PACU™

Reliable corrosion-protection of deep-water mooring-chains

March 2024

Johan Tønsberg, CEO
Imenco Corrosion Technology

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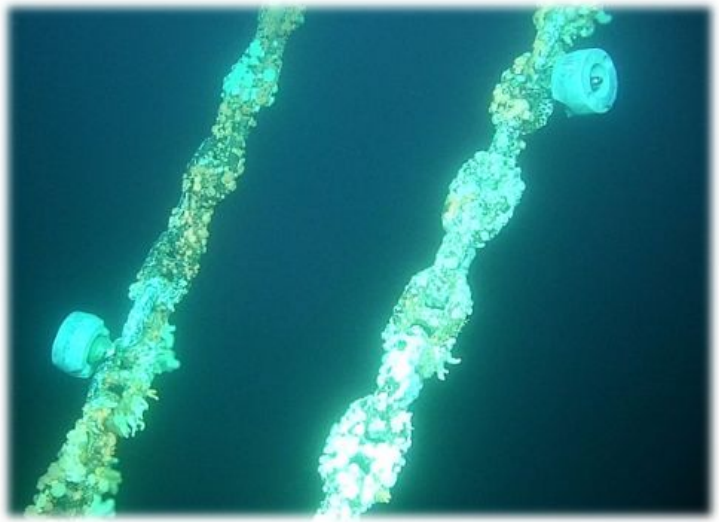

Life-extend your Mooring Chains!

- and save **tons of money** and **tons of CO-emissions** along the way !!

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Pacu™

Corrosion protection
of mooring chain

The ONLY reliable solution in the world

VERY cost effective! & VERY healthy for environment (CO2)!

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Magnitude of Cost savings for an FPSO asset owner, est.:

>100.000.000 USD ++ during life-of-field

, by avoiding mooring-chain change-outs, and extending asset-life

Note:

- Without PACU™, mooring-chain typically last anywhere between 4 and 10 years…
- Mooring failures are one of the most critical events in offshore asset integrity…
- Studies have shown that corrosion is the dominating reason for chain failure…

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Permanently moored offshore structures , and 'Pacu™ track-record'

500+

O&G: FPSOs, FSOs, FLNGs, SPARs, etc.

Shell:

- ✓ Pacu™ tested and approved globally by Shell, with Lloyds ('Development Release')
- ✓ Pacu™ already installed on the 'Shell Bonga FPSO' in Nigeria, West Africa, in 2022, on already corroded chain
- ✓ Pacu™ now being installed on brand-new chain, now in 2024, on 'Shell Bonga FPSO'

10.000+ to come

Floating Offshore Wind structures

- ✓ Pacu™ installed on 'Zefyros' in Norway in March 2022 (the world's oldest offshore floating wind-turbine)
- ✓ See 2min live-video from this installation
- ✓ Corrosion-protection-effect measured and confirmed successfully there, 10 months later, in January 2023

Size of market: TBC

Offshore aquaculture systems

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Corrosion in mooring systems:

Consequences, and 'Value Proposition' of Pacu™

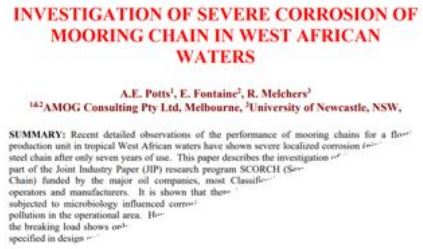
- Corrosion is **the leading cause** of mooring failures and pre-emptive replacement of chain. Chain replacement projects:

  => Cost: 3-digits Mill-USD-figures
  => Enormous CO2-emissions
  => Disconnects, and lost production

  , and 'new reality' now: Supply Chain constraints in chain-fabrication (due to Offshore Floating Wind)

- Without PACU™, extensive 'corrosion allowance' is required + risk of chain-failures due to 'extra-aggressive sorts of corrosion'


OE OFFSHORE ENGINEER
THE FUTURE OF OFFSHORE ENERGY & TECHNOLOGY.
REGIONS ENERGY GEOSCIENCE ENGINEERING TECHNOLOGY VESSELS SUBSEA
Mooring line failures attract industry attention


INVESTIGATION OF SEVERE CORROSION OF MOORING CHAIN IN WEST AFRICAN WATERS

A.E. Potts[1], E. Fontaine[2], R. Melchers[3]
[1&2]AMOG Consulting Pty Ltd, Melbourne, [3]University of Newcastle, NSW,

SUMMARY: Recent detailed observations of the performance of mooring chains for a flo… production unit in tropical West African waters have shown severe localized corrosion (pi… steel chain after only seven years of use. This paper describes the investigation o… part of the Joint Industry Paper (JIP) research program SCORCH (Se… Chain) funded by the major oil companies, most Classific… operators and manufacturers. It is shown that the… subjected to microbiology influenced corro… pollution in the operational area. H… the breaking load shows on… specified in design …


OTC 24025

A Historical Review on Integrity Issues of Permanent Mooring Systems
Kai-tung Ma, Chevron Energy Technology Company; Arun Duggal, SOFEC Inc; Philip Smedley, BP Exploration Operating Company Limited; Didier L'Hostis, TOTAL SA; and Hongbo Shu, Shell International E&P Inc.

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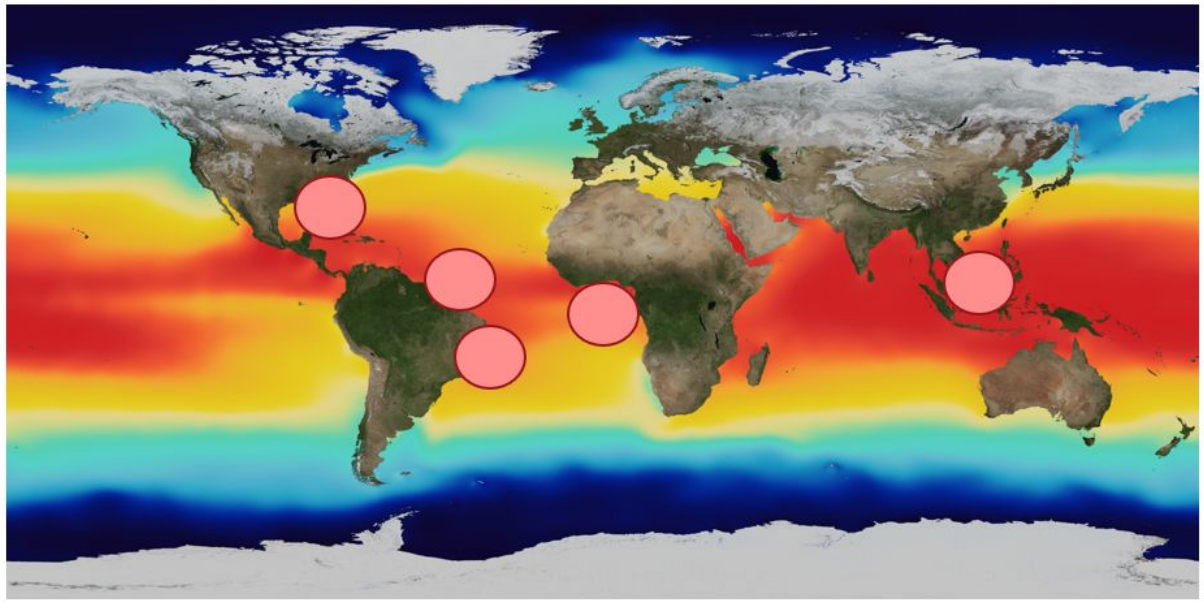
Corrosion in mooring systems – ‘Geographical Hot-spots’



Salinity, temperature and nutrients in sea result in strong variations around the globe.

Hot spots; West-Africa, Gulf of Mexico, East coast of Meso-and South America including Brazil, South-East Asia

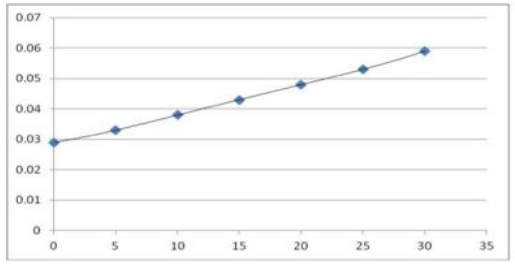


Figure 1C: Conductivity (S/cm) of seawater as a function of temperature over the range 0 to 30°C. Data are from ref. [2].

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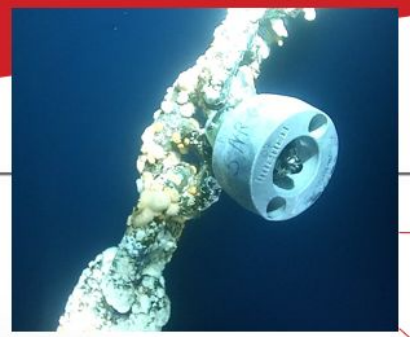
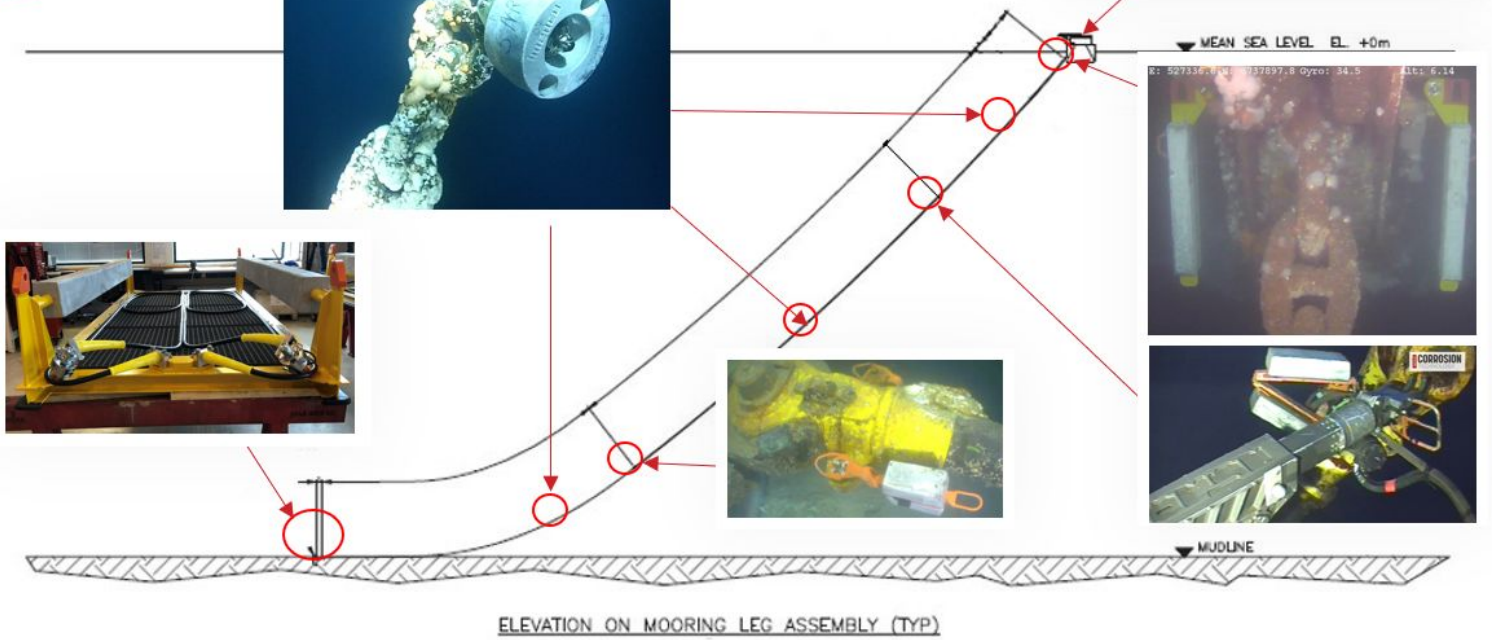
The typical mooring ‘spread’ , and how we protect it



Consisting of:

- Top chain
- Wire/Rope
- Lower chain
- Anchor



ELEVATION ON MOORING LEG ASSEMBLY (TYP)

2min live-video from PACU™-installation in March 2022, on ‘Zefyros’ in Norway:

https://vimeo.com/691858418

As mentioned,

PACU™ is also installed & working on FPSO (Shell Bonga) in West-Africa, Nigeria

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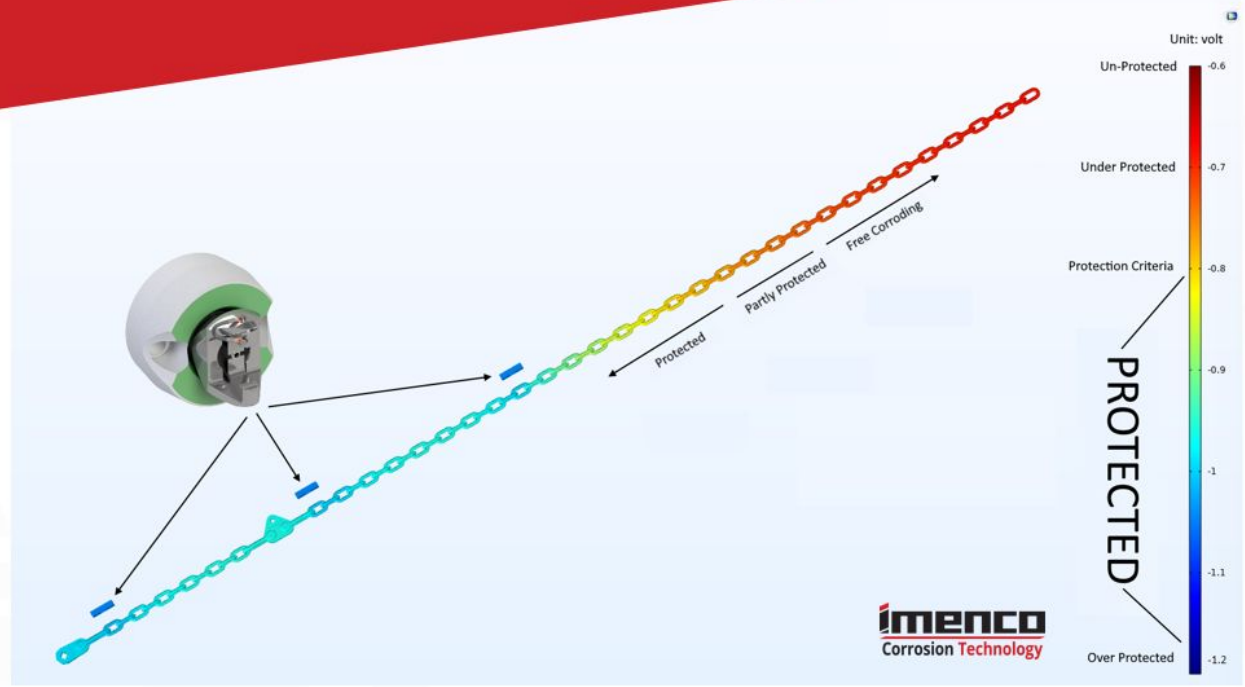
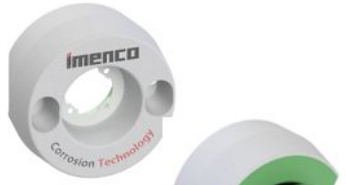
Introducing PACU™



- Dramatically extend the lifespan of your mooring systems
- Discrete anodes attached to our cornerstone product – the Piranha® clamp:



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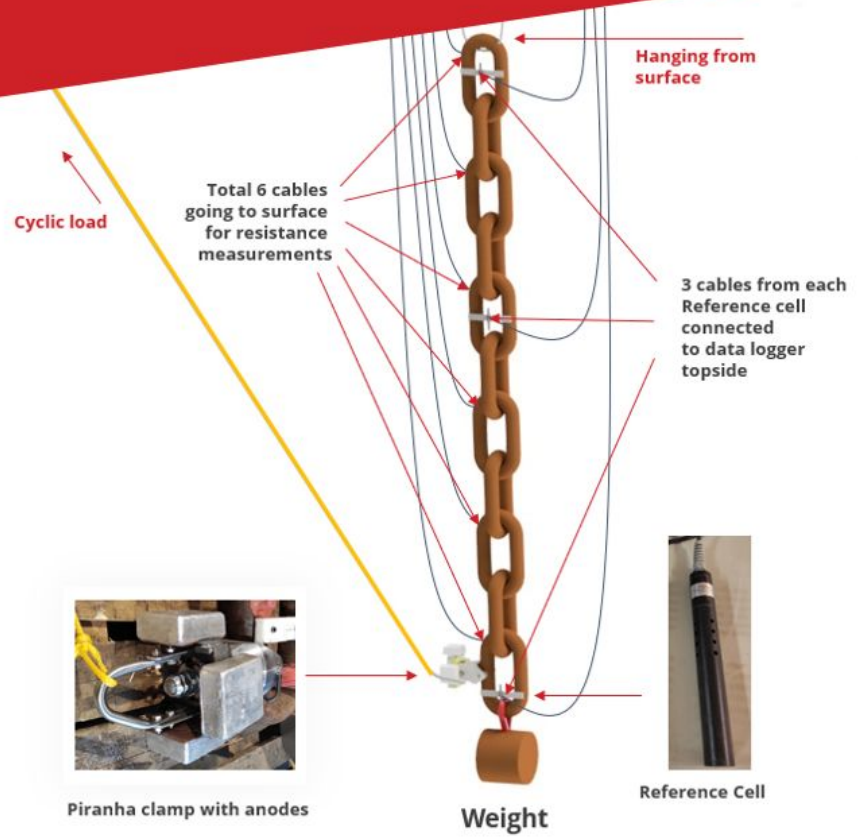
Technology Qualification Program

- Qualification program executed in cooperation and under contract with **Shell, supported by LLOYDS**
- Verification of 3 main points:
  - Can it be installed?
  - Will it survive the conditions?
  - Last but not least: will it work?
- Program executed in 4 main phases:
  - Computer simulations
  - Tests in workshop/laboratory
  - Near-Shore-Sea trials
  - Full size offshore test



, and we are way ahead with obtaining 'technical qualification **by DNV**'

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Live-Monitoring solution (acoustic)

With an extensive track record of acoustic communication, Imenco provides long term wireless live monitoring of level of protection of installed Cathodic Protection (CP).

Gain reliable, repeatable measurements of CP distributed levels of protection across structures, mooring lines and pipelines without the need for drop cells, divers or ROV inspection.

Capture measurements frequently during or post installation, or as required over long term. Quickly compare levels of protection across multiple locations.

Observe CP changes as early as possible, economically plan for inspection, maintenance and remedial actions.

- Proven acoustic monitoring capability
- Alternative to drop cells or periodic diver/ROV surveys
- Long range allows communication with multiple remote assets
- Battery life > 5 years

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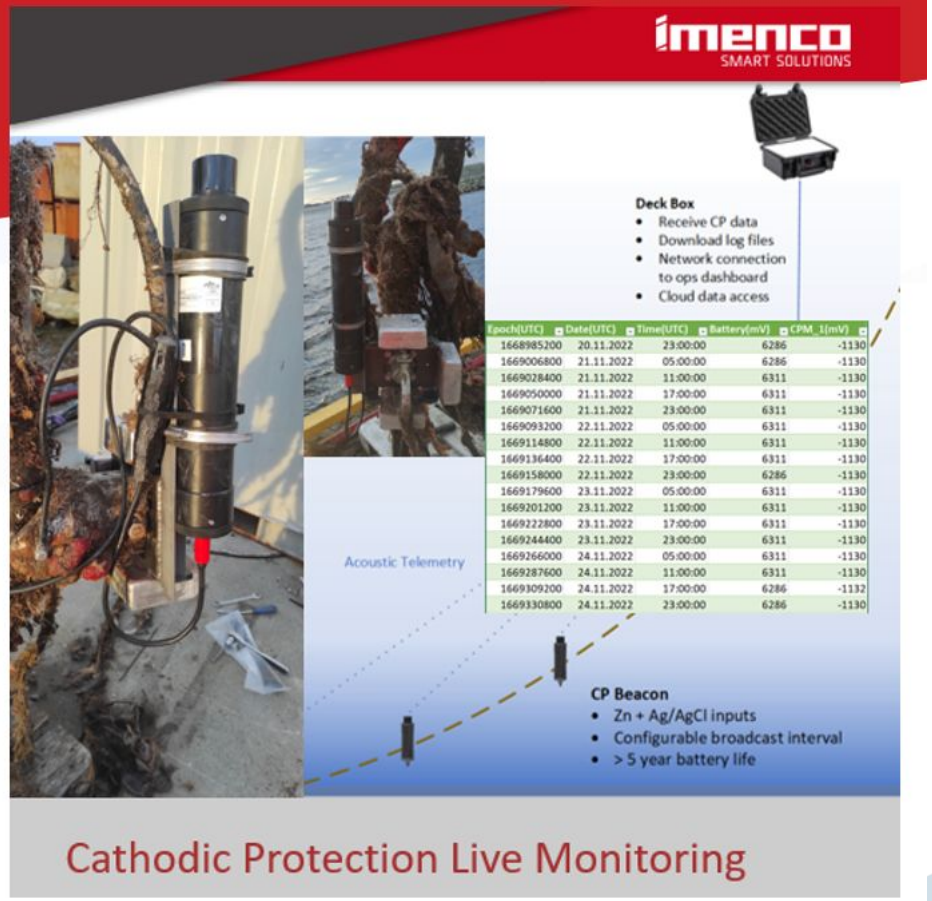

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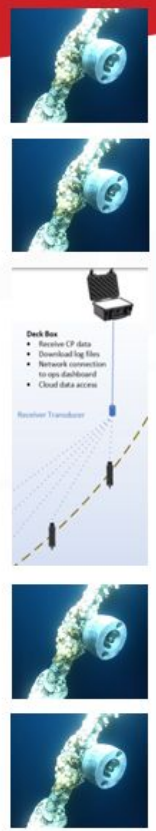
Life-extend your Mooring-chains , with **PACU™**

Main take-aways:

- ✓ Fully tested
- ✓ Fully field-proven
- ✓ Full technical approval by Shell, w Lloyds
- ✓ Already installed by Shell on: Old chain and new chain
- ✓ Fully available for commercial sale & installation
- ✓ **Savings & benefits** for asset-owner, during life-of-field:
  - ✓ Saving '3-digit-Mill-USD-amount' (!)
  - ✓ Saving 'Tons of CO-emissions' (!)
  - ✓ And at the same time: Mitigating a new and VERY REAL supply-chain-constraint: Fabrication-capacity-shortage of new mooring-chains (!)



We deliver Pacu™, and we guarantee that it works:

As a straight-forward equipment sale

, or

As a service: 'Corrosion-protection-as-a service' ('no cure, no pay)

Feel free to contact:
Johan Tønsberg, CEO, johan.tonsberg@imenco.com
And meet us at our stand here at AOG24, in the 'Norwegian section'

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