MetriCorr

Corrosion & Cathodic Protection
Remote Monitoring

V102

OFFSHORE WIND POWER

The MetriCorr Solution

MetriCorr offers a complete solution for remote monitoring of corrosion and cathodic protection of offshore wind power and associated structures. A range of probes and logger modules can be configured to monitor every aspect of offshore CP operation, environmental parameters, coating degradation and corrosion.

The ability to verify the effectiveness of various corrosion protection designs and systems calls for collection of relevant data. Reaching an offshore structure to collect data is however associated with significant costs, and implementation of effective remote monitoring offers large cost savings while significantly increasing the amount of data available at a given time. Being able to document continuous safe operation of the corrosion protection systems may even be useful for re-evaluating the life-time assessment of such structures and potentially provide the basis for prolonged operating time and associated revenue.

Probes and sensors can be installed in a variety of different zones and different corrosion classes:

- Atmospheric zone
- Splash zone
- Tidal zone
- Submerged zone
- Scour protection zone
- Below seabed zone

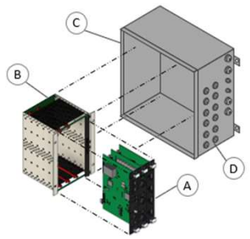
The MetriCorr system for corrosion and cathodic protection remote monitoring is not limited to wind power structures, as it is a highly flexible design that can readily be re-fitted to monitor the integrity of other offshore or coastal structures, with or without cathodic protection applied.

Multi Channel Corrosion Monitor (MCCM)

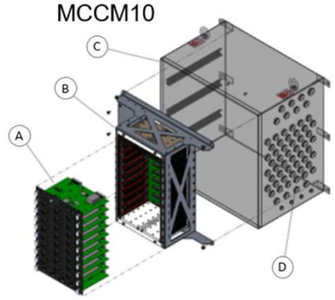
MetriCorr offers two multi channel logger systems depending on measurement requirements. Each system is configurable via different modules. The MCCM3 can fit 3 modules and the larger MCCM10 can fit 10. In both systems it is a requirement that one of the modules is the ML-M control module. Available modules are:

- ML-M: Masterlink module (control and remote monitoring unit)
- ICL-M: ICL module for measurement of ER probe and cathodic protection data (3 ch./module). Each ER probe channel has a reference electrode channel for potential monitoring of both structure and probe. Several probes can easily share the same reference electrode. Probe channels can be configured as “connected” or “native” remotely.
- AI-M: Analogue input module for measurement on auxiliary sensors (4 ch./module) (4-20 mA)

MCCM3



MCCM10



The bullets above indicate the basic system configuration of the two systems.

A. Measuring modules (3 or 10) where one is an ML-M
B. Module rack with grounding connection
C. Cabinet made of S316 stainless steel
D. Holes for cable connections fitted with cable glands and blinds when not in use.

The MCCM’s are robust but still compact, making it possible to carry it onto, and install on existing structures. The installation can be done with very strong magnets without the need for damaging existing coatings or surface treatments.

Probes & Sensors

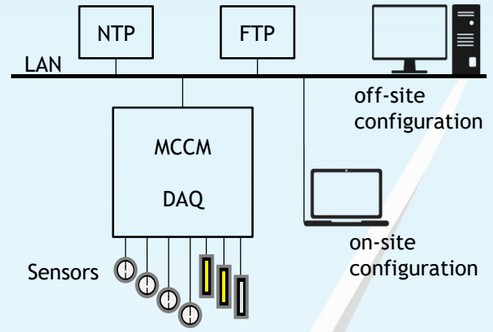
Amongst available sensors that can be implemented in the MetriCorr remote monitoring system are:

- General corrosion sensors (ERG)
- General corrosion sensors with thermal spray coating of e.g. Zn or Zn/Al (ERG-TSZ/TSZA)
- Coating degradation and breakdown sensors (ERC)
- Resistivity sensors (RES) (4-pin Wenner)
- Reference electrodes based on the Ag/AgCl equilibrium potential
- Reference electrodes based on the Zn/Fe equilibrium potential

Other auxiliary sensors with an analogue mA output can also be fitted to the system. These could be sensors for depth, pH, O2, flow or other measurements.

System Architecture

Data is sent to a company owned FTP server and the system can be configured both on- or off-site via a LAN connection



Technical specifications

MCCM – Multi Channel Corrosion Monitor

Technical data		
Dimensions	cabinet (height x width x depth)	MCCM10: 600 x 600 x 400 mm MCCM3: 400 x 400 x 200 mm
	cabinet including measuring cards	MCCM10: Max 35 kg MCCM3: Max 20 kg
	Range	0-156 mΩ
	Repeatability (2σ)*	0.2 µΩ
	Precision (4σ)*	0.4 µΩ
	Temperature drift, (-20°C - +60°C)	< ±1 ppm/°C
	Drift	< ±1 ppm/y
Voltage (Edc, Uac)	Input resistance	10.0 MΩ
	Range	100V
	Resolution	1 mV
	DC accuracy	± 1 mV ± 0.3% reading
	AC accuracy	± 1 mV ± 1% reading
Current (Idc, Iac)	Range	300 mA rms
	Resolution	0.1 µA
	DC accuracy	± 1 µA ± 1% reading
	AC accuracy	± 1 µA ± 1% reading
Spread resistance (Rs) – Coupon element	Generator driving voltage	80 mV to 8V (auto)
	Generator frequency	110Hz
	Range	0.5 Ω – 10MΩ
	Range at 10 cm^2 (0.001 m^2)	0.5 mΩ·m^2 – 10kΩ.m^2
Analogue Inputs	Maximum load	900 Ω
	Input impedance	< 10 Ω
	Range	A
	Resolution	mA
	Accuracy @ 25°C	± (0.3% FS + 0.3% reading)
	Scale	0%: 4 mA 100%: 20 mA
	Fault indication	< 3.8 mA > 20.5 mA

* The cable length will affect this value.

Probes (produced by MetriCorr)

Technical data	ERG	ERC	RES
Metal	EN10130 DC01 (standard) Ask for customer specific requirements	EN10130 DC01 (standard)	S316 stainless steel
Coating	None	According to customer spec.	None
Width*, w (mm)	5	10	Ø10
Length*, L (mm)	620 / 310	100	-
Initial Thickness*, d (µm)	1000 (standard) 500 – 2000 available	1000 (standard)	-
Exposed area*, A (cm^2)	31 / 16	10	4 x 0.8
L/w ratio	124 / 62	10	-
Housing material	PVC	PVC	PVC
Embedding material	Epoxy & polyurethane combination	Epoxy & polyurethane combination	Epoxy & polyurethane combination

* Exposed element/electrode. Not probe dimensions

Cable

Technical data	
Conductors	0.25 mm^2 tinned copper conductors insulated with HDPE. 2 cores twisted together (4 ea).
Void filling	Silicone water-blocking compound and polyester tape/protective non-woven tape
Braiding	Tinned copper braid overall shield, coverage >85%, metallic cross section 1,88 mm^2
Tape	Swelling water-blocking tape
Outer jacket	Polyurethane, nominal thickness 1,15 mm. Hydrolysis UV resistant. Color blue RAL 5015
Outer diameter	8.80 mm ± 0.2 mm
Weight	97 g/m (air) / 35 g/m (seawater)
Min. bending radius	88 mm static / 110 mm radius
Temperature range	-40°C - +80°C
Electrical resistance @ 20°C	≤ 77.32 Ω/km

ER Probe Measurements

Nomenclature	
d (µm)	Thickness, used for corrosion rate measurement
E_{on} (V)	Measured on potential (structure to electrolyte)
E_{off} (V)	Measured instant-off potential of the probe (coupon)
$E_{IR\text{-}free}$ (V)	Calculated IR free probe potential: $E_{IR\text{-}free} = E_{on} – J_{dc}*R_s$
I_{dc} (A)	DC current between probe and structure
J_{dc} (A/m^2)	Calculated DC current density
U_{ac} (V)	The measured AC voltage (momentarily applied) between the structure and the ER probe (used for Rs measurement)
I_{ac} (A)	Measured AC current
J_{ac} (A/m^2)	Calculated AC current density (used for Rs measurement)
R_s ($\Omega.m^2$)	Spread resistance. For coating sensors this will be equivalent to the coating impedance
T(°C)	Temperature measured based on reference element resistance