer, which may outsource some statutory inspection work. On expiry of the service agreement, inspections by third party suppliers are used. Some third party suppliers offer a wide range of turbine maintenance services, and undertake statutory inspections alongside planned turbine maintenance. Often third party contractors must prove they are qualified to inspect and re-certify each piece of equipment to the client.

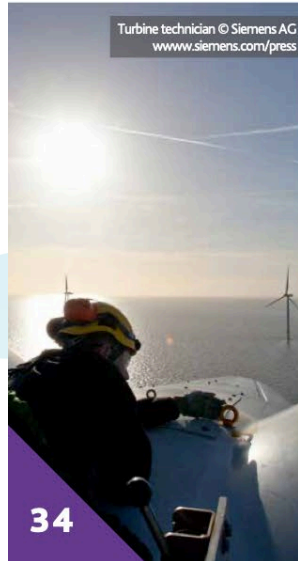
Current third party suppliers of inspectors include 3Sun Group, Hammond and Taylor, Sparrows and Winch Systems.

Crane and rigging inspector: The crane and rigging inspector checks and re-certifies cranes, winches and other lifting equipment to ensure they are fit for purpose. In the event of a fault, the inspector identifies the spare parts required to reduce equipment downtime. A certification by a recognised industry body, such as the Lifting Equipment Engineering Association (LEEA), and an HNC in mechanical engineering is required. Knowledge of current Lifting Operations and Lifting Equipment Regulations (LOLER) and Provision and Use of Work Equipment Regulations (PUWER) is also desirable. The crane and rigging inspector works offshore. The salary ranges between £25,000 and £35,000.

Fire safety technician: The fire safety technician tests fire safety equipment to ensure it is fit for purpose. A theory and practical certificate in the servicing of fire extinguishers from a recognised organisation is required, for example from British Approvals for Fire Equipment (BAFE), the British Fire Consortium (BFC) or the Fire Industry Association (FIA). The fire safety technician works offshore. The salary ranges between £20,000 and £30,000.

Lift technician: The lift technician services, refurbishes and repairs the personnel lifts that are used to transport wind turbine technicians from the bottom of the turbine tower to the turbine nacelle. The lift technician will fix both mechanical and electrical faults. A certification in lift engineering is required, for example level 3 NVQ Lift Engineer, or a HNC or HND in mechanical, electrical or electronic engineering. The lift technician works offshore. The salary ranges between £20,000 and £35,000.

Turbine technician © Siemens AG
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Structural inspection and maintenance

Foundations for wind turbines and offshore substations require structural inspection and maintenance on a regular basis. The mix of atmospheric, marine and biological corrosion can cause damage that is both expensive and difficult to repair. Inspections map the thickness of the foundations, check seals and corrosion projects, take silt

samples and check scour (erosion of the seabed). Inspections can be completed by commercial divers, video or remotely operated vehicles (ROVs). Secondary steel structures, for example boat landing systems, ladders and railings, are inspected in addition to the main foundation structure.

Foundation inspection, repair and maintenance

Foundations need to be inspected regularly for marine growth, corrosion, paint condition and scour. Inspection can be via pre-planned inspection campaigns or ad hoc.

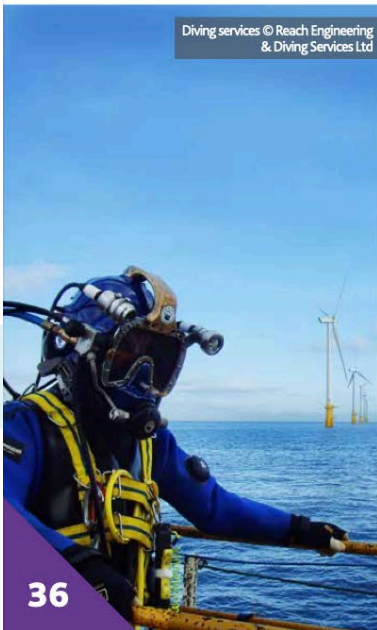
There may be little demand for newly trained divers because there is a surplus of experienced divers in the oil and gas industry and the skills can be easily transferred. The industry is looking towards more safety-innovative ways of inspecting, repairing and maintenance by using ROVs instead of divers. The client is normally the developer, or operations, maintenance and service (OMS) contractors. Divers tend to complete inspection, repair and maintenance over a three to four month period in the summer when weather conditions are more favourable.

Current suppliers include Briggs Marine Contractors, FoundOcean, Reach Engineering & Diving Services (REDS) and ProServ.

Diver: The diver inspects the foundation and determines if repair work is necessary. Two positions are typically required to deliver a contract, because a stand-by diver is required in the case of emergencies. The diver is required to have an HSE Part 1 qualification and preferably HSE Part 2 and 3 qualifications. They also require a valid dive ticket and Global Wind Organisation (GWO) module certificates. The diver works offshore. The salary ranges between £60,000 and £90,000.

Dive supervisor: The supervisor is responsible for the safety of the diving team during a planned dive. This includes monitoring air and gas supply, communicating with the divers and implementing emergency plans is necessary. The supervisor must have an HSE Part 1 qualification and preferably HSE Part 2 and 3 qualifications. They also require a valid 'dive ticket' and GWO module certificates. The dive supervisor works offshore. The salary ranges between £50,000 and £75,000.

Diver tender: The diver tender provides surface support to the diving team and handles the divers' umbilicals. Umbilicals supply air and gas from the surface to the diver. Two positions are typically required to deliver a contract, as a stand-by tender is required in the case of emergencies. The diver tender is required to have a HSE Part 1 qualification and preferably HSE Part 2 and 3 qualifications. They also require a valid dive ticket and GWO module certificates. The role requires an annual dive medical. The diver tender works offshore. The salary ranges between £30,000 and £40,000.



Diving services © Reach Engineering & Diving Services Ltd

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Foundation cleaning

Foundations need to be cleaned as part of a maintenance plan to protect against corrosion and marine growth. Marine growth can significantly affect the structural integrity of the foundation by adding weight and affecting its load-bearing properties. It also creates a safety hazard for technicians accessing the foundation. Foundation cleaning includes the secondary steel, for example boat landing systems, ladders and railings, and the transition piece platform. Cleaning can be completed using tools (such as subsea grit blasting or marine growth removals) and high-pressure jet washers. The client can be the wind farm owner or an OMS contractor.

Current suppliers include Briggs Marine Contractors, Cape PLC and ProServ.

Technical supervisor: The technical supervisor agrees with the client the best technical approach, cost and schedule for the delivery of the cleaning services. The supervisor ensures cleaning activities comply with health and safety standards and quality procedures. Appropriate health and safety, and management qualifications, such as from the Institution of Occupational Safety and Health (IOSH), are required. Three years supervisory experience is desirable. The supervisor works onshore. The salary ranges between £30,000 and £50,000.

Team leader: The team leader oversees a team of cleaning operators. They co-ordinate the resources, equipment and materials required to complete the cleaning activities to the client's requirements. The team leader works onshore and offshore. The team leader requires certification from RenewableUK or Global Wind Organisation for offshore survival and working at height, alongside appropriate health and safety, and management qualifications, such as from the Institution of Occupational Safety and Health (IOSH). Two years supervisory experience is desirable. The salary ranges between £25,000 and £40,000.

Cleaning operator: The operator uses specialist cleaning equipment and often works with chemicals and hazardous materials. Two to three cleaning operators are required to deliver a contract. The cleaning operator requires certification from RenewableUK or Global Wind Organisation for offshore survival and working at height, alongside appropriate health and safety qualifications, such as from the Institution of Occupational Safety and Health (IOSH). They typically receive in-house high-pressure water jet training. The operator works offshore. The salary ranges between £20,000 and £30,000.

Cross cutting: Port and harbour services

Ports and harbours are used during the installation of wind farms and their operations, maintenance and service. Services include the provision of lay-down and storage land for large components, access to waterways and railways, cranes and lifting equipment and warehouses and workshops for storage or offices.

Current suppliers include Associated British Ports and Port of Grimsby East. The client could be the wind farm owner, the wind turbine manufacturer, installation contractor or the OMS service provider.

Dock master: The dock master manages the day-to-day operations of a dock used for freight, logistics or maintenance of vessels. One position is typically required per port. A dock master qualification is required, for example standards of Training, Certification and Watchkeeping for Seafarers (STCW), Master Mariner Class 1 Certificate of Competency or a Harbour Master Certificate endorsed by the Maritime and Coastguard Agency (MCA). The dock master works onshore. The salary ranges between £45,000 and £55,000.

Dock gateman: The dock gateman is responsible for the security of the dock, operating any lock gates and providing safe passage for vessels. Three positions are generally required to deliver 24-hour port operations. No technical knowledge is required, but a construction skills certificate would be desirable. The dock gateman works onshore. The salary ranges between £25,000 and £40,000.

Line handler: The line handler manages the mooring lines of vessels entering and leaving the ports and harbours. Around nine positions are typically required to deliver 24-hour port operations. Manual handling training is required. The line handler works onshore. The salary ranges between £20,000 and £25,000.



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Maintenance and service logistics

Logistics is the planning and movement of resources from one location to another. In the operations, maintenance and service (OMS) of offshore wind farms, there is both onshore and offshore logistics.

Crew transfer vessels (CTVs) typically provide transport for technicians and spares from the onshore base to offshore wind farms less than about 90 minutes transfer time from port. Some wind farms supplement CTVs with full-time helicopter support, for transporting technicians when the task in hand does not require heavy

tools or spares, or when sea conditions are severe. Spare parts are stocked in onshore warehouses.

Service operations vessels (SOVs) are larger and more capable than CTVs and are typically used for wind farms more than about 90 minutes transfer time from port. They are effectively a floating OMS base, accommodate between 60 and 90 passengers and contain workshops and storage for equipment, consumables and spares.

Marine coordination

Marine coordination is the organisation of personnel and vessels moving from the onshore base to the offshore wind farm. Weather conditions, visibility and tides are monitored daily in order to coordinate efficiently. It is a 24-hour service. Workers usually live close to companies offering marine coordination.

Current suppliers include Carlbom Shipping, Green Marine Solutions and TDL Wind. The client can be the wind farm owner or an installation contractor.

Marine coordinator: The coordinator manages the movement of personnel and the operations of vessels. This includes checking and tracking vessel certifications, monitoring weather, emergency response planning and liaising with interested parties, such as the Maritime and Coastguard Agency. Two to eight positions are typically required to deliver a contract. No specific technical knowledge or qualifications are required. The marine coordinator works onshore. The salary ranges between £40,000 and £50,000.

Ships agent: The agent carries out port-based business on behalf of a vessel's owner or operator. This includes arranging services such as supplies for the vessel and transfer of crew to port while ensuring each ship meets applicable port regulations, restrictions and requirements. A minimum of four positions is required to deliver a contract. No technical knowledge or qualifications are required. The agent works onshore. A new starter would expect a salary of £15,000 to £20,000.

Safe transfer of technicians between the SOV and the wind turbines © Siemens AG, www.siemens.com/press



Marine Coordination Centre, coordinating personnel, vessels and all operations © Green Marine Solutions

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Warehouse and spares management

During the operation of a wind farm, components need maintaining or replacing quickly to reduce lost energy production. If spares are transported to the wind farm by CTVs, the warehouse is usually located close to the onshore base and loaded onto the CTVs on a regular (usually daily) basis. Workers are typically employed locally to the warehouse. If spares are transported by SOVs, they are loaded onto the vessel when it is in port (usually around every two weeks) and kept in smaller warehouse storage on board until required. It is not as important for the worker to be located close to the onshore base as they may be required to manage stock offshore onboard the SOV.

Wind turbine manufacturers supply spares during the turbine warranty period (usually five years). For out-of-warranty turbines, some wind farm owners manage the supply of spares in-house or contract with an independent third party supplier. Third party suppliers include GWA Supplies, Renewable Parts and Spares in Motion.

Warehouse manager: The warehouse manager plans the day-to-day operations of the warehouse, interfaces with clients and ensures health and safety procedures are followed. No formal qualifications are required, but a degree in business, retail management or economics is desirable. Relevant Chartered Institute of Logistics and Transport (UK) Level 3 Certificates are also an advantage. The warehouse manager works onshore. The salary ranges between £20,000 and £40,000.

Warehouse operative: The warehouse operative records and controls stock movement and manage the delivery of equipment to site. No formal qualifications are required, but a strong understanding of health and safety and experience with computer management software are desirable. If using CTVs, the warehouse operative works onshore. If using SOVs, the warehouse operative may work both onshore and offshore. The salary ranges between £15,000 and £20,000.

Vessel operations and maintenance

CTVs and SOVs are the vessels used to move personnel and spares from shore to and within the wind farm. The operation of the vessels requires meticulous organisation of crew, spares and consumables in order to implement the OMS strategy efficiently. It is necessary to follow a regular vessel maintenance programme, such as inspecting the hull for exterior damage and checking the engine and communication tools are working properly.

Deciding the best OMS strategy depends upon the wind farm site characteristics and the preference of the developer or the turbine supplier. For SOVs, worker location is not significant. For CTVs it may be more preferable for workers to be employed locally, although someone living in Hull and East Riding of Yorkshire could be employed by a non-local company.

Current CTV suppliers include Bibby Offshore, CWind, Dalby Offshore, Dunston, Rix Sea Shuttle and Seahorse Marine. Current SOV suppliers include Acta Marine, Bernhard Schulte Shipmanagement and Esvagt. Some larger operators also have in-house maintenance capability. Smaller operators typically contract with specialist maintenance companies for large maintenance work, for example to vessel engines. Current maintenance companies include Rollo Power Solutions.

Vessel superintendent (operations): The vessel superintendent co-ordinates activities of the onshore team and the offshore team. They co-ordinate and induct crew, prepare new vessels for work and schedule and prepare for vessel audits. A degree level qualification is required in a relevant field, such as marine engineering or mechanical engineering. The vessel superintendent works onshore. The salary ranges between £35,000 and £45,000.

Crew manager (operations): The crew manager assigns crews to vessels and records qualifications, training and experience of the masters and deckhands. The crew manager works onshore. A degree level qualification is required in a relevant field such as maritime operations, business or economics. The crew manager works onshore. The salary ranges between £20,000 and £30,000.

Field service engineer (maintenance): The field service engineer maintains electrical equipment on board vessels, for example generators and engines. A degree in mechanical or electrical engineering is required. The field service engineer works both onshore and offshore. The salary ranges between £20,000 and £35,000. Master, mate and deckhand job roles are also required for CTV and service operation vessel (SOV) operations and are detailed in the guard vessels function.

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Value your work!



*Good luck with your research and hope to
see you soon in more activities of the
Consortium!*

Thank you for your time.

Amorina: amorina.armayor@wavec.org

