



STORK & WIND

How Stork supports the energy transition through next technologies

SMART MAINTENANCE INNOVATION AND ASSET MANAGEMENT

- Stork is a founding father of knowledge transfer & smart maintenance innovation platform World Class Maintenance. Consequently Stork is steering member of Fieldlab Zephyros.
- Its ambition is to achieve zero downtime & zero (human) on-site maintenance to offshore windfarms.
- One of their initiatives is the AIRTuB (Automatic Inspection & Repair of Turbine Blades) program, which will make extensive use of drones & crawlers. Stork leads the work-packages Data modeling and Asset Management Strategy.
- Besides this Fieldlab Zephyros runs a development, test and demo facility called their living lab in Vlissingen – Zeeland.

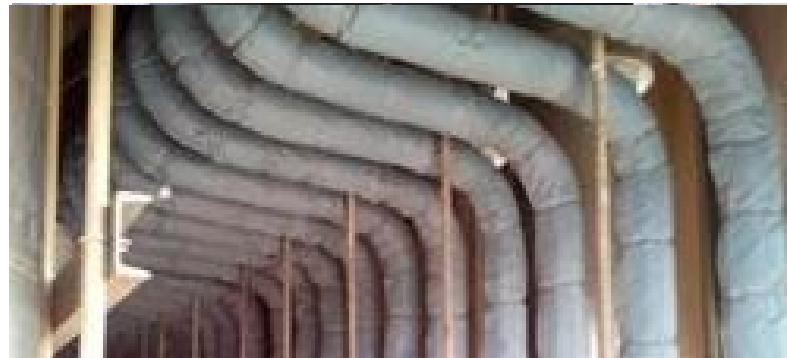
GEARS

As an independent service company many clients rely on our extensive wind turbine knowhow, detailed analysis, technical reports and high quality end-of-warranty inspections. We can repair nearly any type of gearbox, and are able to meet exceptionally tight deadlines and that has made Stork's wind turbine gear inspection & repair part of our daily operation. Some examples:

- Stork provides maintenance services to gears related to Horizontal Axis Wind Turbines (HAWT), the most common of all wind turbines. In one specific project in 2020, Stork Gears refurbished seven Jahnel Kestermann, type 2 CS500 gearboxes that had significantly been worn, lengthening the lifetime and reliability and therefore availability.
- With more than 5,000 units in operation worldwide, GE's 1.5 MW turbine continues to be one of the world's most widely used wind turbines in its class. And Stork has experience with them all (s/se/sl/sle/xl/xle), inspection & refurbishing gearboxes from Flender PEAS 4390.2, Lohmann & Stolterfoht GPV 450 451n (T1, R3) and Eickhoff CPNHZ 195.
- Inspection & revision of Lohmann & Stolterfoht gearboxes in Vestas 52 (850 kW) wind turbines. After finding numerous damage areas it was decided to apply laser cladding to repair them (without weakening the gear housing, as risk that is commonly associated with conventional press fitting techniques) – UK (executed from Stork's facility in Germany)
- Stork Gears & Services was invited by E.ON Climate and Renewables to inspect the gearboxes of two V66 offshore wind turbines, each of 2 MW capacity.

GEARS (continued)

- The wind turbines off the coast of Blyth (United Kingdom) were once the world's largest erected turbines in the world. Stork Gears performed inspection of the gearboxes of these Vestas V66 offshore wind turbines for E.On Climate & Renewables group.
- A client in New Zealand needed an end-of-warranty inspection to be performed on its 60 onshore wind turbines. As a fully independent company, Stork was invited to perform the inspections due to its extensive track record, experience and in-depth knowledge of gearbox and bearing technology. The client was extremely pleased with our findings.



PROJECT EXAMPLE: 2.0 MW WINDTURBINE GEARBOX UPGRADE

One of the world's largest wind turbine manufacturers reached out to Stork to help them resolve a the reoccurring problem that they were having with a large series of Metso PLH, 2.0 MW gearboxes: they were heavily leaking oil after only a few years of operation. One of the damaged gearboxes was sent to Stork's Gear revision workshops for failure analysis. Here Stork

- Disassembled, cleaned and inspected the gearbox
- Performed root cause failure analysis, making extensive use of 3D computer simulations to better understand what was happening
- Recommended the preferred remediation approach
- Modified and upgraded the gearbox
- Extensively tested the revised gearbox

The customer was so pleased with the impressive end result that they decided to have this upgrade carried out on a large range of their gearboxes.



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SUBSTATIONS

Individual windmills generate alternating current (AC) electricity which vary in frequency (due to varying wind gusts). Converter stations are needed to collect and convert these to direct current (DC) and subsequently transport them back onshore with minimum energy loss.

Stork Istimewa has been involved in many of these projects, performing the following E&I services:

- Detail design/engineering
- Prefab & installation of all low, medium & high voltage support for E&I equipment and cable/racks
- Installation of cable trays
- Installation of all equipment & panels
- Cable pulling & termination
- Mechanical completion testing (cold wire checks)

Next to its core E&I services Istimewa is typically responsible for delivery of:

- Logistics of all materials
- Sequence/ space planning
- Contract management services towards the client
- Construction
- Mechanical Completion to offshore certifying
- Commissioning assistance
- Equipment rental services to all related companies such as: Manufacturers (ABB, Siemens, ...), Platform builders (Heerema, ...), End-users (Tennet, Orsted, Dong, Eneco, ...)

EXECUTED PROJECTS

Borwin Alpha Transformer platform

(AC/DC convertor station): Offshore 500 MW-HVDC-transformer installation that collects 155 kV-3-phase alternate currents from surrounding wind parks and converts them to a 320 kV direct current, before sending it on to the onshore transformer

Dolwin Alpha Transformer platform

(AC/DC converter station): Offshore 800 MW-HVDC-transformer installation that collects 155 kV-3-phase alternate currents from surrounding wind parks and converts them to a 320 kV direct current, before sending it on to the onshore transformer in Dörpen (Germany), where it is reconverted to AC electricity that can be introduced to the net without creating grid instability.

Borkum Riffgrund 2 Offshore Transformer platform

Substation: With a total capacity of 450 MW, the Borkum Riffgrund 2 HVAC transformer station collects the electricity from surrounding 56 MHI Vestas 8 MW wind turbines. After conversion from 33 kV to 155 kV, this high voltage electricity is transported to the HVDC converter platform Dolwin Alpha. This wind park delivers electricity to approx. 500,000 households.

Helwin Beta Transformer platform

Converter station: This platform connects the 690 MW offshore wind park with the German mainland through 85 km of high voltage cables.

Elia Offshore MOG OSY Switch Yard platform

High voltage switch station: This platform links 4 offshore wind parks (Rentel, Northwester 2, Mermaid and Seastar) with the coast via 3 subsea 220 kV cables. The combined capacity is just over 1 GW.

Siemens Albatros Offshore Transformer Module

Offshore transformer platform has a capacity of about 116 MW and is one of the most important components between the Albatros and Hohe See offshore wind parks and the coast. This is enough to power a big city like München and enables an annual saving of ~1.9 million ton CO2 compared to conventional power stations.

Westermeerwind Wind Farm

Installed and tested the electrical installations located on the concrete base pillars of this wind farm located in the IJsselmeer, that will supply green electricity to some 160,000 households. Short lead-times made this project quite challenging.

