

# CORROSION



## ICCP Offshore Wind

Impressed Current Cathodic Protection



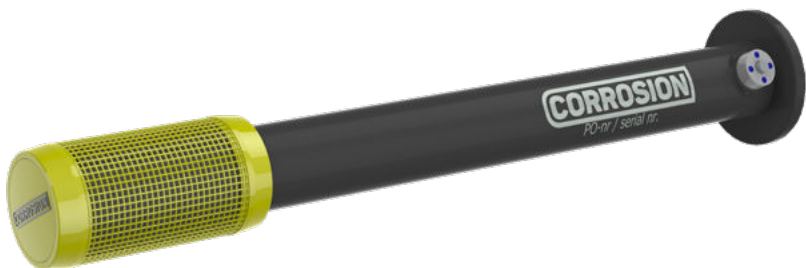
# ICCP Offshore Wind

Let's make wind **truly** sustainable

Modern day wind turbines are often located in or near (sea) water. This means they too are susceptible to corrosion. CORROSION is at the forefront of innovation in the wind sector and is the worldwide market leader in protecting wind turbine foundations against corrosion in an environmentally friendly way by using Impressed Current Cathodic Protection (ICCP).

With our Dutch roots in the use and development of wind turbines, we as CORROSION are proud to contribute to this industry. We were the first to see the possibilities and we continue to bring successful sustainable solutions to this industry.

In today's environmentally conscious world, industry classification societies establish and maintain a growing set of standards regarding the protection of submerged and buried parts of wind turbine foundations against corrosion. Cathodic Protection (CP) systems are one example of these mandatory systems.





CP is a technique used to control the corrosion of a metal surface by making it the cathode of an electrochemical cell. This can be achieved in different ways. One way is to use a passive Galvanic Anode Cathodic Protection (GACP) installation system which uses aluminium anodes. However, this system is a major source of pollution due to the extreme amounts of anode material it deposits into the water as the anodes dissolve.

A more eco-friendly manner is to use an almost inert mixed-metal oxide coated titanium anodes in an active electrical controllable system called an Impressed Current Cathodic Protection (ICCP) system. Because the world is becoming increasingly aware of environmental factors, some countries now prohibit the use of GACP installations as the CP for metal constructions in open waters. Then, an ICCP system is the only solution to protect the assets. What's more, ICCP is less expensive in both OPEX and APEX.

CORROSION is the global leader and specialist in designing, manufacturing, maintaining, and operating ICCP-systems. Our systems are innovative and compliant to legislative regulations. And they achieve the highest levels of efficiency and protection.

# ICCP systems

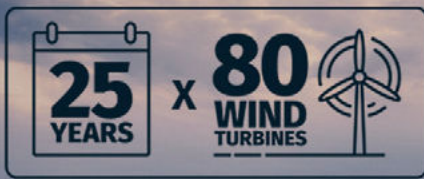
## The ICCP-system consists of:

- Anodes made of an inert mixed metal oxide (MMO) anode material
- Sensors that continuously measure the protection rate of the foundation construction
- Cabling, specially designed and tailor-made to meet the challenges of the harsh offshore environment
- Optimum CP design
- High frequency power control unit that provides the required protective currents calculated by a software control program specifically designed for ICCP systems
- SCADA system for remote monitoring and control from any location, such as a substation, an onshore control centre, or directly from our offices

ICCP systems have become the standard solution for internal protection against corrosion in monopile foundations. Only a few ICCP anodes are needed to provide optimum protection. Several low weight ICCP anodes hang down from the airtight platform in the monopile and provide optimum cathodic protection. The control of the internal protection requires precise and ongoing attention due to the confined space and special environmental conditions. CORROSION has developed a unique Reduced Hydrogen Development Software program (RHDS) specifically for the internal protection of monopiles.







Traditional method  
~~1.500.000KG~~  
ALUMINIUM WASTE

**CORROSION** ICCP technology  
**1KG** MIXED  
METAL OXIDE

## Sustainability

Few people realize that many wind farms are far more eco-friendly above water than below it. Like any metal structures in marine environments, wind turbine foundations are susceptible to corrosion. Unfortunately, traditional methods of protecting against this are by no means pollution free and sustainable.

The use of sacrificial anodes leads to the release of heavy metals and metals such as zinc and aluminum into the marine environment. The result? Over the 25-year lifetime of a wind farm, literally millions of kilograms of metal alloys can be discharged into the seawater. What's more, the sourcing, transportation and maintenance of the metals used in sacrificial anodes, also comes with a significant carbon footprint.

Thankfully this is not a problem without a solution. Impressed Current Cathodic Protection (ICCP) systems provide superior protection to traditional systems, but without the negative effects on the environment. We hope more and more companies in the wind sector will continue to embrace ICCP technologies. Together we can make wind turbines as clean and sustainable as the energy they produce.

# CORROSION Partners

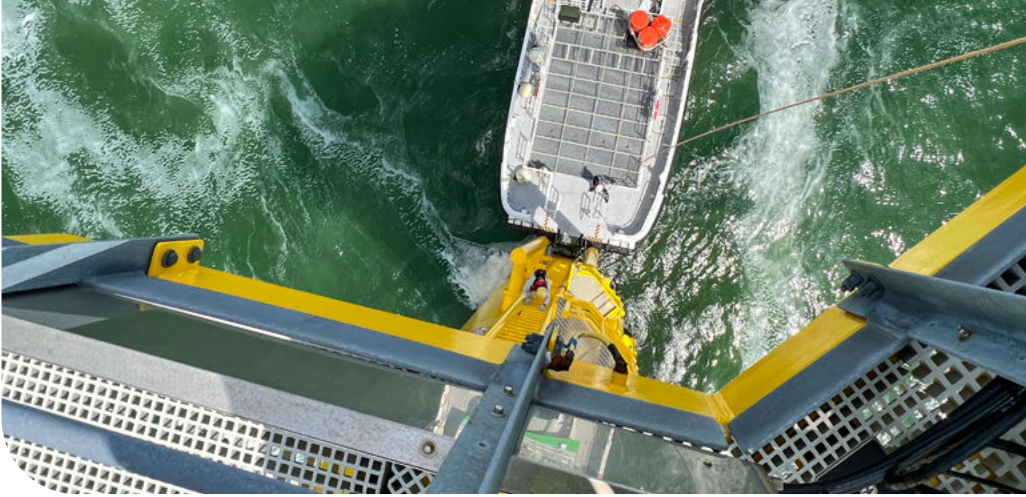
Partnerships are more than a business model. We believe that by combining forces and expertise we can offer (turnkey) solutions to better serve our customers. Together we provide sustainable cathodic protection (ICCP) solutions for offshore wind farms. From design and manufacturing, to commissioning and maintenance.



Bluestream is a leading offshore contractor, providing specialist technical services above and below the waterline. They are highly skilled in surface supplied diving, Remotely Operated Vehicles (ROVs), working at height, rope access and Unmanned Aerial Vehicles (UAV). They provide their clients with tailored solutions to ensure sustainability and profitability during the installation, maintenance and decommissioning of their offshore assets. To do this, they combine profound knowledge and decades of experience with the ambition to innovate in a world where the energy industry is evolving.



ProCon is an international ISO9001, ISO14001, ISO45001 and UN SDG certified company that offers specialized and high-quality solutions to the global offshore and onshore wind industry as well as the solar power industry. ProCon provides full electrical EPCI and service of projects regarding transition pieces, jackets, e-modules, wind turbine generators, balance of plants, substations and solar farms – including the medium and high voltage work.



Elsyca is active in the markets of corrosion design & engineering, cathodic protection & AC mitigation, surface finishing, and electrochemical manufacturing. Within a variety of industries – such as oil & gas, automotive, aerospace & defense, electronics and medical. The combination of the practical engineering knowledge, the in-house developed family of engineering simulation tools, and the continuous focus on R&D and innovation has established Elsyca as a trustworthy and appreciated partner for many clients across the globe.



Amphibious Energy is a specialist in designing offshore, autonomous and 100% renewable energy power generators, the company combines wind and solar power with storage, in a compact and transportable design. These first-of-its-kind electrical power generators – EnergyPods – are a sustainable, zero-emission alternative to diesel gensets, and offer affordable, reliable and clean energy. Amphibious Energy is actively involved in Central North Sea projects to support operators in becoming net-zero in their operations.

# Laboratory

CORROSION is unique in many ways. One of the things that makes us different is our on-site research laboratory. This is the place where we build on our many years of experience and expertise.

And while we have a sound reputation and proven products, we want to continue bringing you new developments. CORROSION strives to pioneer in ways that go beyond theory and ideas. Our lab is an ideal place to continue our mission to bring you the most sophisticated, high-quality products and services available in cathodic protection and anti-fouling technologies. It adds specialized services to our already strong reputation for product reliability and performance. And because the environment is an ever-growing concern, our lab also allows us to look into more sustainable solutions and improvements. The best products, with an eye on our surroundings whenever it's possible.







# Applied Science

Our laboratory is an arena for applied science. We strive to be the bridge between academic knowledge and practical application. Science for the real world. So, we work with partners who are widely recognized, and like us, specialists in materials and corrosion solutions in a wide variety of environments. This collaboration comes together in our on-site lab, like a melting pot where our expertise is mixed with new ideas. Our findings are then applied to the problems our clients face every day in many different industries.

In addition to these cooperative efforts and our on-site practical facilities, our lab also has access to a large database of scientific publications and reports. This means our clients will always benefit from the latest developments in materials, technology, and scientific knowledge in the field of corrosion and anti-fouling.

# SCADA Remote Monitoring

CORROSION ICCP systems have been designed to be SMART. The corrosion protection performance of each wind turbine can be tracked from wherever you are, while data readings and adjustments can be achieved at the click of a mouse.

SCADA systems are able to monitor and provide remote control of wind farms spread over a large geographical area for which organizations do not have sufficient personnel to cover. Reliable communication and operability of these areas or sites is critical to operational reliability.

## Contact us

“We hope that this brochure has been of interest to you. We would be happy to answer any questions you may have or work with you to see whether ICCP meets your specific needs.”

For further information, other brochures and whitepapers, please visit our website [corrosion.nl](http://corrosion.nl).

You can also reach us by telephone at: +31 (0) 79 593 1295.



**Niels Ros**

Manager Offshore Wind  
Location: the Netherlands

# Offshore Wind projects

- Greater Gabbard
- Riffgat
- Dan Tysk
- Luchterduinen
- Butendiek
- Zhongmin I & II
- Albatros
- Alpha ventus
- Hohe See
- Horns Rev III
- Merkur
- Borkum West II
- Meerwind
- Sandbank
- VejaMate
- Galloper
- Belwind
- Yunlin
- Triton Knoll
- Akita Port
- Borssele III, IV & V
- Noshiro Port
- Mermaid
- Seastar
- Rentel
- Arkona Becken
- Northwester II
- St. Nazaire
- Deutsche Bucht
- Kaskasi
- Three Gorges  
Changle A & C
- Three Gorges H6 +  
H10
- Dafeng Longyuan
- Baltic Eagle
- Hollandse Kust  
Zuid
- Hollandse Kust  
Noord
- Walney
- Sofia
- China Energy  
Peninsula 4
- Jiangsu Longyuan  
OWF H4 H

## **Floating**

- Golf Du Lion

## **Substations**

- Dan Tysk
- Dan Tysk OAP
- Meerwind
- Borkum West II
- Global Tech
- Xinghua Bay
- Northwester II
- Dolwin Gamma
- Baltic II
- Riffgat
- Changle A
- Kaskasi



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