Development of coatings to last the life of the asset

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Water based?
Zero VOC?
Solvent Free?
DT 73
DT 10

The Need

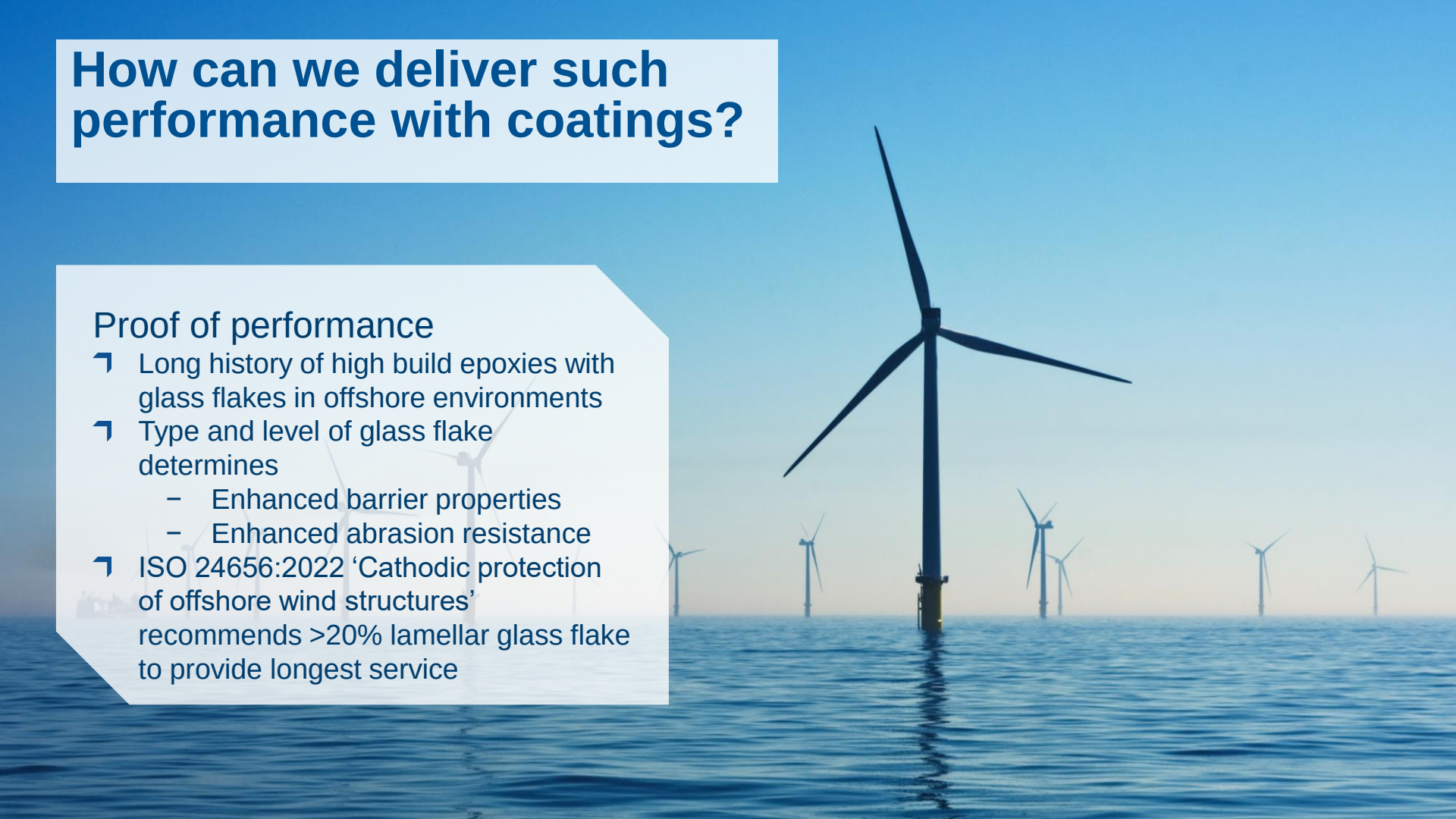
- 30-40 year design life
- Reduced environmental impact
- Proven reliability
- Minimal offshore maintenance
- Shop productivity

We need coating systems that can meet or exceed the design life with minimal or no maintenance

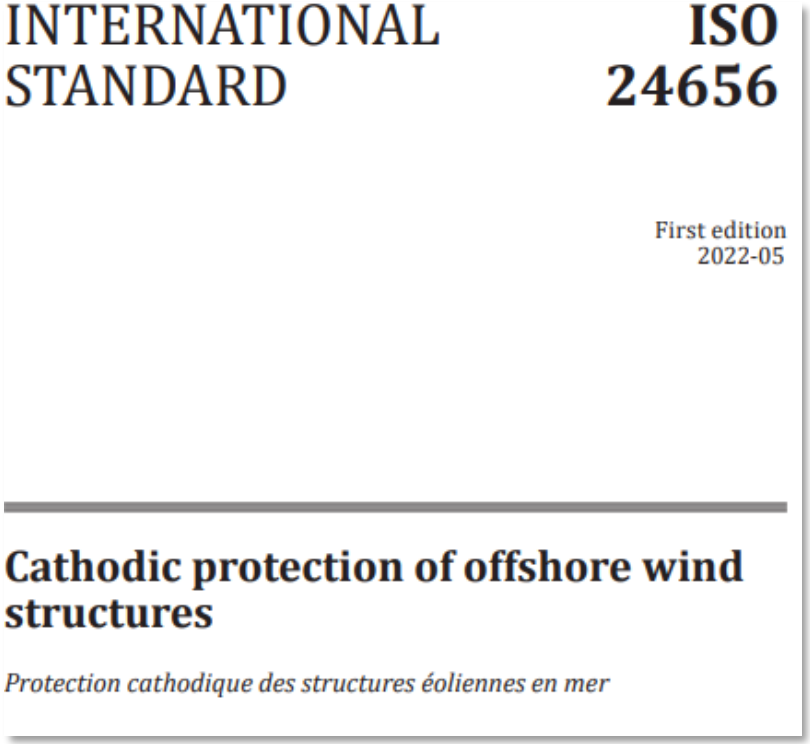
How can we deliver such performance with coatings?

Proof of performance

- Long history of high build epoxies with glass flakes in offshore environments
- Type and level of glass flake determines
  - Enhanced barrier properties
  - Enhanced abrasion resistance
- ISO 24656:2022 ‘Cathodic protection of offshore wind structures’ recommends >20% lamellar glass flake to provide longest service



Why ISO 24656?



INTERNATIONAL STANDARD

ISO 24656

First edition
2022-05

Cathodic protection of offshore wind structures

Protection cathodique des structures éoliennes en mer

Designed to protect submerged and buried areas

ISO 24656

Table D.1 — Coating categories

Coating Category	I	II	III	IV	V
Related Standard and Code categories	N/A	N/A	ISO 12944-9 Im4	ISO 12944-9 CX Im4	N/A
			NORSOK M-501 7B	NORSOK M-501 7A	N/A
	DNVGL RPB401 Cat I	DNVGL RPB401 Cat II	DNVGL RPB401 Cat III	N/A	N/A
Coating system	2 component epoxy based	2 component epoxy based	2 component epoxy based	2 component epoxy based	2 component glass flake epoxy or polyester. Lamellar glass flake, non-micronised > 20 % by weight
Minimum number of coats	1	1	2	2	2
NDFT (µm)	≥ 20	≥ 250	≥ 350	≥ 600	≥ 1000

NOTES

1 Some of the codes and standards referenced in Table D.1 allow the use of zinc-rich primers. In this standard, zinc rich primers are not recommended for use in the immersed, tidal and splash zones.

2 The use of any of the coating systems in Table D.1 demands that all coatings, surface preparation, application, inspection and testing has been carried out in full accordance with all relevant parts of the referenced related codes and standards.

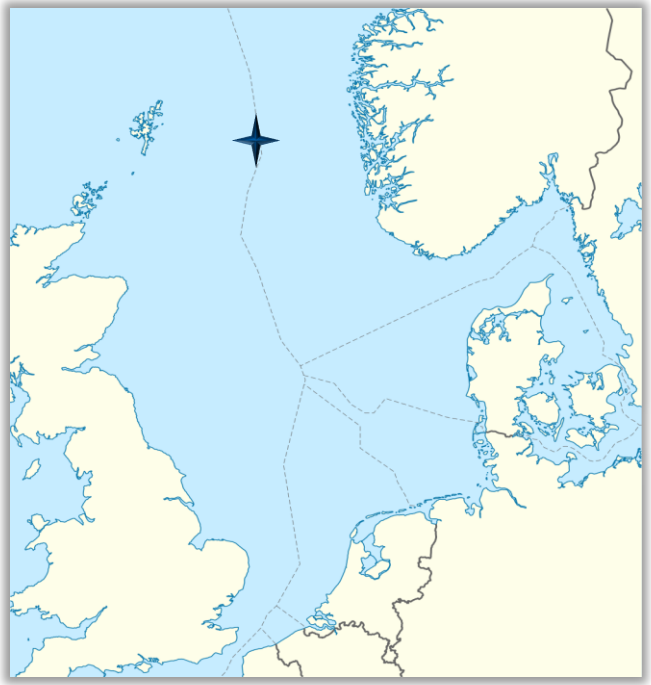
ISO 24656

Table D.2 — Coating breakdown factors expressed as percentages

Coating category			I	II	III	IV	V	I	II	III	IV	V
Zone	Initial After coating A %	Initial After installation B %	Annual breakdown rate for surfaces exposed to free-flowing seawater C %/year					Annual breakdown rate for surfaces within confined spaces not exposed to free-flowing seawater C %/year				
$FWZ_{50\,\%}$ to $FWZ_{5\,\%}$	Cat. III 1,0 Cat. IX: 0,75 Cat. V 0,5	Cat. III 1,0 Cat. IX: 0,75 Cat. V 0,5	NA	NA	1,5	0,8	0,6	NA	NA	1,5	0,8	0,6
From $FWZ_{5\,\%}$ to −30mLAT	Cat. I: 5,0 Cat. II: 2,5 Cat. III: 1,0 Cat. IX: 0,75 Cat. V: 0,5	Cat. I 5,0 Cat. II 2,5 Cat. III 1,0 Cat. IX: 0,75 Cat. V 0,5	10	2,5	1,2	0,6	0,4	5	1,5	0,8	0,4	0,3
From −30mLAT to scour	Cat. I: 5,0 Cat. II: 2,5 Cat. III: 1,0 Cat. IX: 0,75 Cat. V: 0,5	Cat. I 5,0 Cat. II 2,5 Cat. III 1,0 Cat. IX: 0,75 Cat. V 0,5	5	1,5	0,8	0,6	0,4	5	1,5	0,8	0,4	0,3
From scour to pile toe	Cat. I: 5 Cat. II: 2,5 Cat. III: 1,0 Cat. IX: 0,75 Cat. V: 0,5	10 to 25 % Low in fine sands and Clay. Higher in gravels and boulders	1	1	0,5	0,2	0,1	1	1	0,5	0,2	0,1

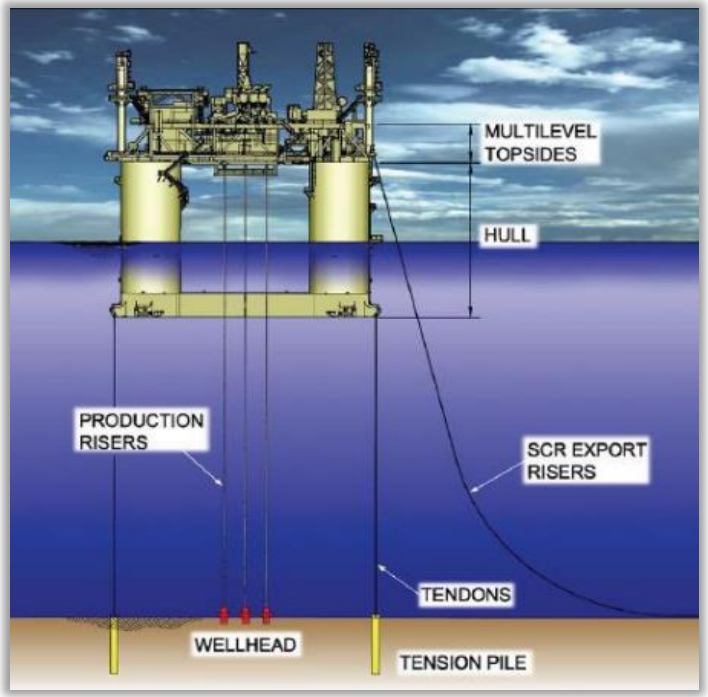
Hutton TLP
Case History

Case History
Hutton Tension Leg Platform



- Owner Conoco Phillips
- Hutton TLP built in 1982
- Started production in 1984
- Peak production 34 million barrels per annum
- Production ceased 2001 (17 years)
- 2002 towed to Murmansk
- Topside removed and recycled
- Jackets stationed offshore north of Scotland

Tension Leg Platform



In service performance: Hutton TLP

Coating Systems Applied (1982):

Splashzone			
Layer	**Product**	**DFT**	**Application**
1	Primer	25um	Airless Spray
2	Heavy Duty GF Coating	500um	Airless Spray
3	Heavy Duty GF Coating	500um	Airless Spray
4	Heavy Duty GF Coating	500um	Airless Spray
5	Finish	75um	Airless Spray

In service performance: Hutton TLP 1st Assessment

- First assessment in 2011 after almost 30 years in service
- The original coating in the splashzone was found to be in excellent condition
- At this time in 2011, Chris Jordan, Coatings Specialist for Conoco, during construction of the Hutton TLP was quoted to say:

"It is clear that after nearly 30 years in service the high loaded glass flake epoxy is still performing very well on the painted tubular splashzone sections of the Hutton TLP hull. Estimated corrosion is less than 1% over the coated splashzone".

Hutton TLP after 30 years

Case history 2011

Focus product
Year of project: 1982
Location: North Sea, UK
Type of project: Tension Leg Platform (TLP)
Project owner: Conoco
Applicator/fabricator: Highland Fabricators, UK
Project size: 40,000 litres
12,600m², over Sa 2.5

The Hutton was the first ever tension leg platform in the world. It was operated by Conoco for nearly 20 years on the Hutton oil field in the North Sea. At its peak it produced more than 110,000 barrels of oil a day. A coating system was required for the splashzone that would provide a minimum of 20 years anti-corrosion protection in the harsh North Sea.

Area inspected after 29 years: less than 1% corrosion on painted tubular sections

After decommissioning a visual inspection was carried out in August 2011. The original yellow Interzone 1000 in the splashzone is in excellent condition after almost 30 years in a C5-M environment. The bottom section of the Hutton TLP was coated with a holding primer and relied on an Impressed current protection system for the submerged section and pontoon. Having 33% non-micronised glass flake in the dry film is what makes Interzone 1000 unique and helps provide the outstanding barrier protection seen on the Hutton TLP.

Excellent corrosion protection provided by Interzone 1000 after almost 30 years

Non-micronised glass flake is critical to achieving outstanding corrosion protection

"It is clear that after nearly 30 years in service the high loaded glass flake epoxy is still performing very well on the painted tubular splashzone sections of the Hutton TLP hull. Estimated corrosion is less than 1% over the coated splashzone. Even areas subjected to abrasion from topside equipment such as pumps, ropes and chains are in excellent condition. For the Hutton we chose the high loaded non-micronised glass flake epoxy over polyester glass flake technology for a number of reasons. One of those was that the glass flake epoxy was much easier to apply."

"After almost 40 years of offshore surveying in the North Sea, I would consider a glass flake epoxy, as used on the Hutton TLP, to offer the best corrosion protection for the splashzone of offshore assets."

Chris Jordan, Coatings Specialist for Conoco during construction of the Hutton TLP

Nov 2022 – Second Assessment Report
Element Independent Test Company

3rd Party assessment & verification

This is a summary of the results of testing undertaken on large samples / sections of the Hutton TLP jacket

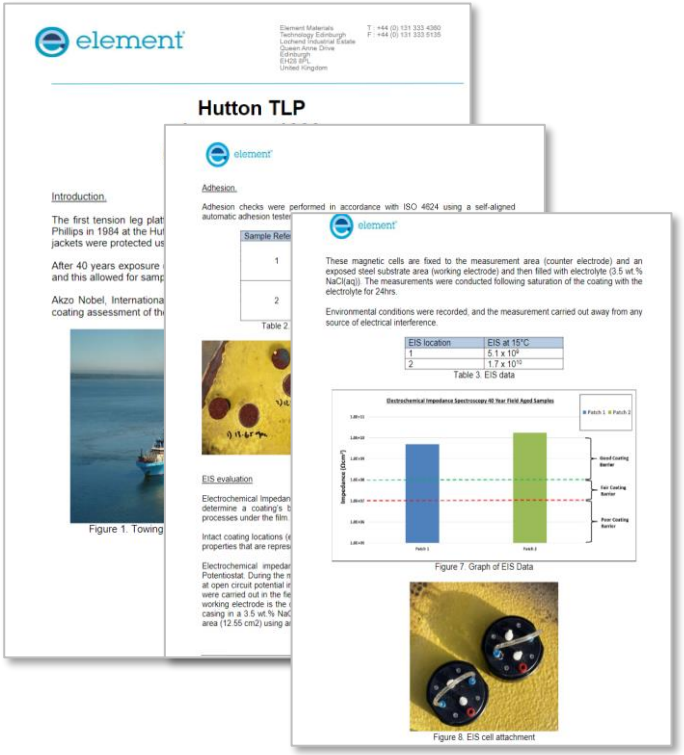
AkzoNobel conducted these assessments of the coating system and has worked with world leading materials testing company Element to independently verify and report the results.

Several tests and assessments were undertaken and completed on sections of the TLP to determine the performance of the coating system.

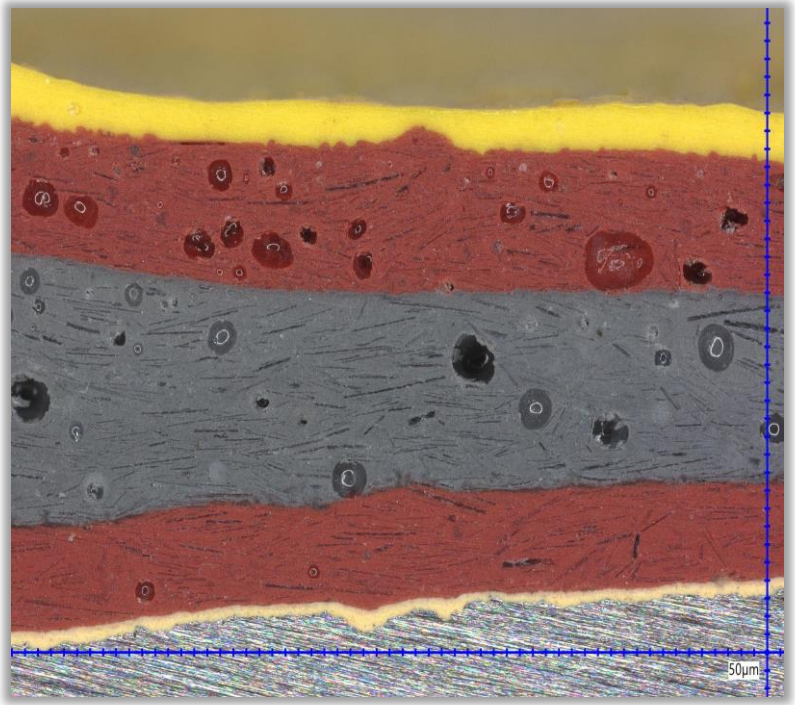
Date: 18th November 2022

Attendees: AkzoNobel Technical Services

Element S Sharman



Inspection



Adhesion checks were performed in accordance with ISO 4624 using a self-aligned automatic adhesion tester.

Sample Reference	Adhesion Value (MPa)	Mode of Failure
1	13.65	10%D 90%E
	12.38	10%B 50%D 40%E
	9.02	10%D 10%E 80%F
	Average – 11.68	
2	12.42	10%D 10%E 80%F
	13.72	50%D 50%E
	14.94	10%E 80%F 10%YZ
	Average – 13.69	

Table 2. Pull-off Adhesion in accordance with ISO 4624.

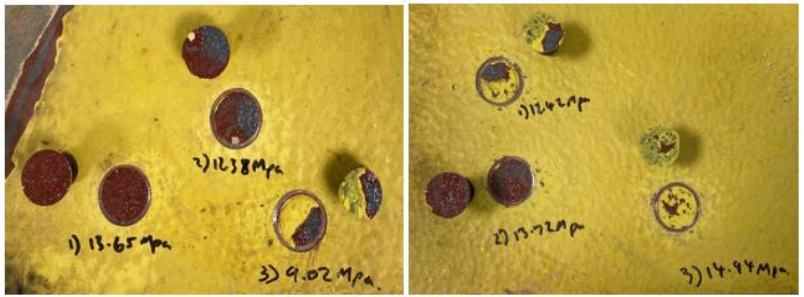


Figure 6. Pull-off adhesion

Inspection

Electrical Impedance Spectroscopy is a non-destructive method for determining the barrier properties of a coating

EIS location	EIS at 15°C
1	5.1×10^{9}
2	1.7×10^{10}

Table 3. EIS data

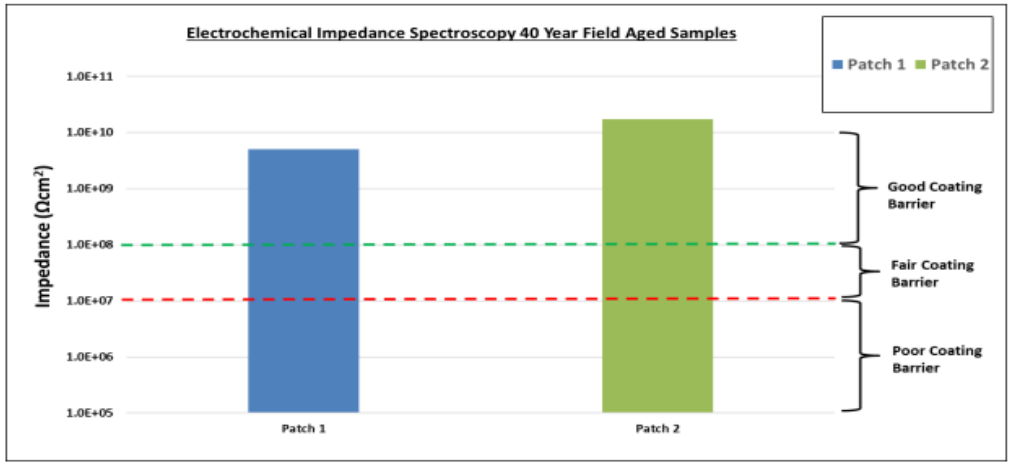


Figure 7. Graph of EIS Data

Low maintenance solutions

High build glass flake epoxies have proven performance in offshore environment

High levels of lamellar glass flake in compliance with ISO 24656:2022

Offers 40+ years maintenance free solution

“a Special thank you to Jonathan Townley, Nerida & Element Materials, for making it possible for us to perform the inspection and gather the required samples”


Questions?