


FORCE Technology

Wind Power Services

http://www.forcetechnology.com

Safeguarding life and assets in a sustainable manner

FORCE Technology Group Facts

- ✓ 70 years of experience with innovation and application of knowledge and technology
- ✓ Turnover app 164 million Euro (2014)
- ✓ 60% of the turnover is generated on the international market
- ✓ Serves customers in more than 60 countries
- ✓ More than 1600 employees
- ✓ Spend more than 25 million Euro yearly on R&D activities

Locations worldwide

FORCE Technology: Wind Power Services

Wind Power Services

Our services to the wind industry covers:

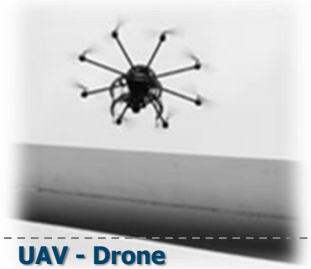
- Development and implementation of inspection/maintenance strategies and programs (RBI/RCM)
- Structural design and dynamic analysis (structural integrity, structural assessment)
- Condition monitoring
- Monitoring of concrete foundations (online load measurements)
- Non-destructive-testing (NDT of the wind turbines – steel, concrete and composite materials)
- Corrosion protection and materials & surface technology
- Corrosion management
- Inspection services

Our facilities and equipment to the wind industry:

- Wind tunnel tests
- Hydrodynamic tests (towing tank)
- Automatic scanning of wind turbine blades
- Automatic scanning of welds on wind turbine towers
- Thermography (identify defects and excessive loads in different components of the turbine)
- Software tools for Maintenance planning and inspection planning (RCM/RBI)

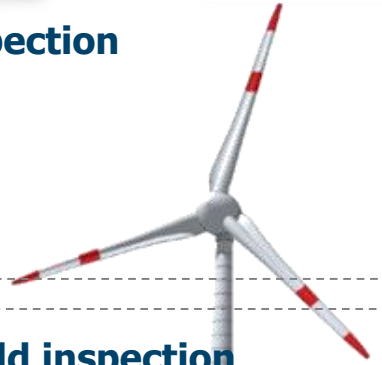
On-site inspections (onshore & offshore)


Blade Scanning and inspection

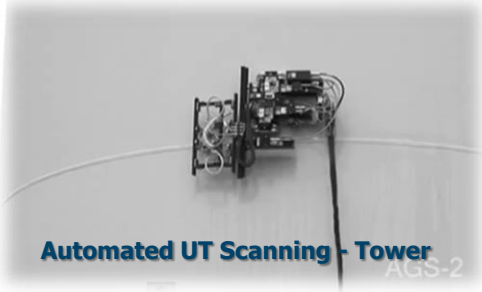

UAV - Drone


Blade Scanning

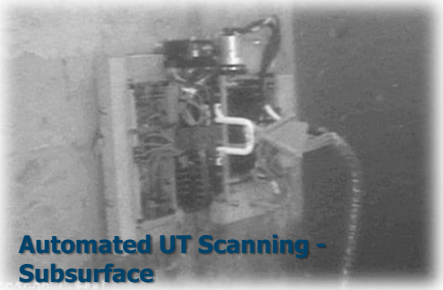
Blade inspection



Tower - Weld inspection


Automated UT Scanning - Tower

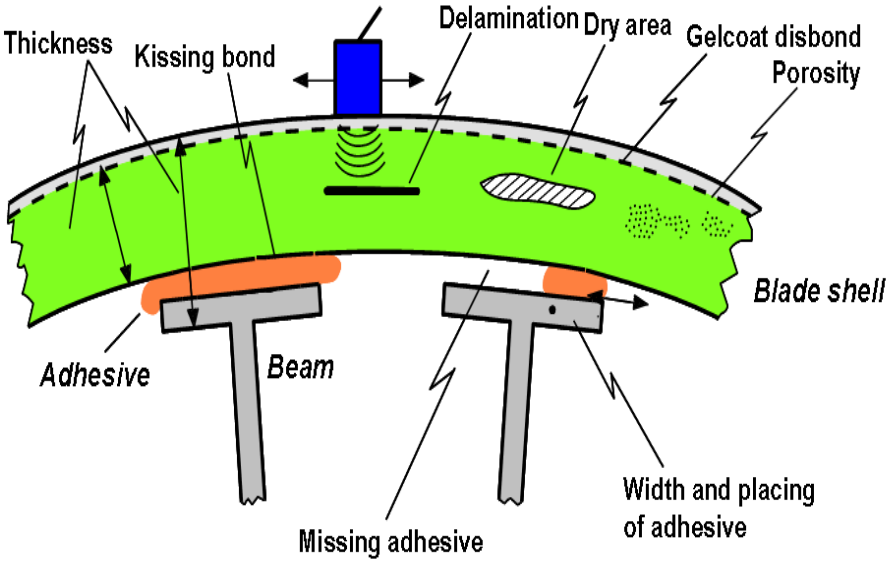
Subsea inspection

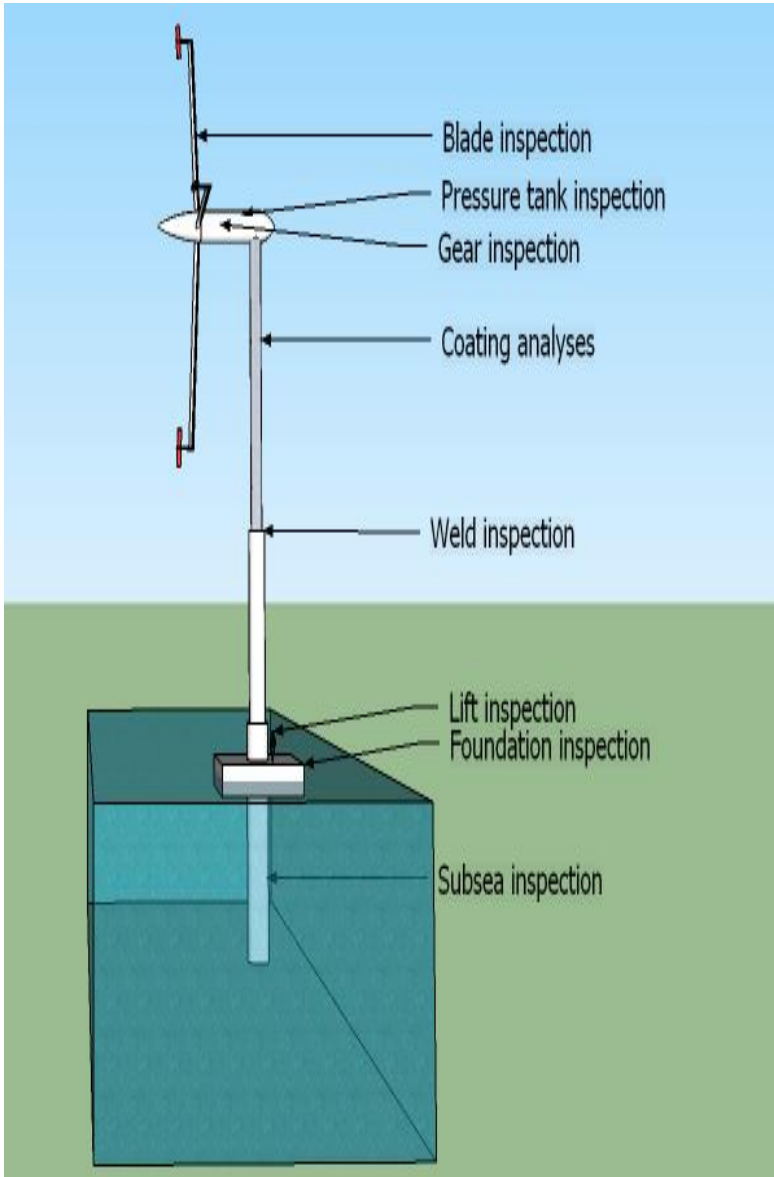

Automated UT Scanning - Subsurface

Services

Blade inspections

- UT inspection for hidden wrinkles between fibre layers, no adhesion, dry areas and porosities in laminates, laminate thickness and lack of bonding between the shell and beam.



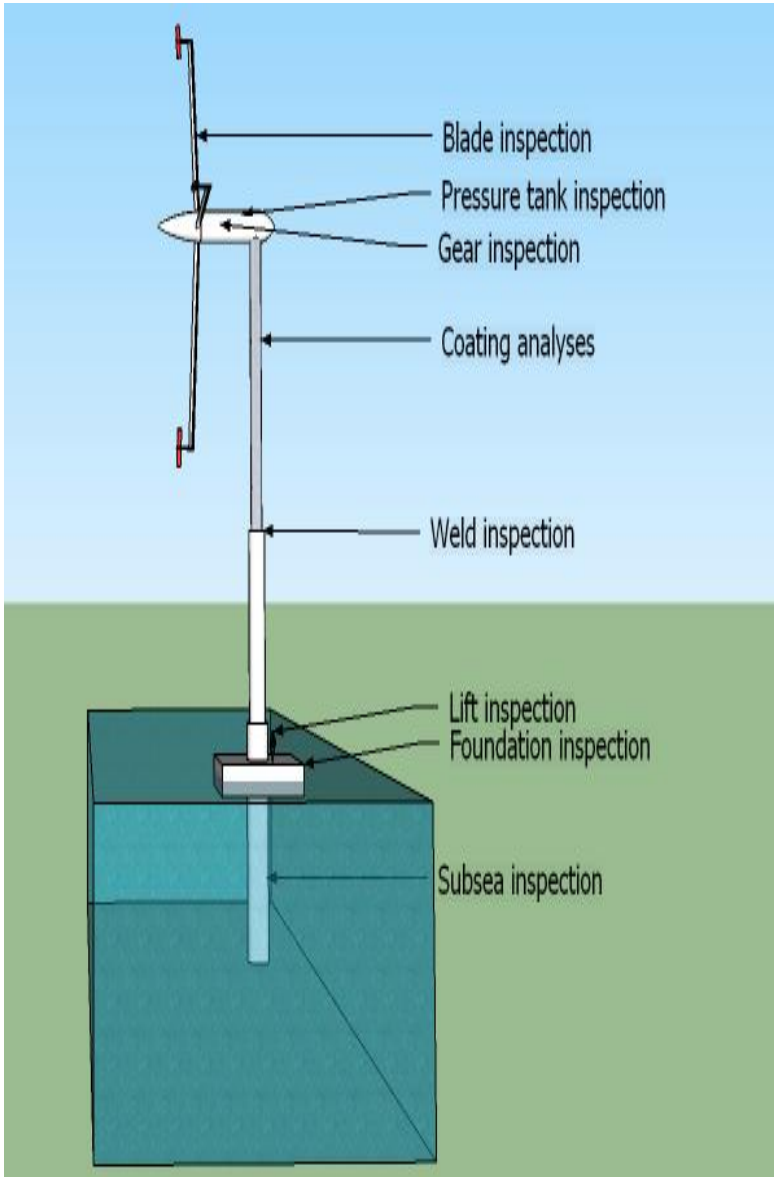


Services

Coating and corrosion protection inspections and consulting

• Assessing the need for corrosion protection and condition monitoring of steel structures, counselling and selection of coating types and systems.

• Work Planning and implementation for customer-specific system for checking before, during and after surface treatment.

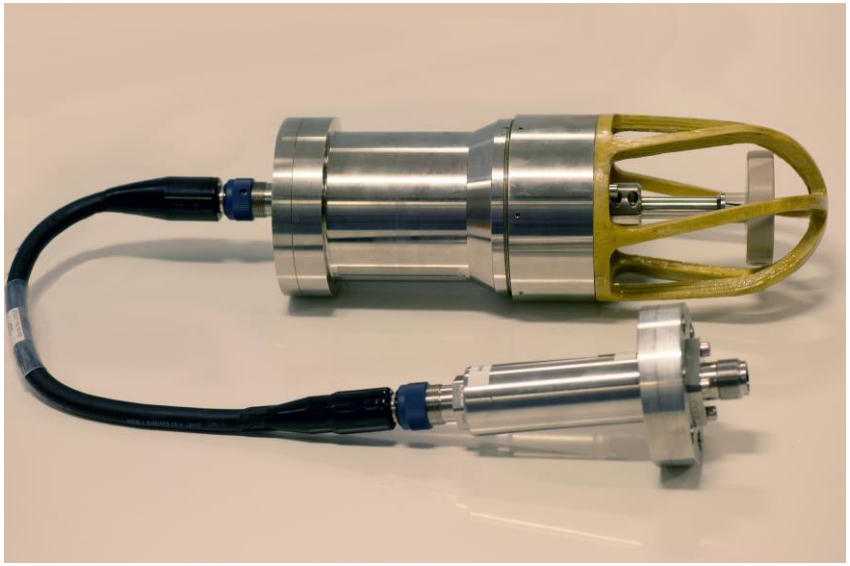


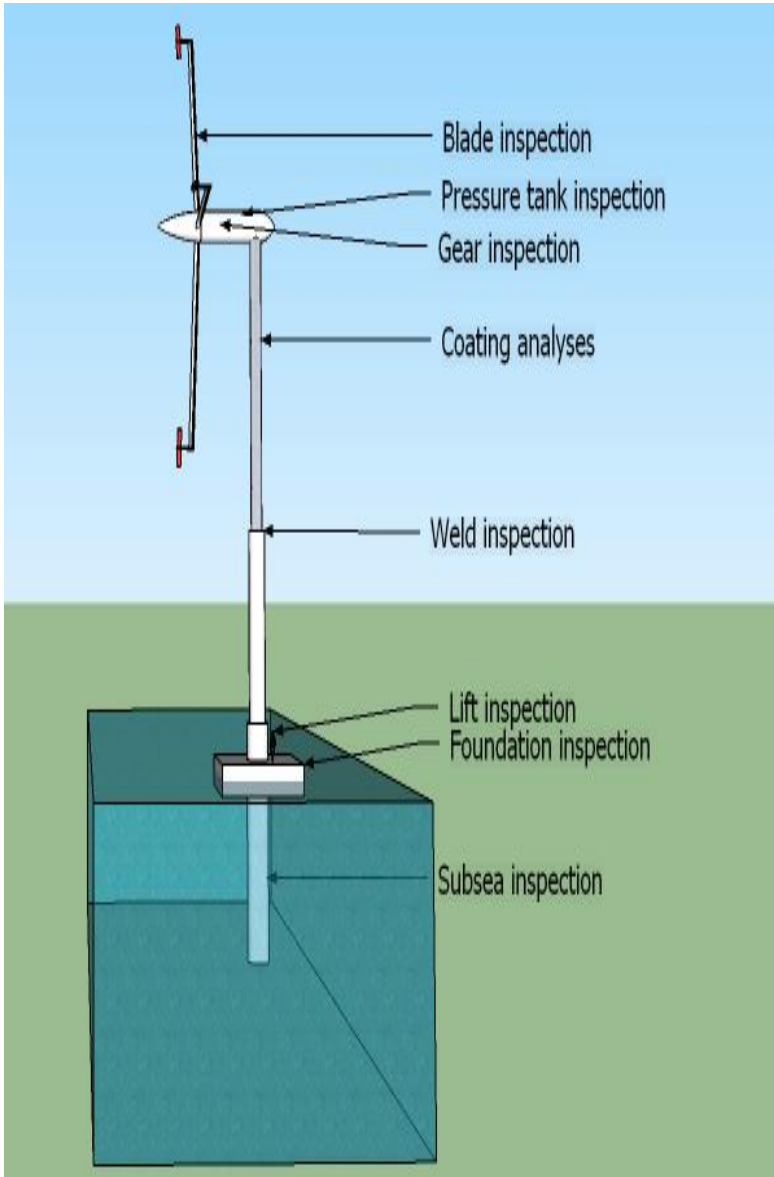
Services

Internal and external Cathodic Protection services

- CP design and computer modelling of all types of design monopile, jacket, floater, concrete, etc.

- CP inspection with drop cell, stab probe or FiGS (field gradient sensor)

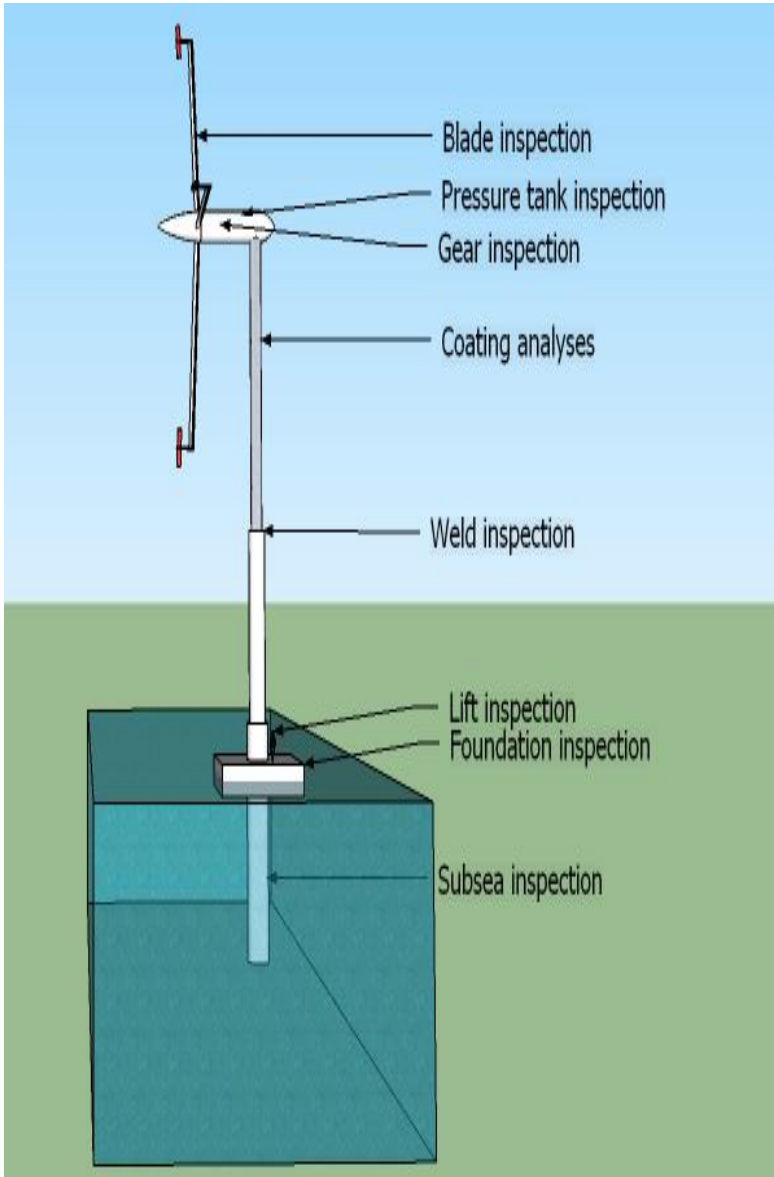




Services

Monitoring on the offshore support structures

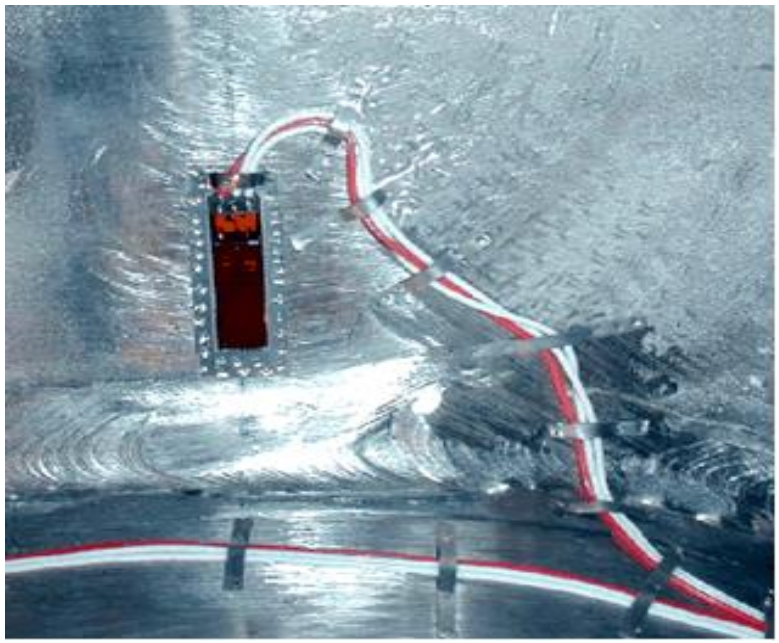
• Monitoring system in order to assess initial design assumptions and anticipate operation and maintenance issues by use of strain gauges, gas, temperature and water level sensors as well as corrosion probes, accelerometers, inclination sensors and scour sensors

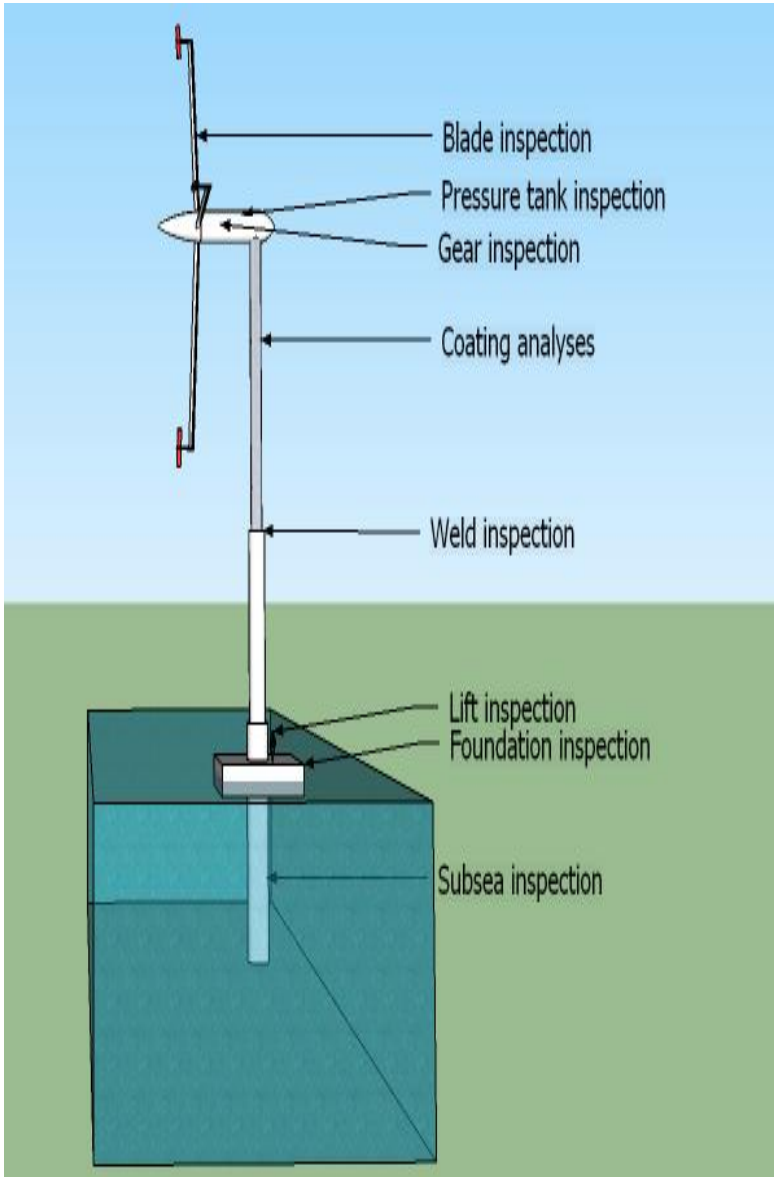


Services

Strain Gauge Monitoring

• Monitoring of deformation, stresses and strains in a structure, such as gear boxes, concrete structures, steel towers and platforms, and composite materials such as blades and nacelles.

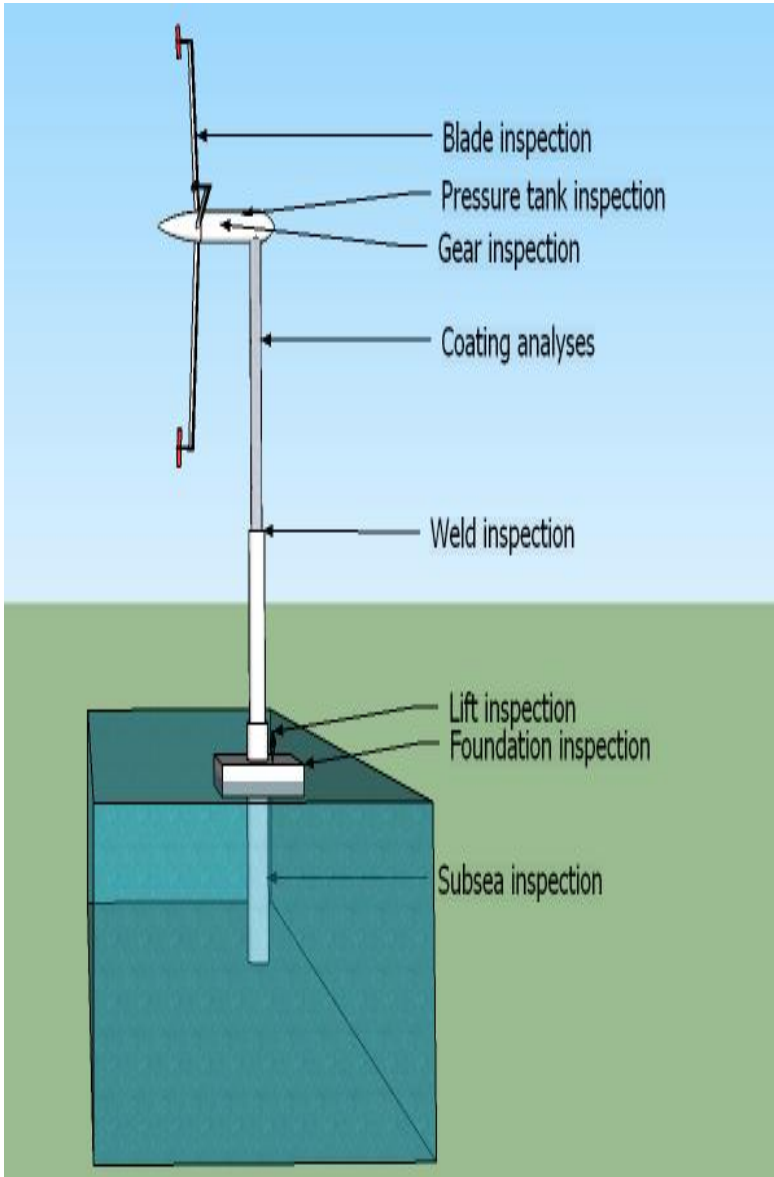




Services

Steel and welding inspections

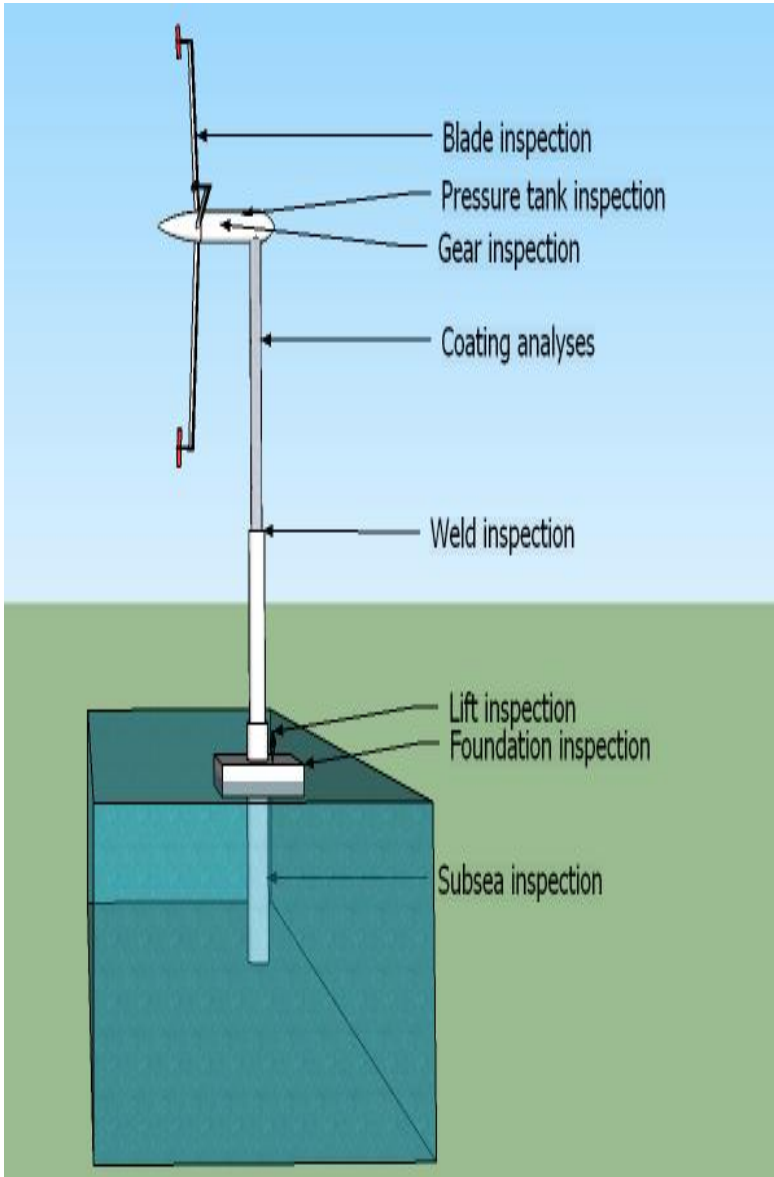
• Design and examination of proposals from suppliers, quality control, plans for reception control, control of materials, evaluation of welding procedure tests (WPAR) and methods, review of procedures, welders' certificates, NDE and inspection of NDE procedures and certificates, audit and final documentation.



Services

3rd party inspection

• Audits and selection support of suppliers, evaluation and control of subcontractors, review of procedures, specifications for manufacture and inspection of documentation from subcontractors. FORCE Technology as building consultant for foundations manufacturing.

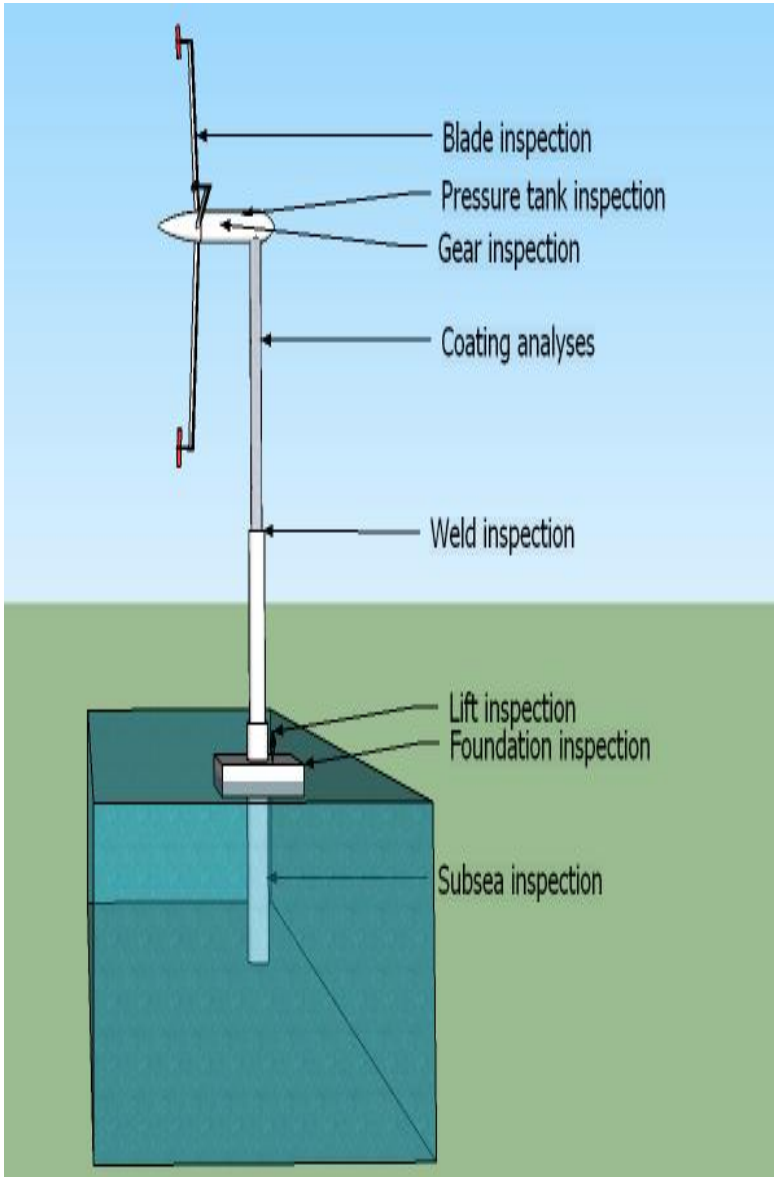


Services

On-site inspection

• Operating turbines, offshore as onshore and above and below the waterline and from the foundation to the blade tip.

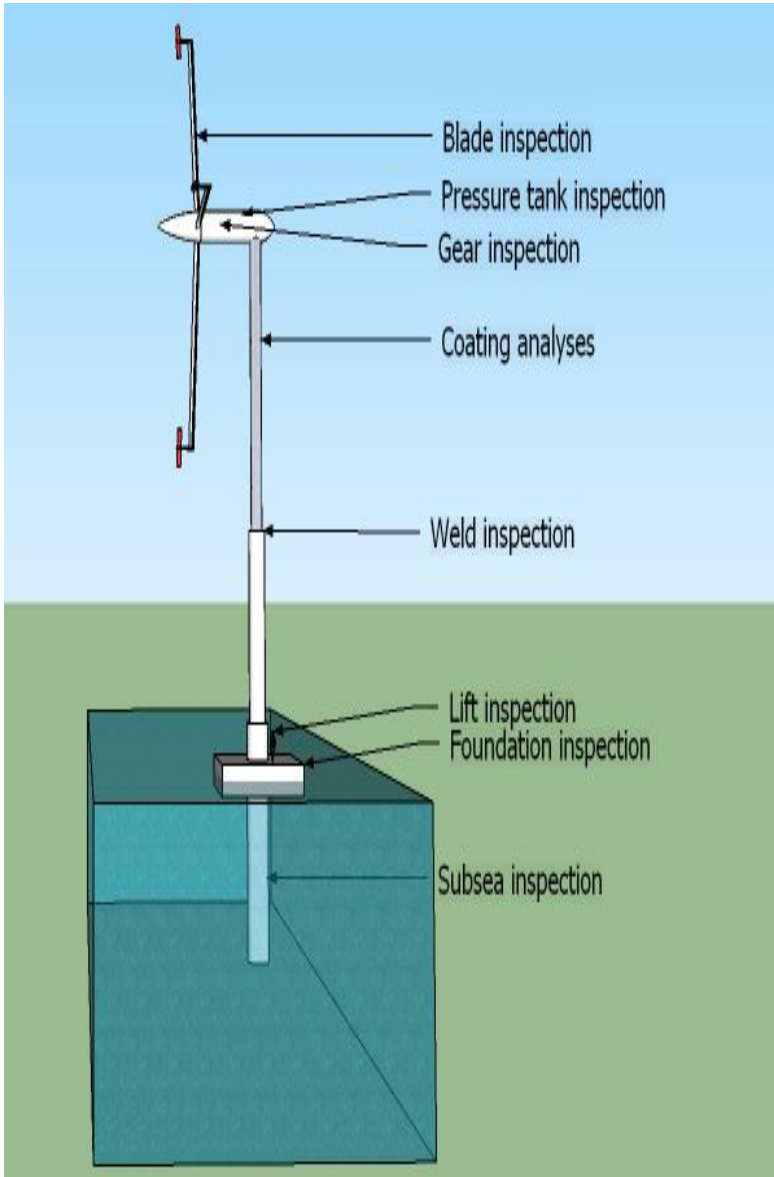
• Assessment and calculations of remaining service life based on the results collected during the inspection.



Services

Concrete inspections

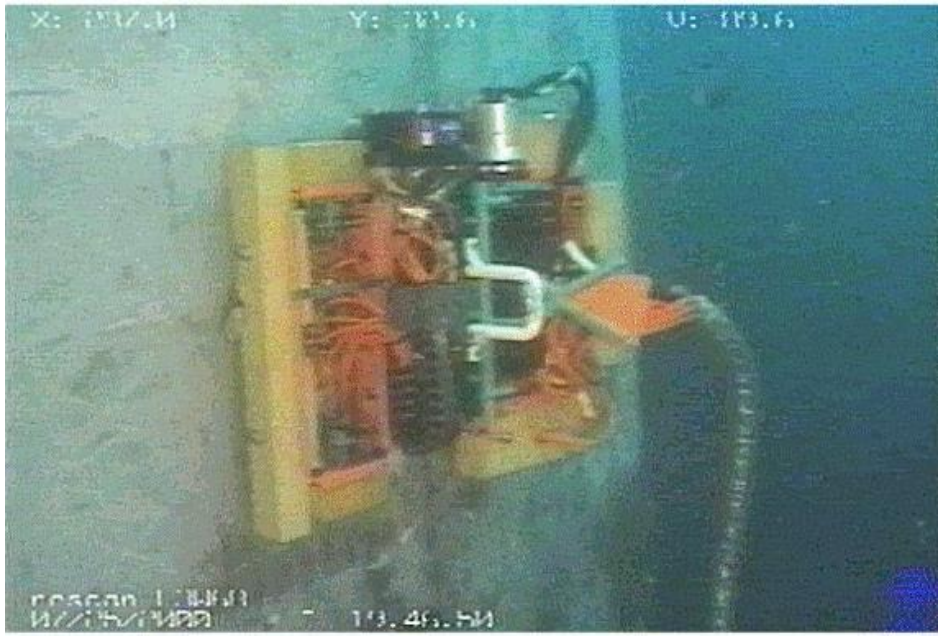
• Periodic inspections of structures, visually combined with NDT. Condition Assessment Scheme and damage analyses using both the NDT and laboratory tests, corrosion measurement and monitoring, and protection against corrosion.

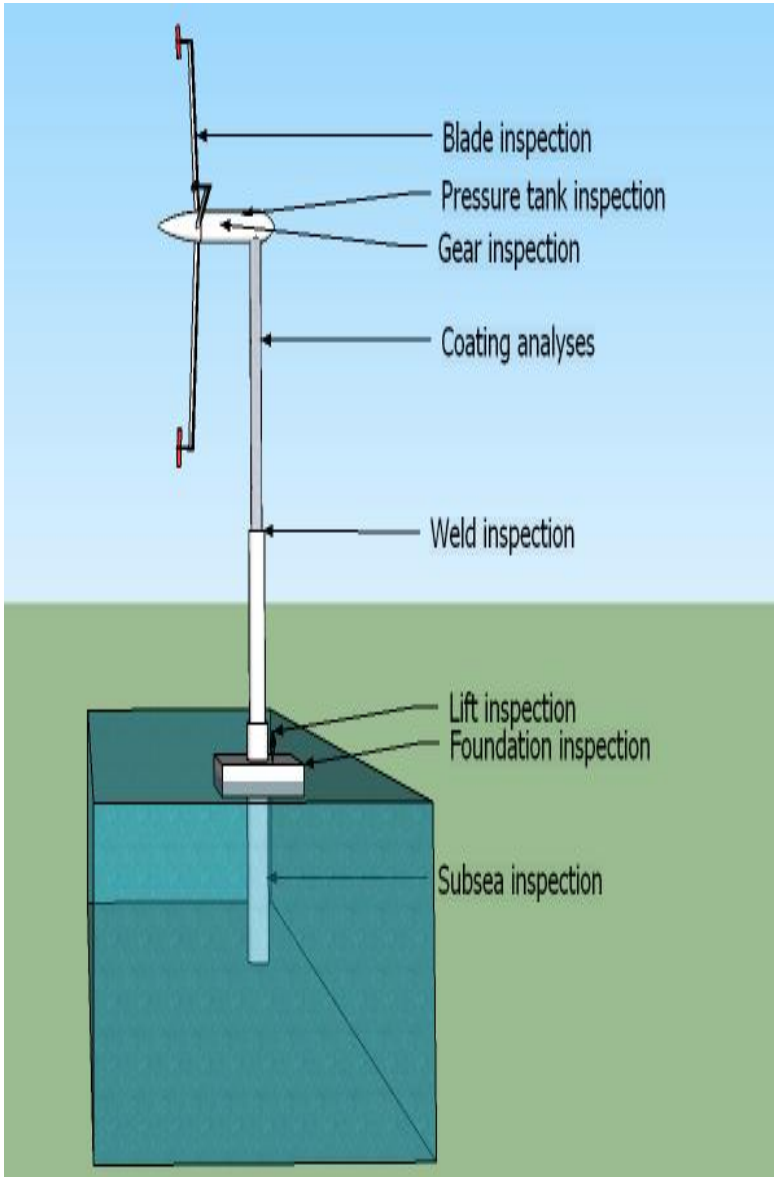


Services

Subsea inspections

• Detailed visual, UT, or eddy current inspections and documentation. With FORCE Technology-developed underwater NDE inspection equipment that can be configured for operation by diver or ROV.

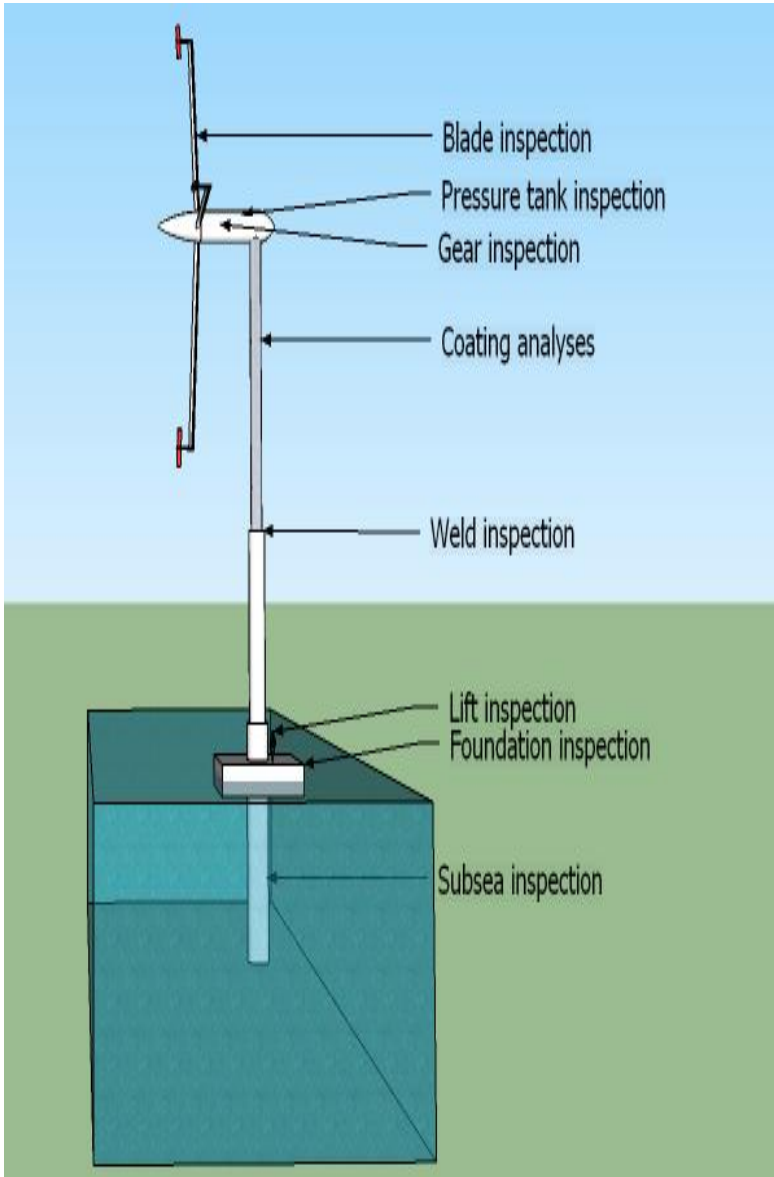




Services

Failure analyses

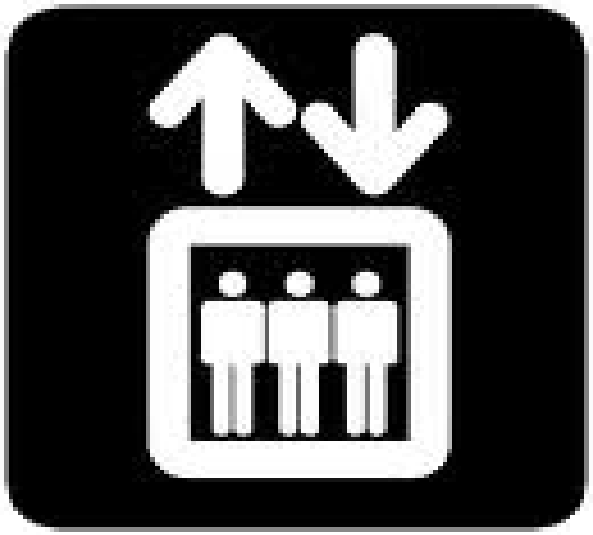
• Accident, damage and RCA analyses of components and structures on-site and in the laboratory.

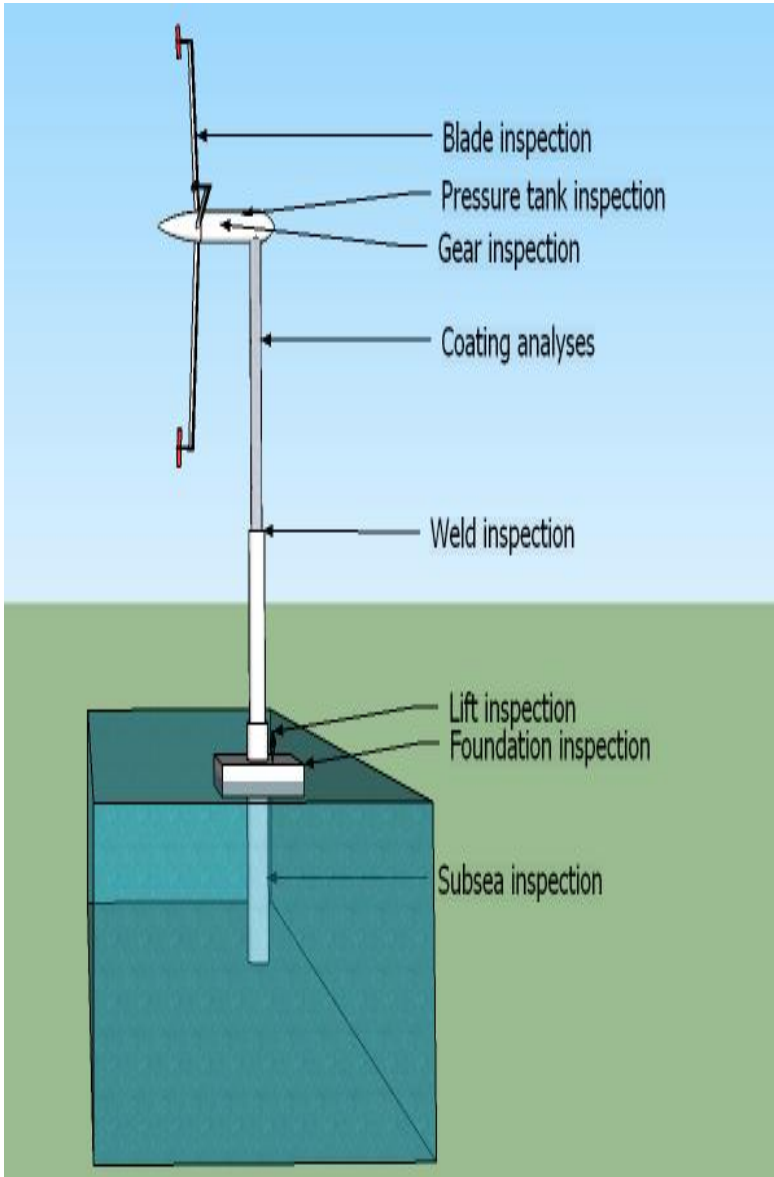


Services

Lift/elevator inspections

• As accredited inspection and testing institution, FORCE Technology performs professional and independent inspection and testing of all types of lifts and elevators.

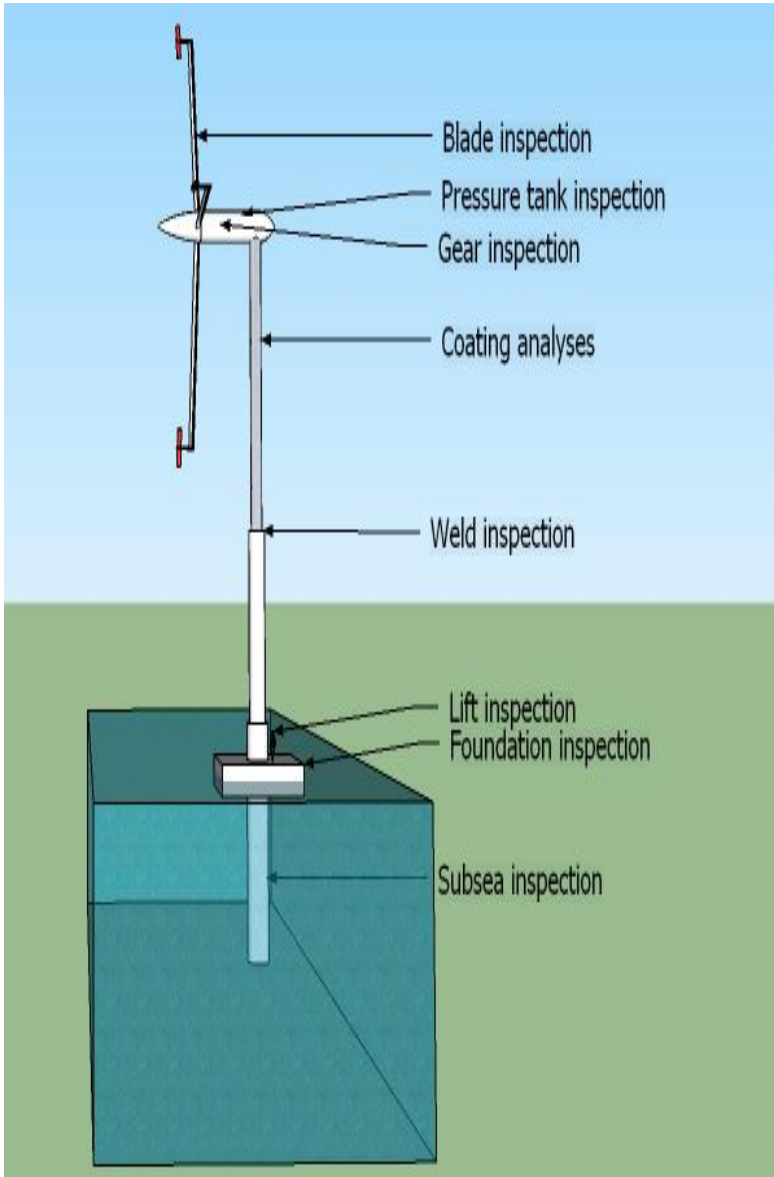




Services

Pressure tanks

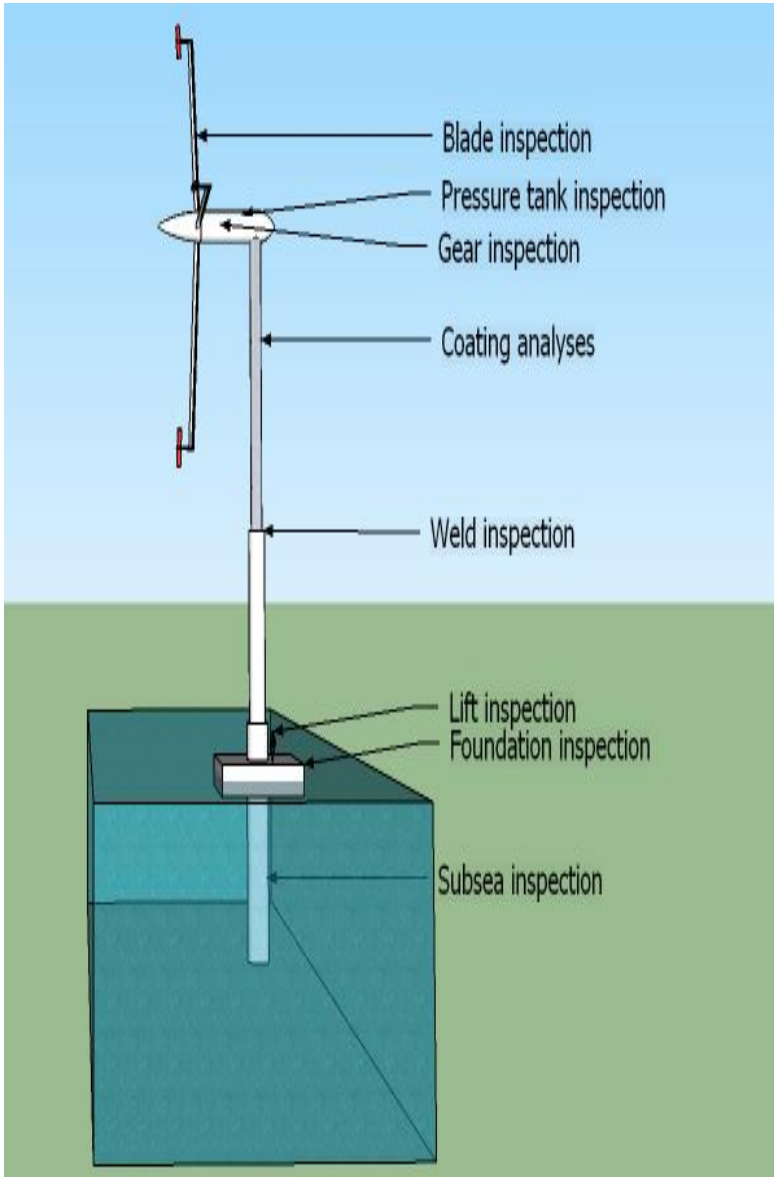
• Periodic surveys and conformity assessment of Pressure Assemblies in turbines.



Services

Wind Tunnels

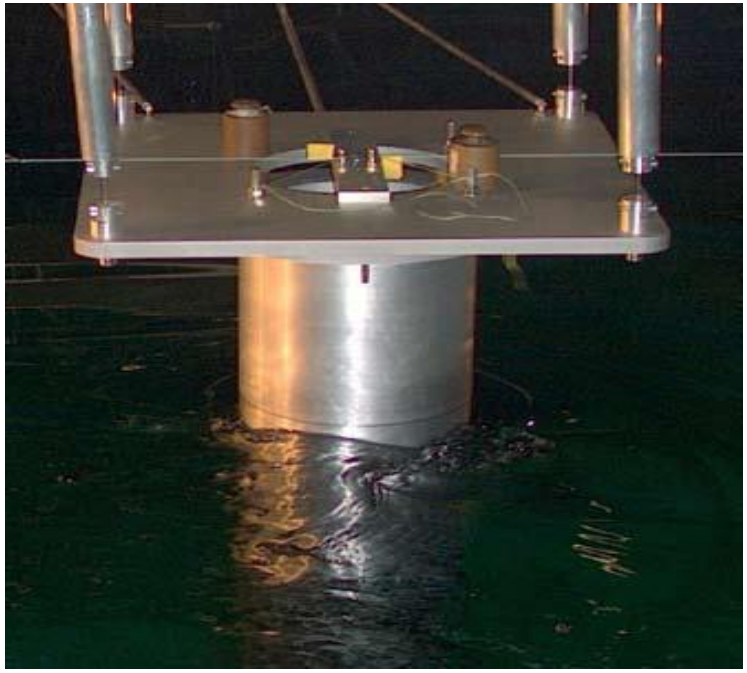
• Our largest tunnel has a length of 21 metres. Used especially for testing of ships, offshore installations, bridges and building structures.

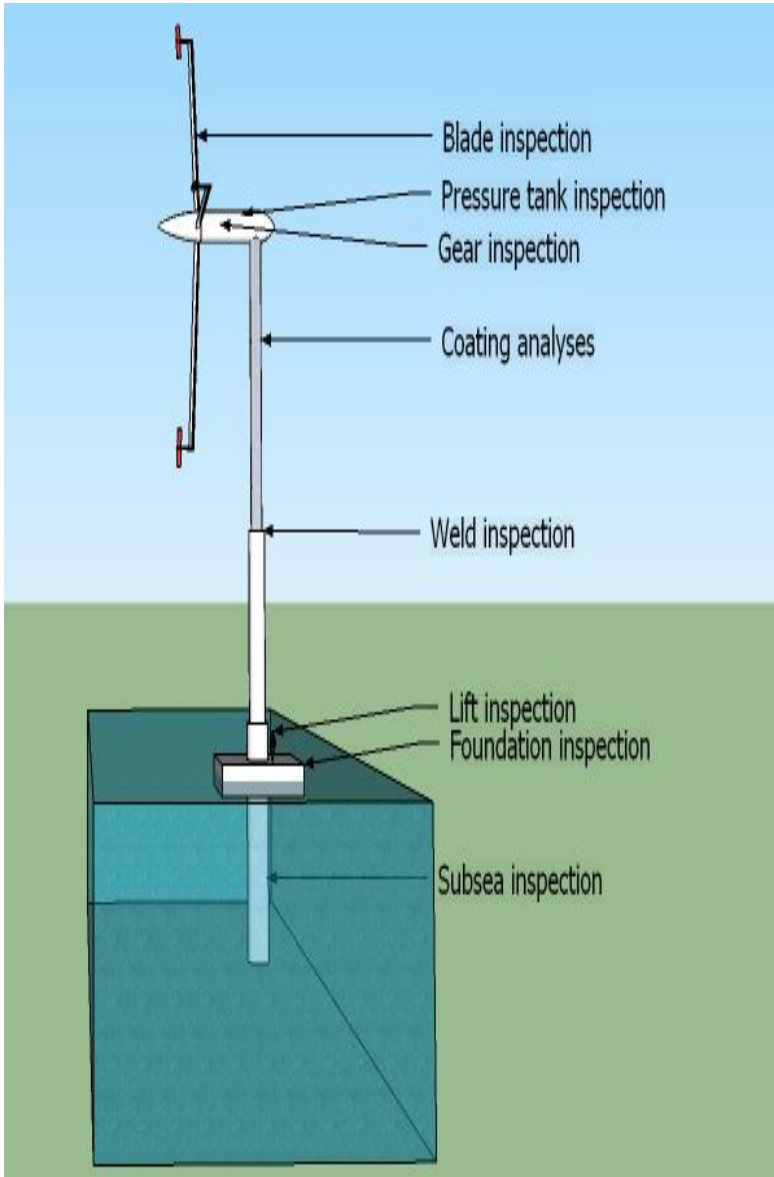


Services

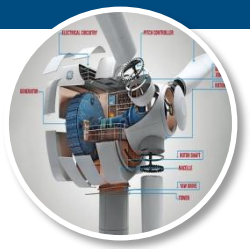
Vortex vibrator

• Vortex vibration study of maritime structures, including SPAR platforms and subsea structures.





Wind Farms Integrity Management – FORCE Technology Package



Inspection services
Specialized personnel and tools

Inspection products and technologies
- Visual inspection (UAV helicopter)
- Scanners (ATS-2, MWS-6)

Inspection data

Corrosion management
- Materials technology
- Coating and corrosion
- Cathodic protection
- Corrosion monitoring services

Corrosion data

Required struct. analysis

Structural integrity
- Structural reliability assessment of turbine components (loads/ resistance analysis)

Structural reliability

Inspection and maintenance planning
Software tool: MANIFER

Monit. data

Monitoring
- Load/response sensors (strain, accelerations, inclination, etc.)

Inspection plan

Monitoring data

External data (complementary information)

- Monitoring data about the condition of other turbine components (e.g. rotor, electrical systems)
- Production forecasts

Wind Power RCM analysis - Software

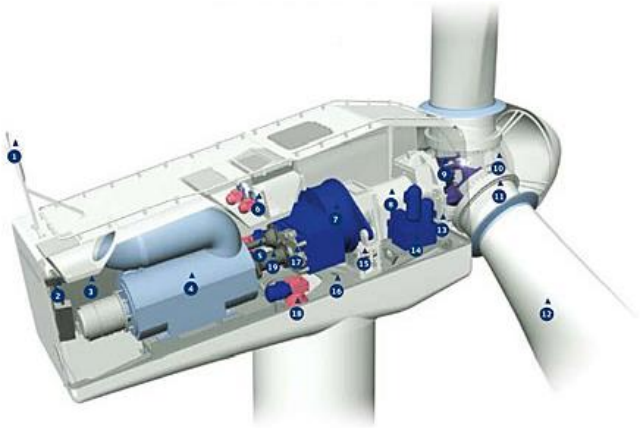
MANIFER

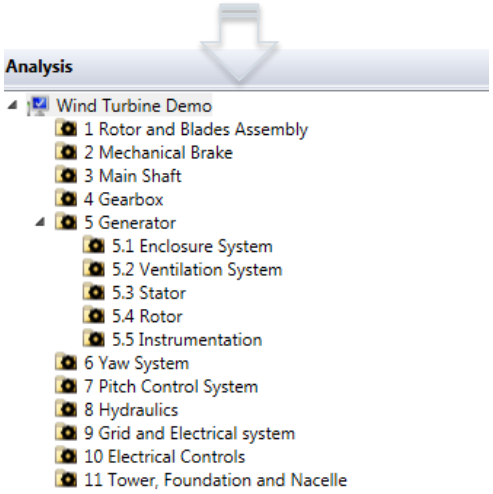
A software tool that facilitates maintenance analysis according to the RCM methodology

Main features

- **Detailed assessment of the turbine components**
  - Equipments
  - Failure Modes
  - Maintenance Tasks

- **Cost-effective maintenance planning based on the component criticality**





Wind Power References

SIEMENS
Siemens Wind Power

aibel

DONG energy

Statoil

Vestas

ABB

VATTENFALL

EEW SPC

Statkraft

HOCHTIEF

Sheringham Shoal
Scira Offshore Energy

TenneT
Taking power further

Project reference list Norway

Project	Year	Customer
Dong Energy - CP modelling of offshore Wind farms	2010	DONG Energy A/S
Sheringham Shoal. CP Verification of Wind Turbine Foundation	2011	Scira Offshore Energy Limited
Walney I Offshore Wind Farm. CP Modelling of Steel Foundation	2011	DONG Energy Power A/S
Meerwind. CP Evaluation of Foundation	2011	WindMW GmbH
DolWin2 HVDC Platform, CP Design	2011	Aibel AS
Corrosion Control for Windfarm Structures	2012	BAC Corrosion Control A/S
West of Duddon Sands Wind Farm. CP Modelling	2012	DONG Energy Power A/S
Borkum Riffgrund 1 Windfarm CP design & modelling	2012	DONG Energy Power A/S
Borkum Riffgrund 1 Windfarm CP design & modelling	2012	DONG Energy Power A/S
Thanet Offshore Windfarm CP Inspection	2012	Vattenfall Wind Power Ltd Wind Operations UK
Westermost Rough Offshore Windfarm CP modelling	2012	DONG Energy A/S
Universal Foundations CP Optimisation	2013	Universal Foundation A/S
GODE02 Windfarm Cathodic Protection Design & Modelling	2013	Gode Wind GmbH c/o DONG Energy Wind Power AS
Belwind Wind farm CP Modelling	2013	Rambøll DK
Sheringham Shoal. Chemical Treatment Feed Study	2013	Statoil ASA
Sheringham Shoal. Retrofit CP Design	2013	Global Maritime AS
Baltic II Wind Farm. CP Modelling	2014	Hochtief GmBH
Baltic II Wind Farm. CP Inspection	2014	Hochtief GmBH
Sheringham Shoal Internal CP retrofit design	2014	Statoil ASA
BAC Sacrificial anode study	2015	BAC Corrosion Control A/S
Dudgeon CP modelling	2015	Statoil ASA
Rampion CP design	2015	Optimus
Hywind	2015	Aibel
Jacket CP Modelling	2015	Siemens
Arkona Becken. CP consept study	2016	EEW-SPC
Kriegers Flak, CP design	2016	Statoil ASA

FORCE Technology Norway

FROM KNOWLEDGE TO VALUE