FiGS® Contactless CP on AUV

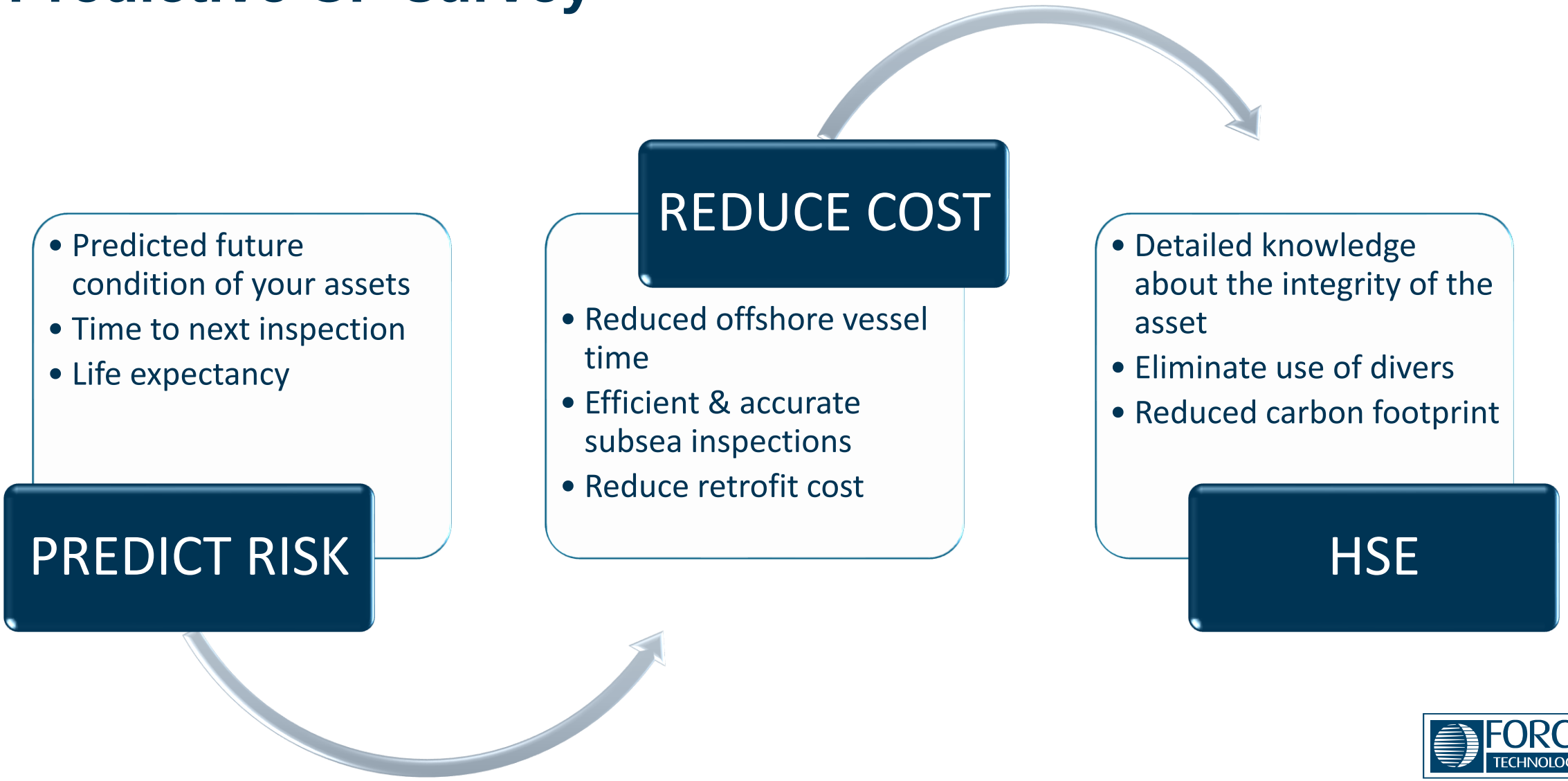
AUT CONFERENCE PERTH 23.OCT

LEIV ERLING GRYTTEN

SALES MANAGER


FIGS®

Predictive CP survey



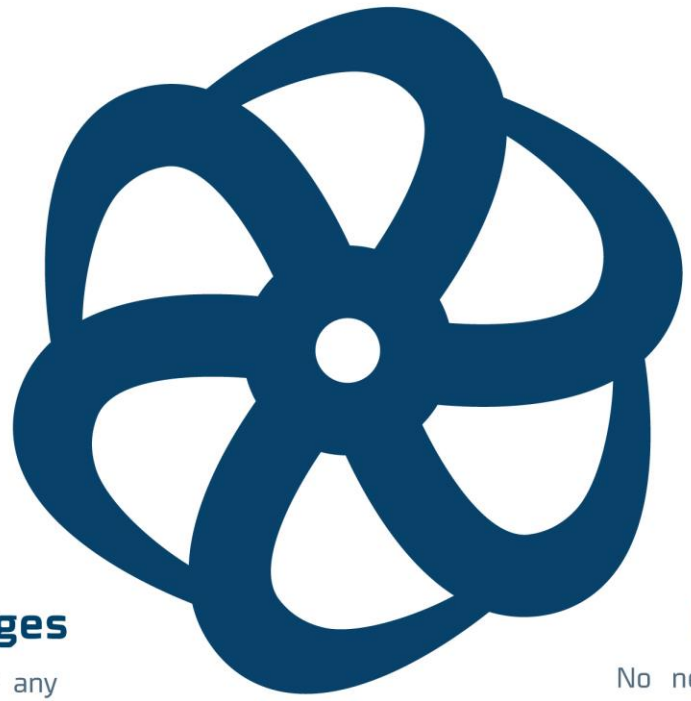
Operational benefits of performing a FiGS® CP survey

Non-contact CP survey

Maps potential, life expectancy and coating damages of buried & exposed pipelines/structures without contact

Inspect all assets

A FiGS® CP survey can be used to inspect floating/fixed platforms & jackets, subsea structures, as well as both buried & exposed pipelines



Reduced vessel time

A FiGS® survey can be done at up to 12km/h. FiGS® enables continuous mapping without calibration stops

High sensitivity

The sensitivity of the sensors (0,01 µ V/cm) enables a safe distance of 2-5 meters from the inspection object

Compatibility

The FiGS® system is compatible with all main ROV & AUV platforms. It can be run simultaneously with most standard survey equipment e.g. pipe tracker (TS440)

Detect coating damages

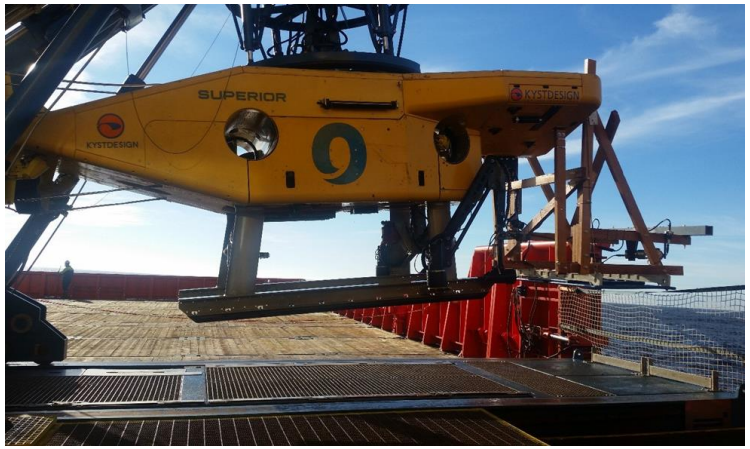
Detects and calculates size of any coating damages on both buried & exposed pipelines

No intervention

No need to clean anodes, remove rocks, or concrete matresses

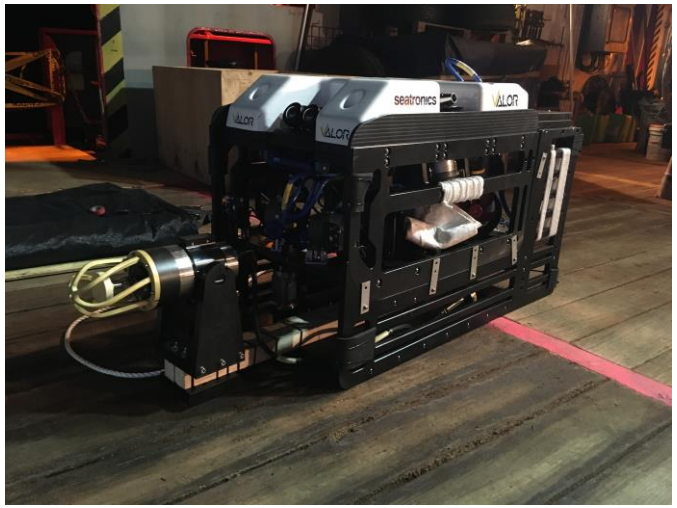
Working Class ROV

Fast ROV

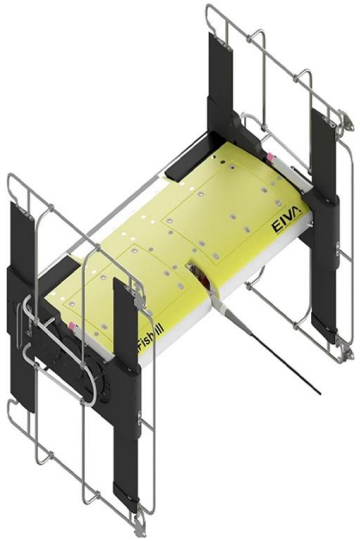


Inspection Class ROV

Small ROV



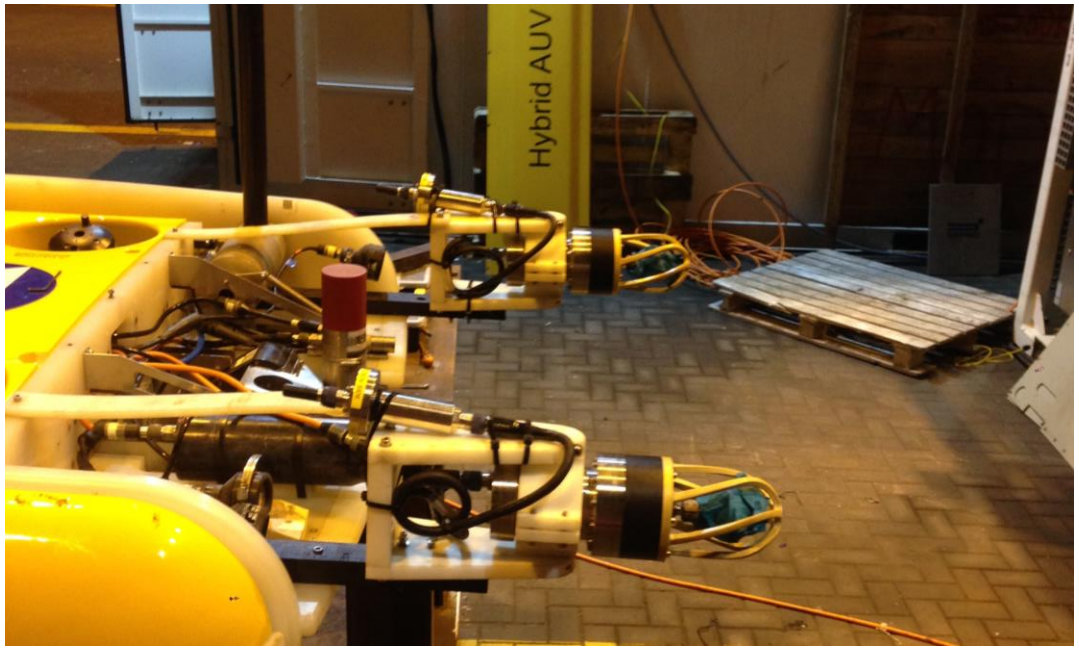
Towed ROTV

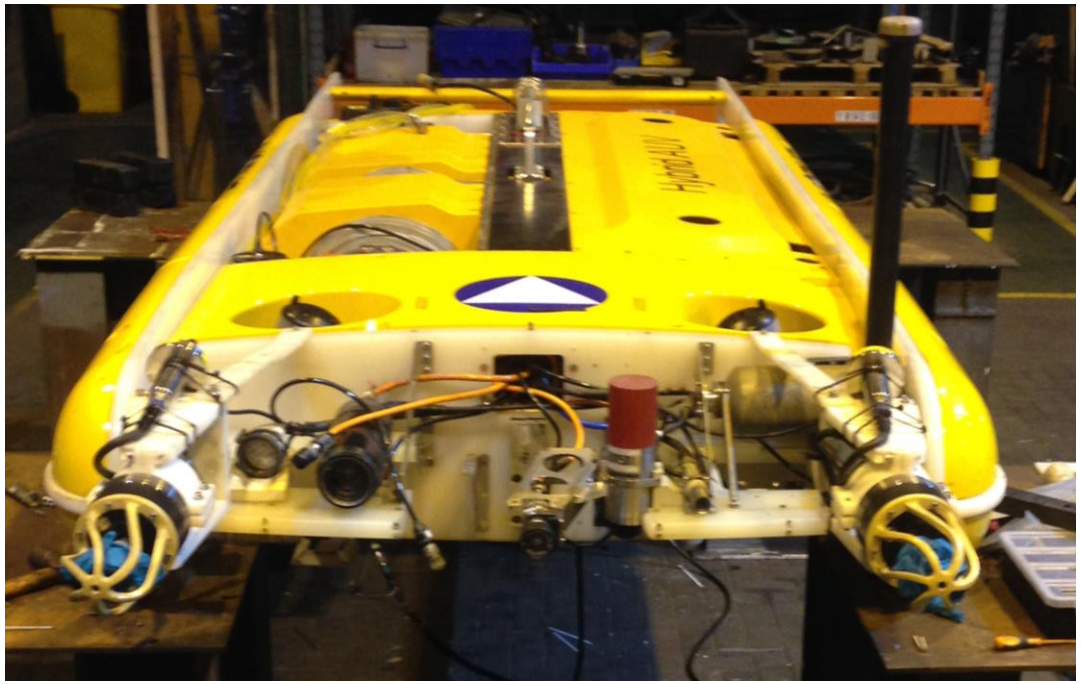


AUV

AUV/ Resident AUV

SAAB Sabertooth AUV





Hugin AUV test with Kongsberg

New platforms in the coming

FiGS® is currently in different stages of integration with

- 3 different Resident AUV platforms
- 4 different AUV platforms
- 3 different small ROV’s
- 2 different ROTV

FiGS® 2.0

Particularly developed for AUV and small ROV

Based on the same technology. All existing sensors will be upgraded to same spec.

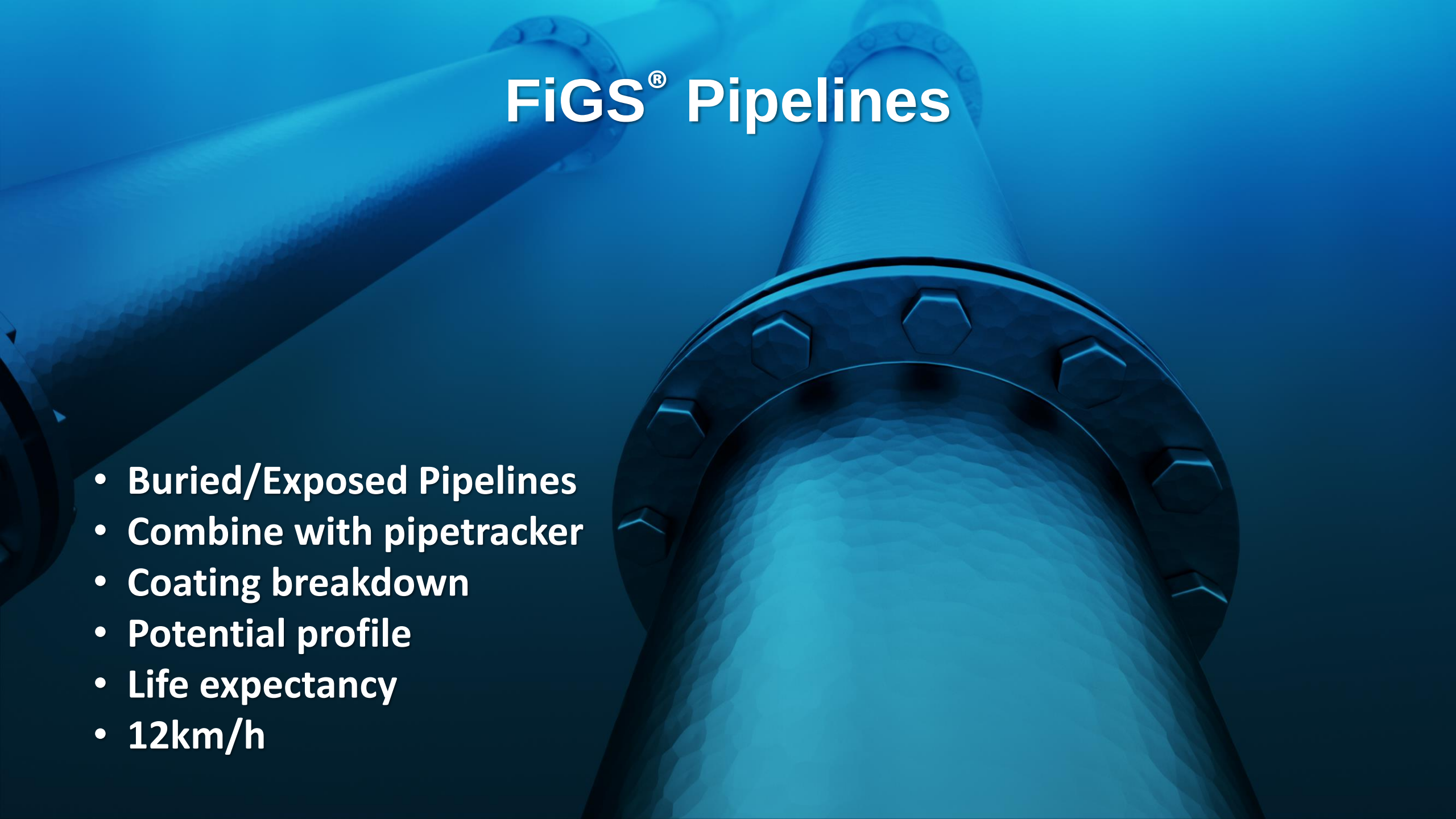
Benefits

- Technology already approved with long track-record
- Software and interface (electrical) stays the same
- Easy mount, low drag

FiGS® 2.0 Operation window and spec to be confirmed

- 0-12km/h (7knots)
- 0-10 meters above pipeline
- Weight: 2,5 Kg (wet)
- Connection: RS232, RS485 and LAN ready
- 24V DC, 15W
- No interference with other survey tools (e.g TSS440)
- Sensitivity 7nV/cm (0.007µV/cm)

FiGS® Pipelines



- Buried/Exposed Pipelines
- Combine with pipetracker
- Coating breakdown
- Potential profile
- Life expectancy
- 12km/h

Baseline, FiGS® inspection of pipeline

General observations:

- Very little activity from anodes after KP5-10 (mid-section)
- Anodes in mid section becomes cathodic, often only every 5 anodes with current output
- Drain to connected structures
- Field gradient signals too weak for traditional methods

FiGS® benefits:

- Sensitivity to observes all activity, even cathodic anodes
- Provides current drain to connected structures and remaining life
- Confirmation on anode connection

Periodic, FiGS® inspection of pipeline

General observations:

- Drain to connected structures often biggest consumer of anode mass
- Generally lower anode consumption than expected based on DNV standards
- Anode banks generally deliver lower output than promised

FiGS® benefits:

- Provides current drain between connected structures and remaining life
- Can be used on buried pipelines
- Enables risk based inspection planning, focus on high risk areas
- Extend inspection intervals
- Detects even small coating damages
- Full CP integrity report

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Life extension, FiGS® inspection of pipeline

General observations:

- Much lower steel current density than CP design standards suggest
- Old designs are usually very conservative
- Often find disconnected anodes, even though they look good

FiGS® benefits:

- Early prediction on end of life, avoiding costly retrofit
- Establish steel current density for asset
- Reduced retrofit cost, design based on measured steel current densities
- How much and where to retrofit

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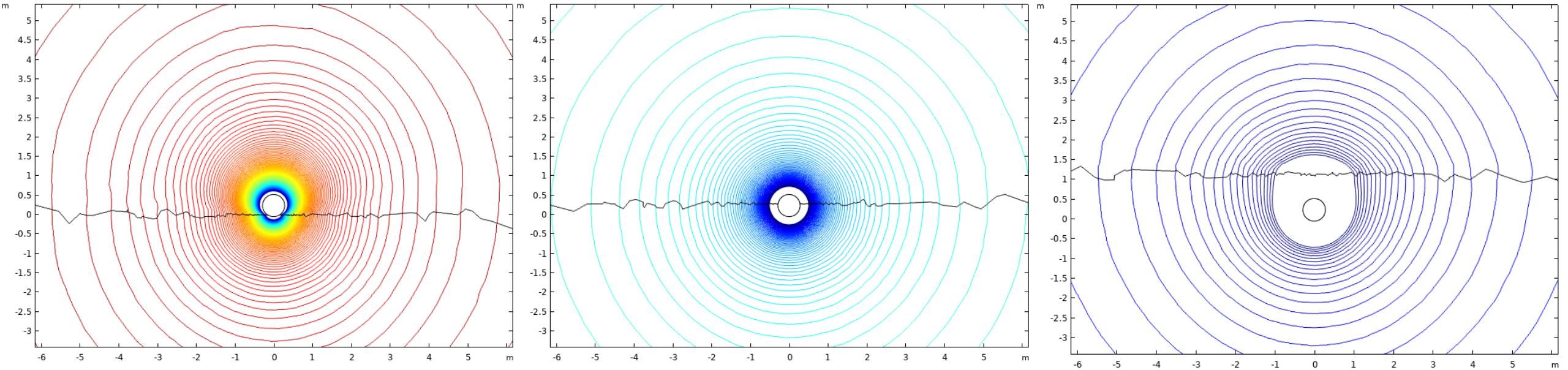
Modelling and burial condition



Shows how the electrical field changes with burial.
Modelling is essential to determine accurate current output from field gradient.

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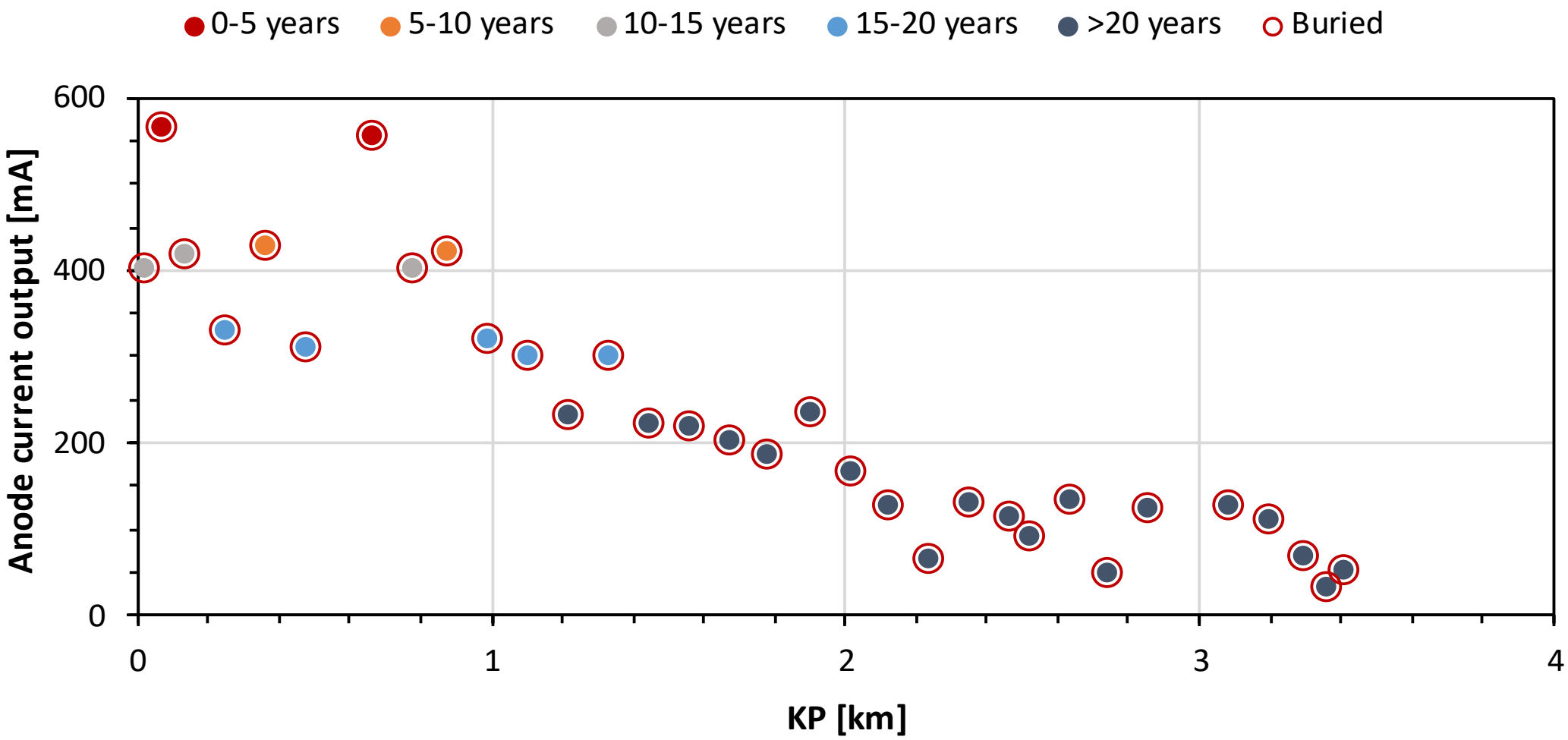
0-5 years
5-10 years
10-15 years
15-20 years
>20 years
Buried
Anode current output [mA]
600
400
200
0
0
1
2
3
4
KP [km]

Management decision summary

Pipeline ID	14” Water Disposal Pipeline		
Survey details			
• CP inspection and GVI conducted during the offshore inspection • Pipeline characterized in terms of diameter, burial status, status of coating (average current on pipe), etc. • Data used: field gradient along pipeline, NAV data, depth of burial			
Survey start date:	xx.xx.2018	Survey end date:	xx.xx. 2018
KP start:	-0.006	KP end:	3.491
Status of pipeline CP			
Condition of pipeline CP system is good, except for limited remaining life for some anodes due to heavy CP drain towards PLEM. Calculated potentials are confirmed by CP stab measurements. Cathodic activity on the pipeline is low, coating is generally intact.			
Summary of findings			
Calculated potential (max.)	**Coating breakdown**	**Anodes not observed**	**Anodes with RL < 10 years**
-948 mV	<1 %	1 of 33	5
General comments			
Pipeline installed in xxxx with CP design life 20 years, i.e. to xxxx.			
Recommended actions			
Due to the extensive drain towards PLEM, a new FiGS® survey within 3 years is recommended, combined with CP stab measurements at flanges/connectors at each end of pipeline.			

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EIVA export / reporting

Continuous values as function of N-E:

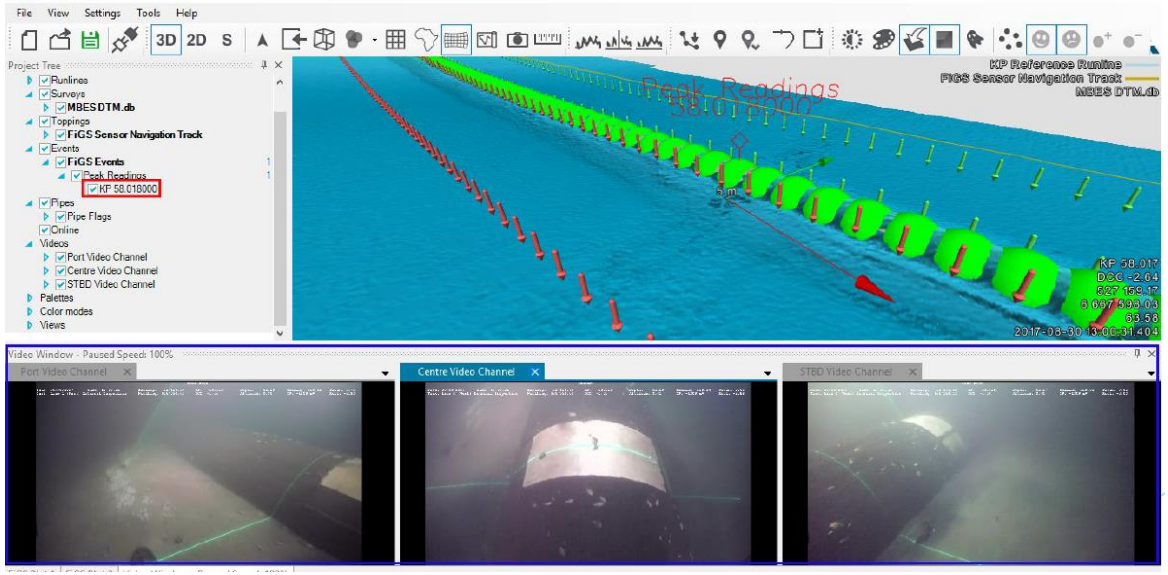
- Potential [mV]
- Burial [m] Current [mA]
- Peak indication [-1/0/+1]
- KP [km]

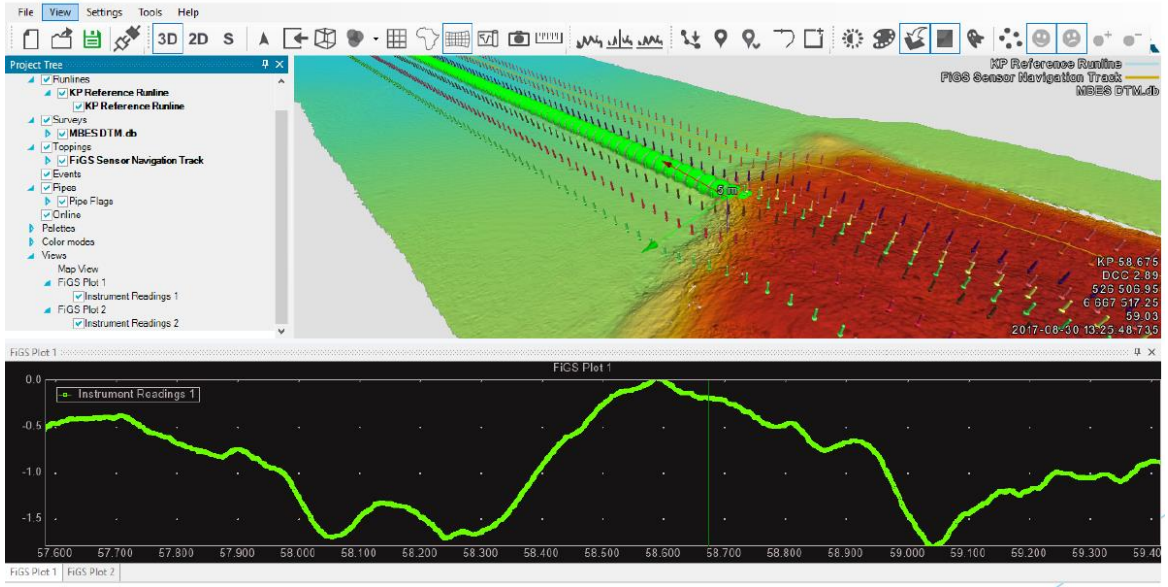
Point values as function of KP: (Anodes)

- Spacing [m] (the distance from the current anode to the next anode, delta KP)
- Anode Current [mA]
- Net mass consumed [kg]
- AW [%] (Anode Waste)
- RL [years] (remaining life)
- Comment, text.

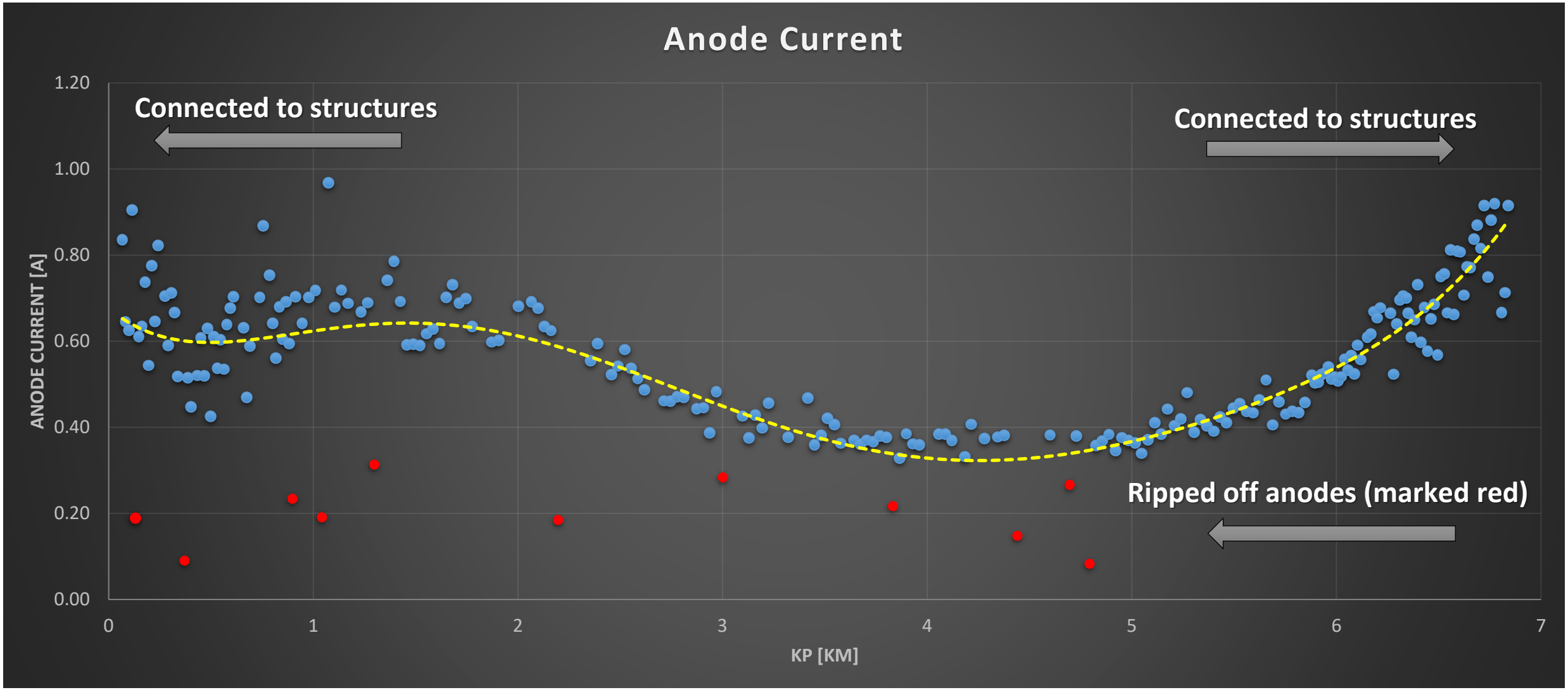
Point values as function of KP: (Not anodes)

- Comment, text

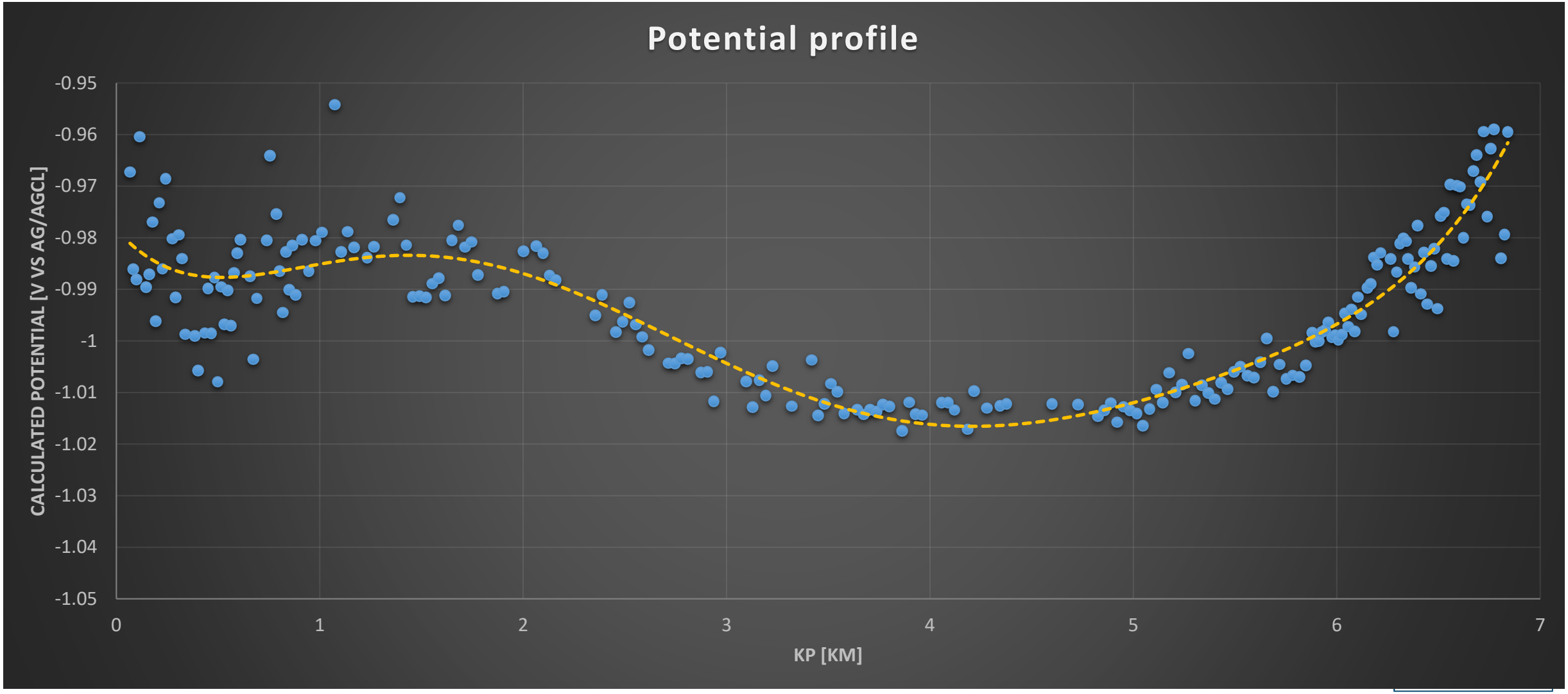




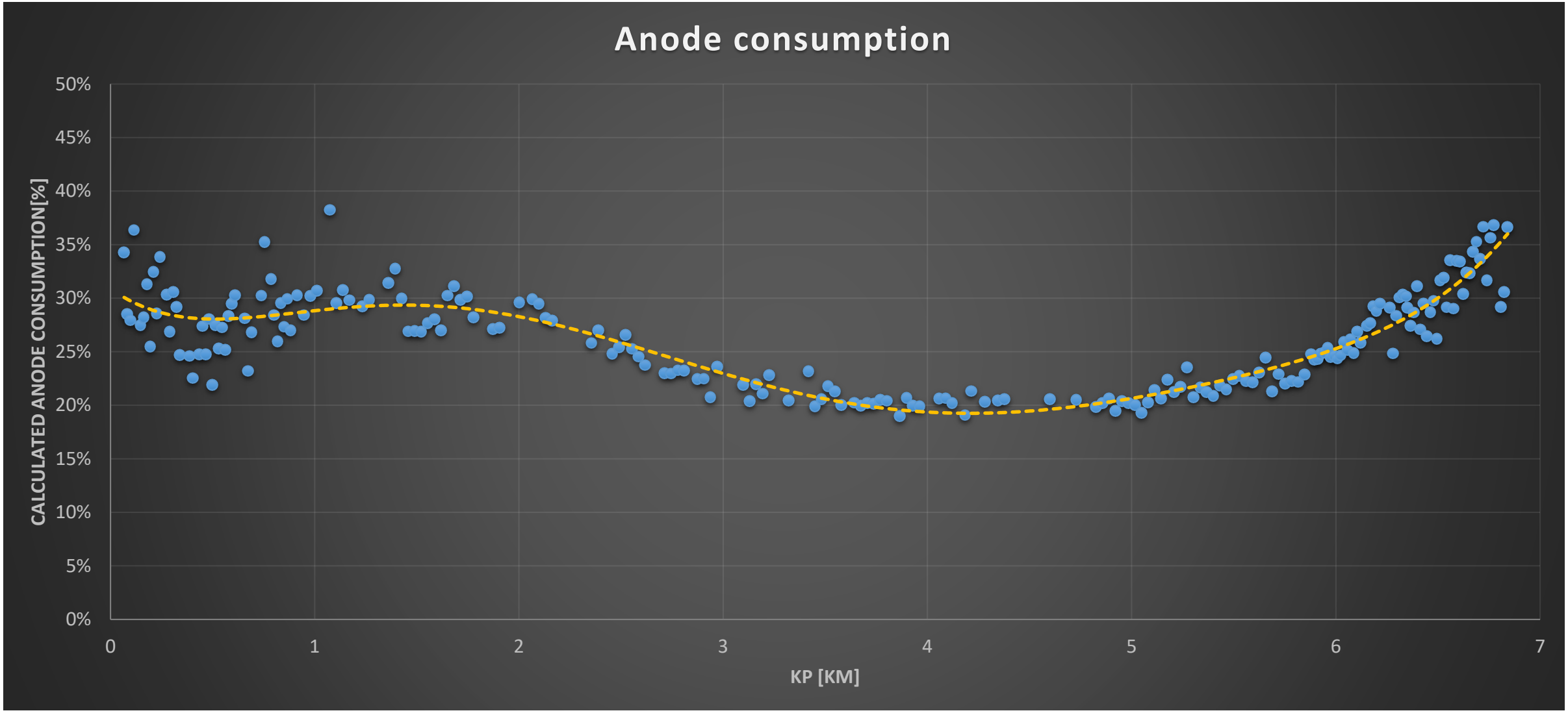
Results exposed pipeline



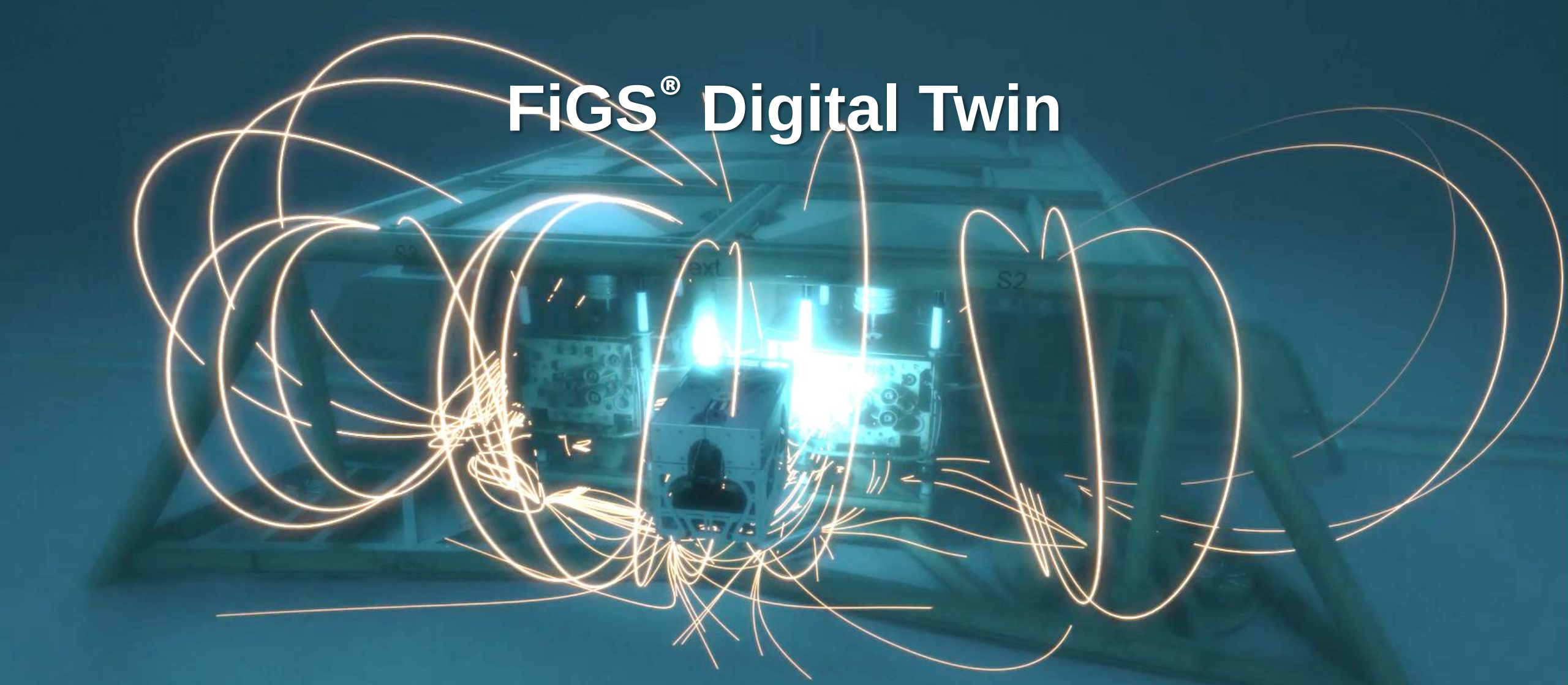
Results exposed pipeline



Results exposed pipeline

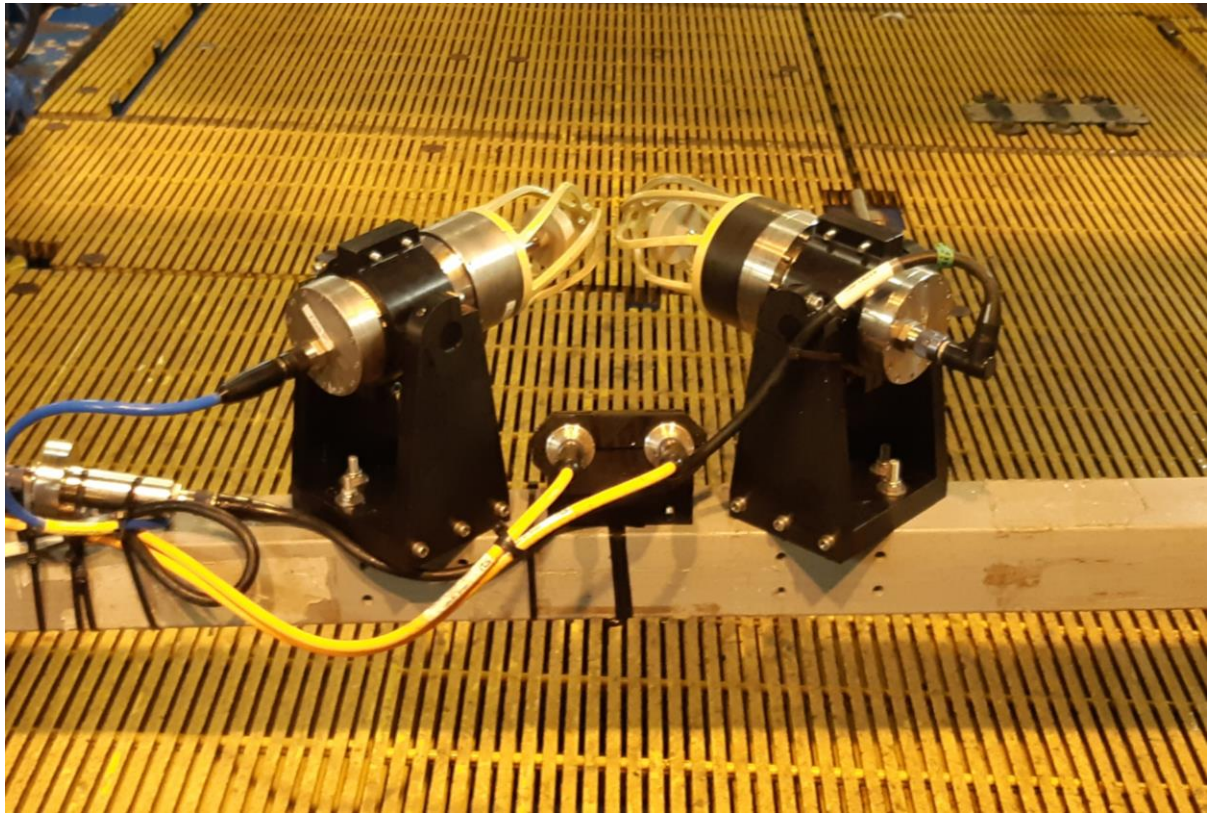


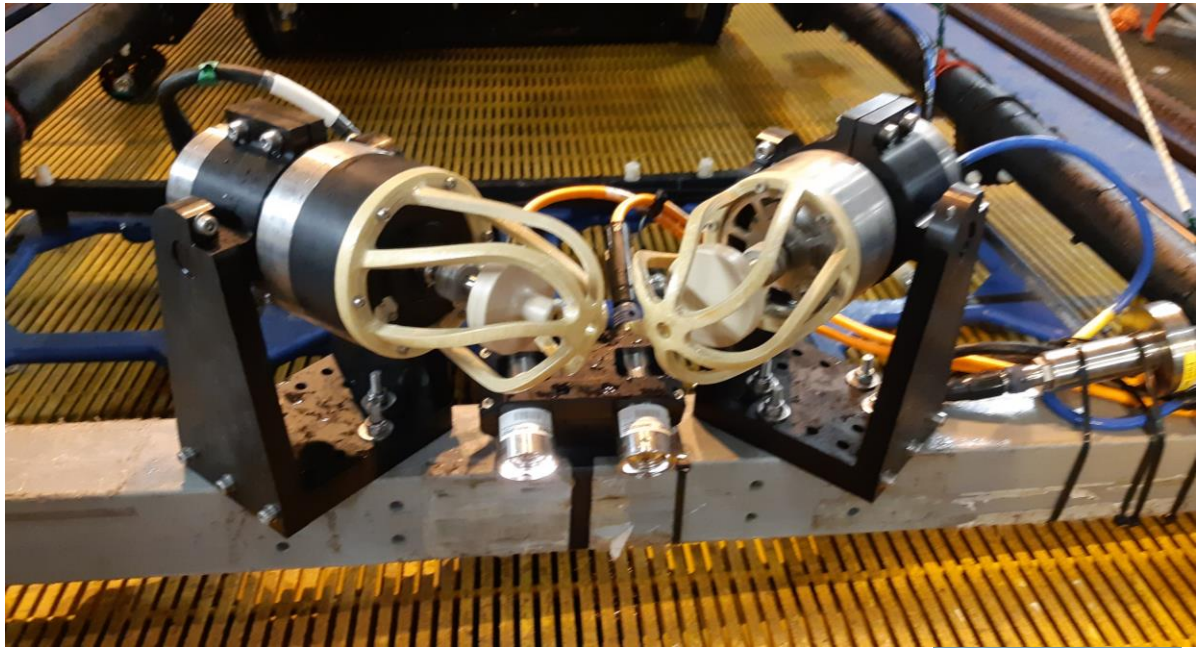
FiGS® Digital Twin



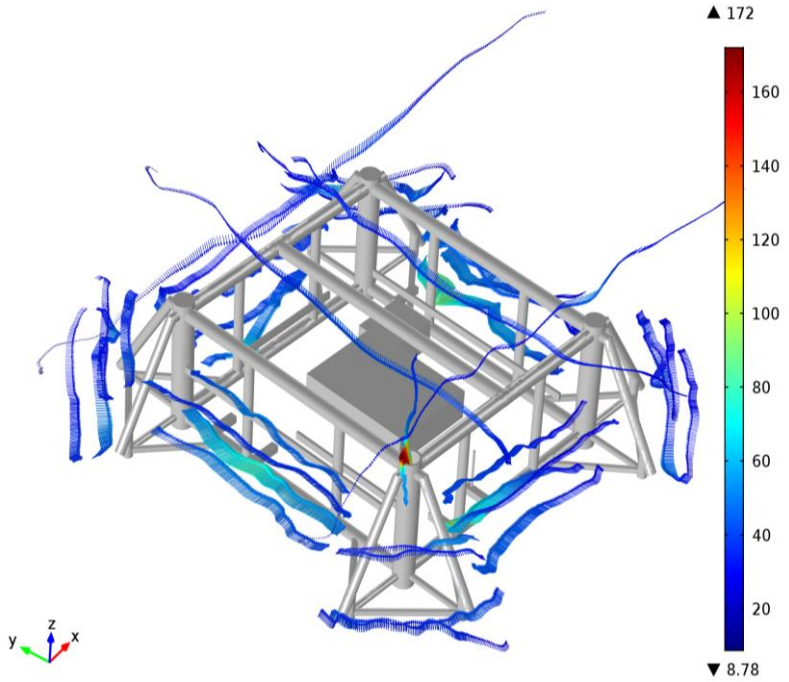
3D mapping of the CP system with FiGS®, in combination with SeaCorr™ CP modelling

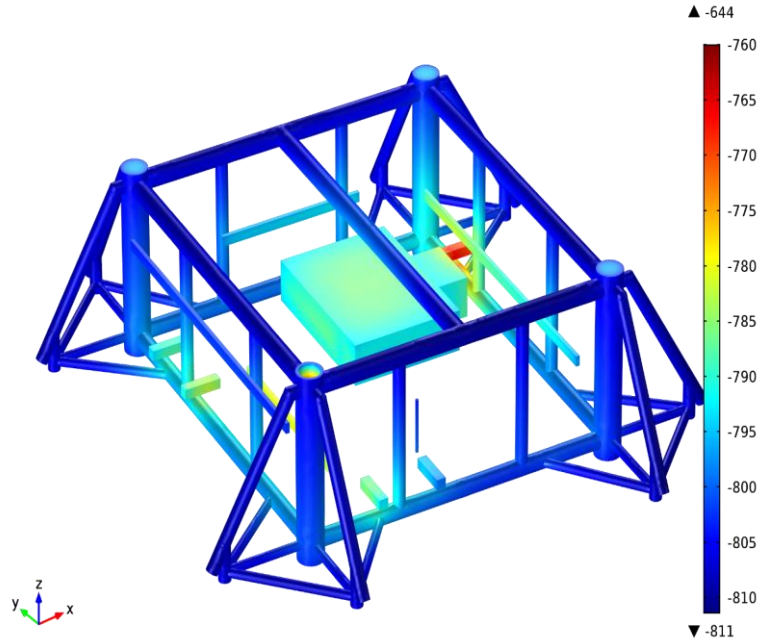
FiGS® 3D Survey setup





SSIV - FiGS® Qualification for AIV (Shell Global 2015)





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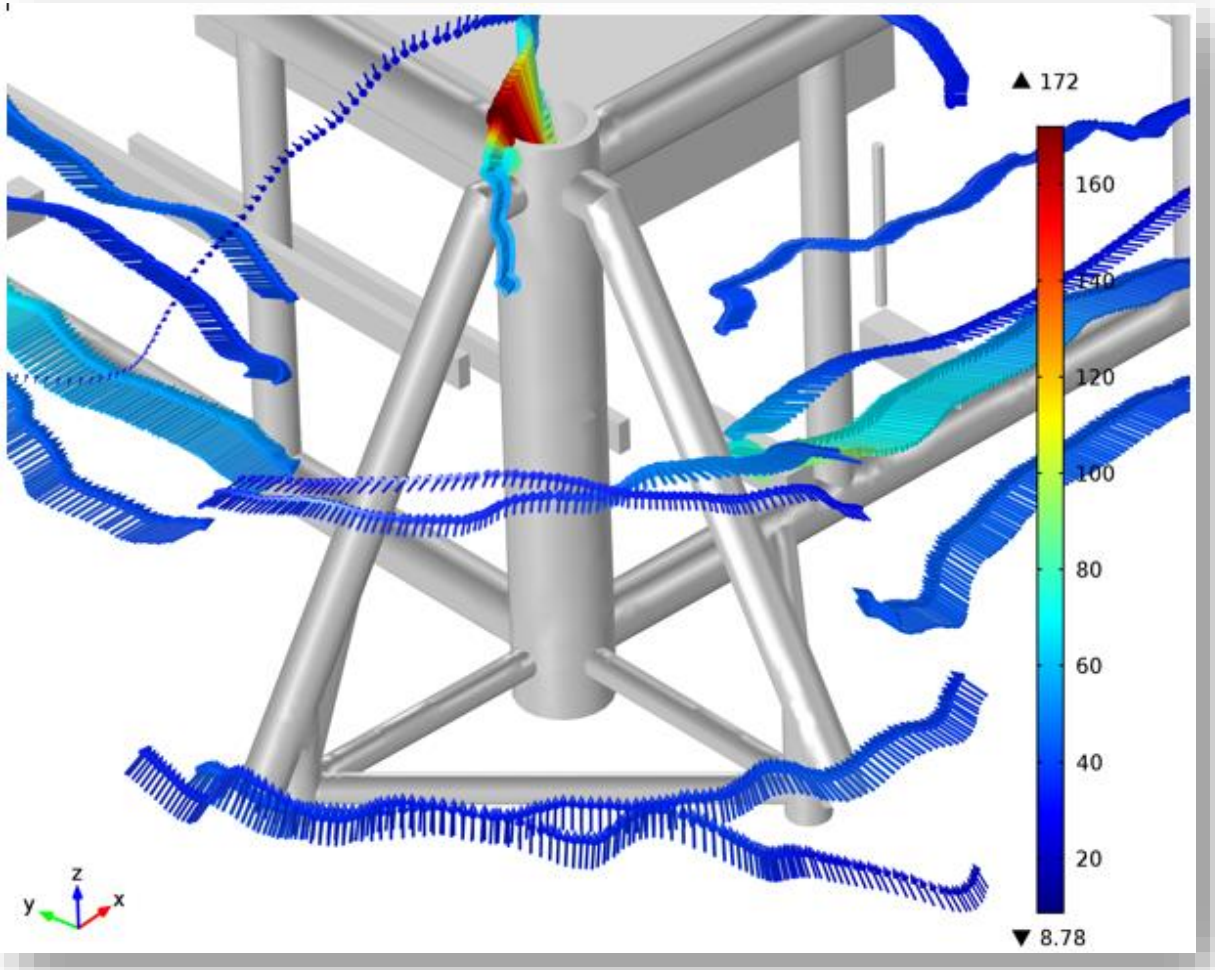
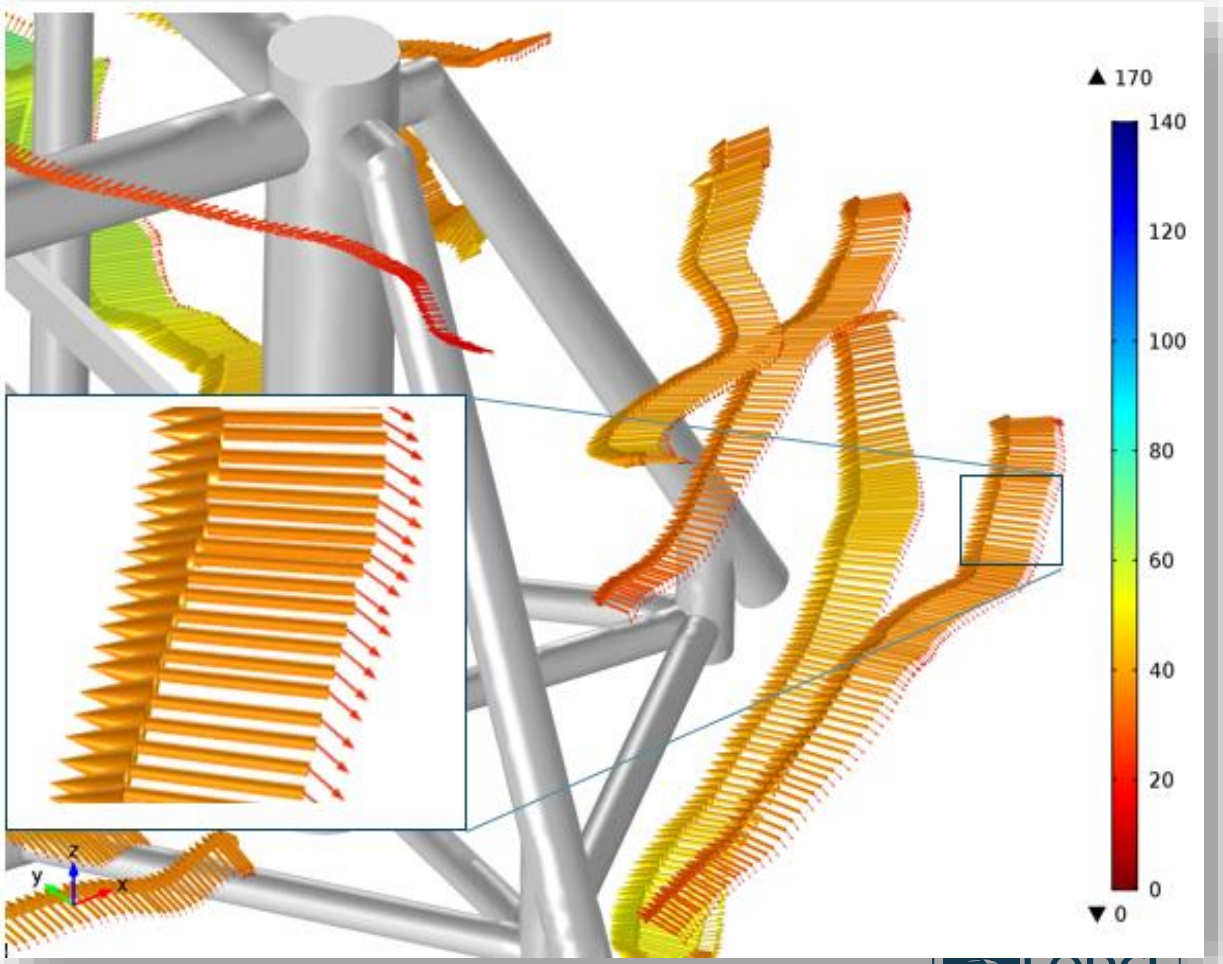
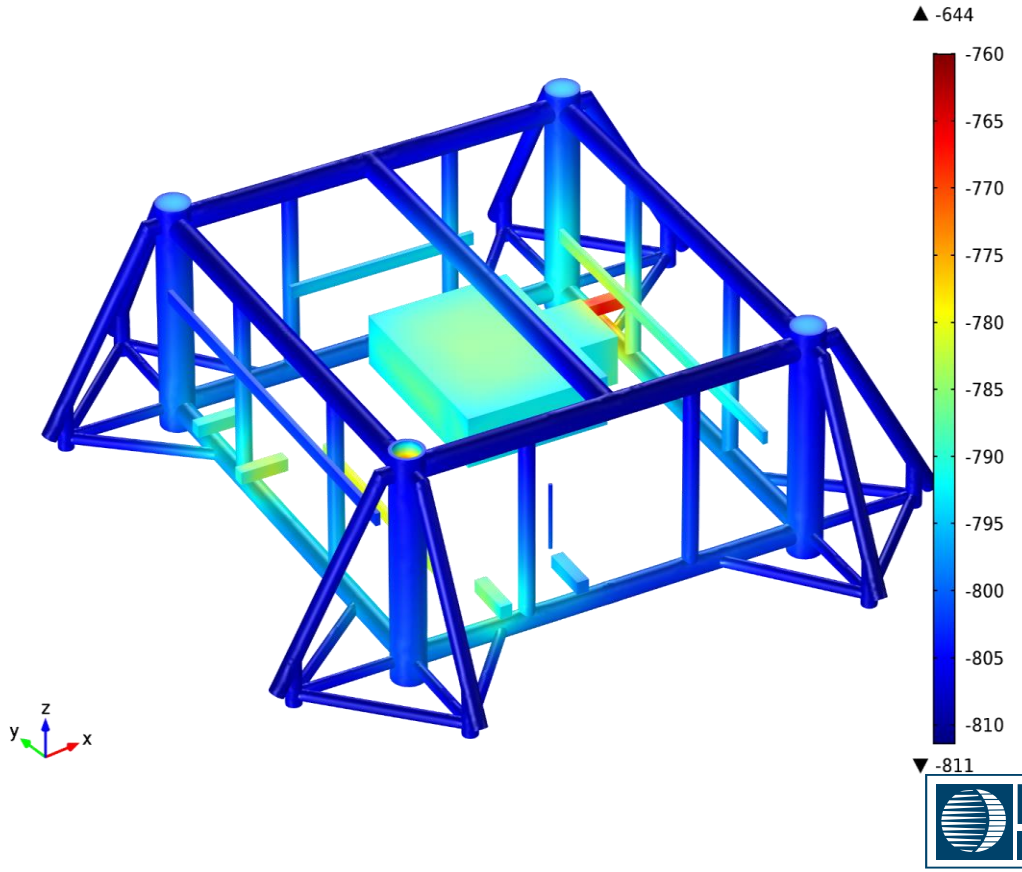
3D Plots - details

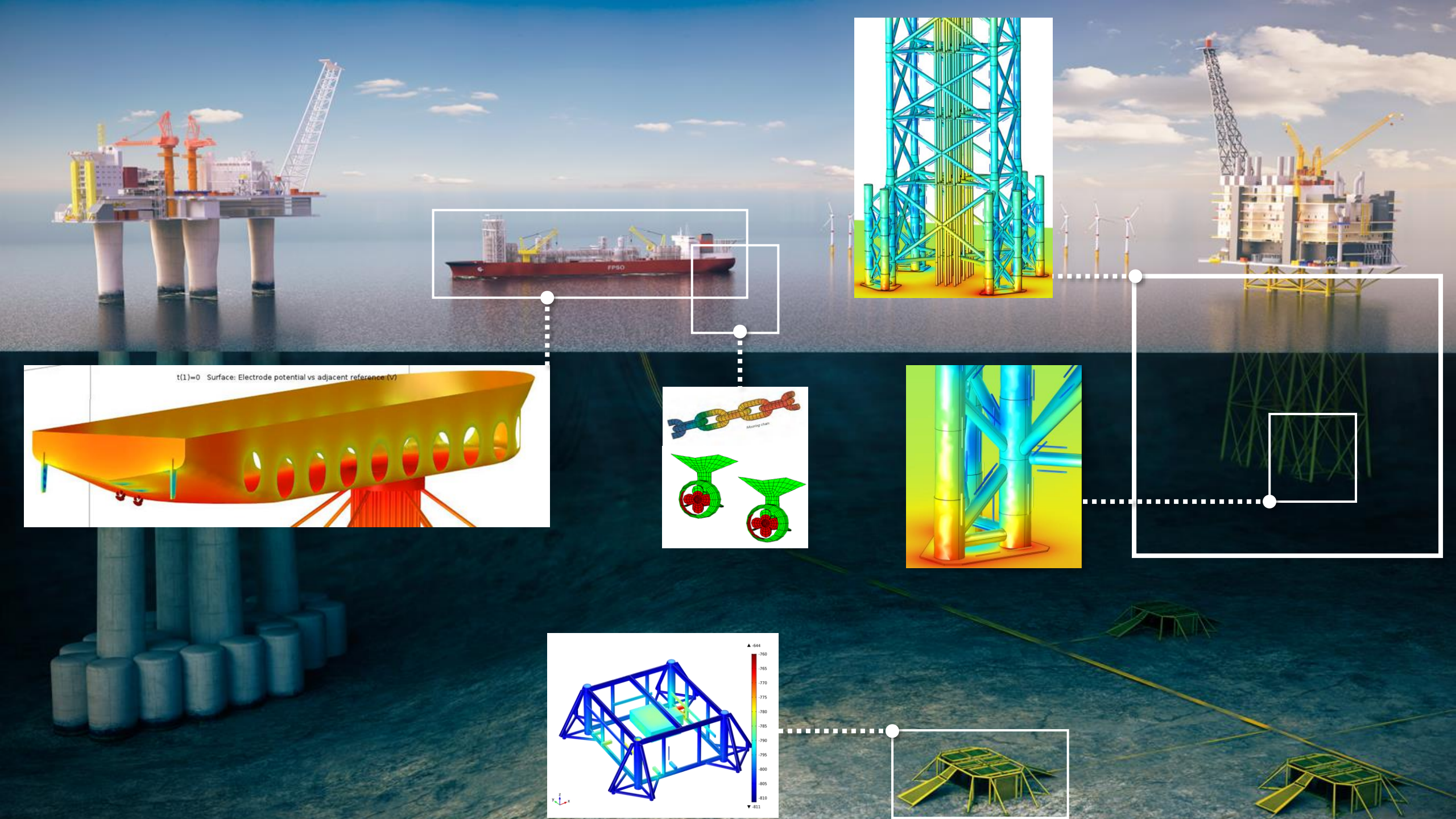




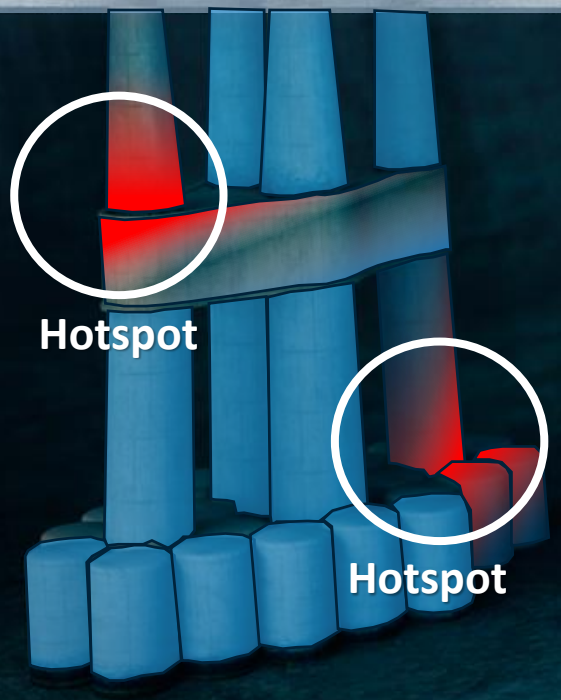
Precision of the measurements

- CP model was compared to 20 stab points
- CP model was within – 6 to + 4 mV

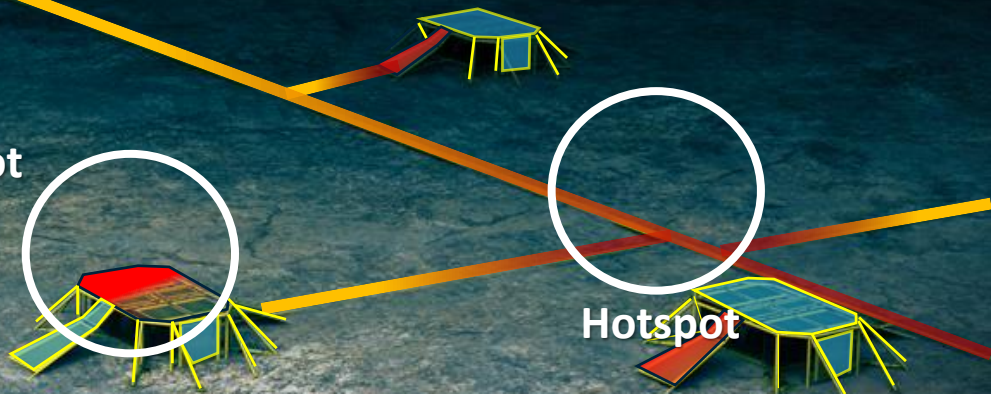



FPSO
t(1)=0 Surface: Electrode potential vs adjacent reference (V)
Mooring chain
▲ -644
-760
-765
-770
-775
-780
-785
-790
-795
-800
-805
-810
▼ -811

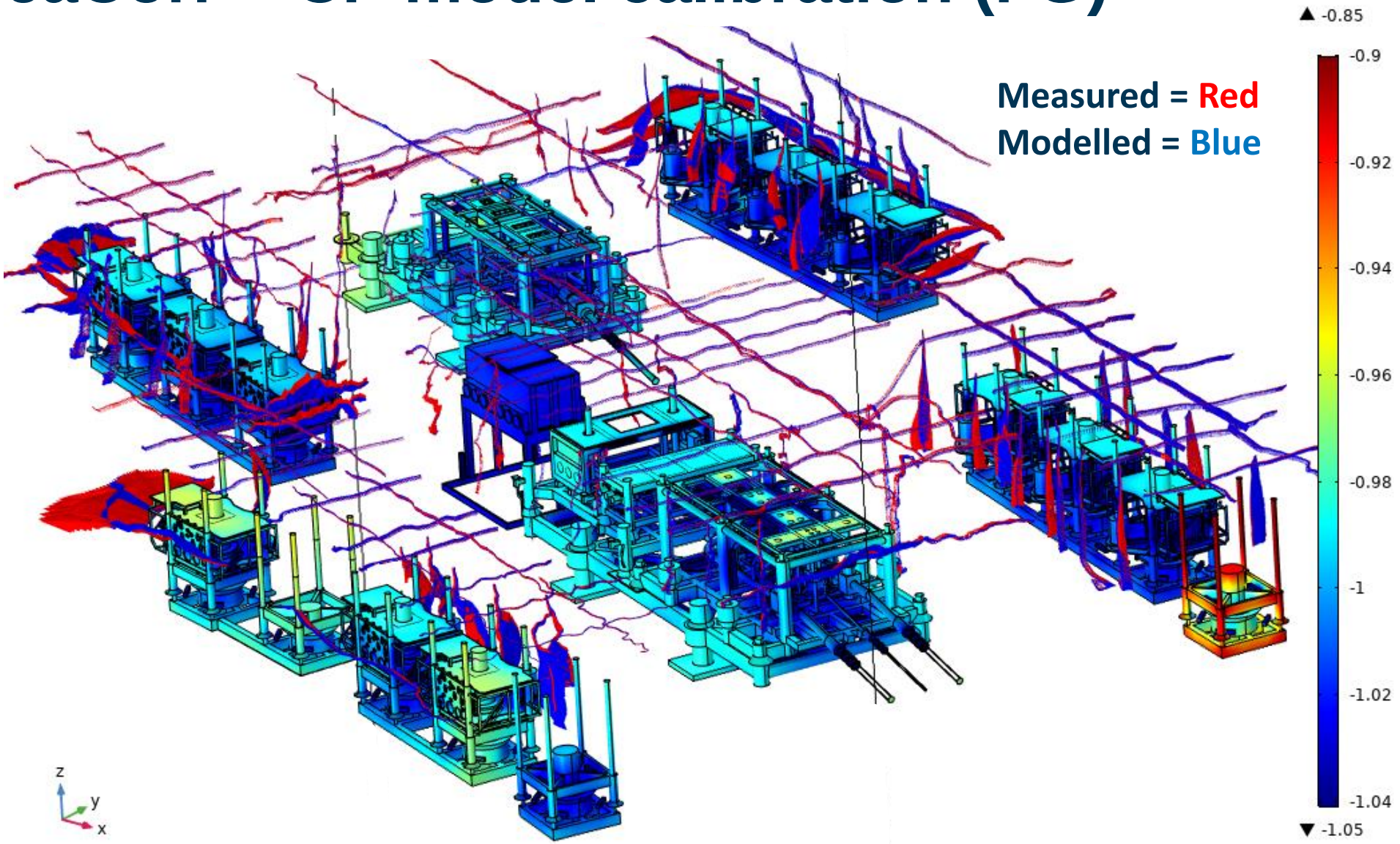
Entire Fields



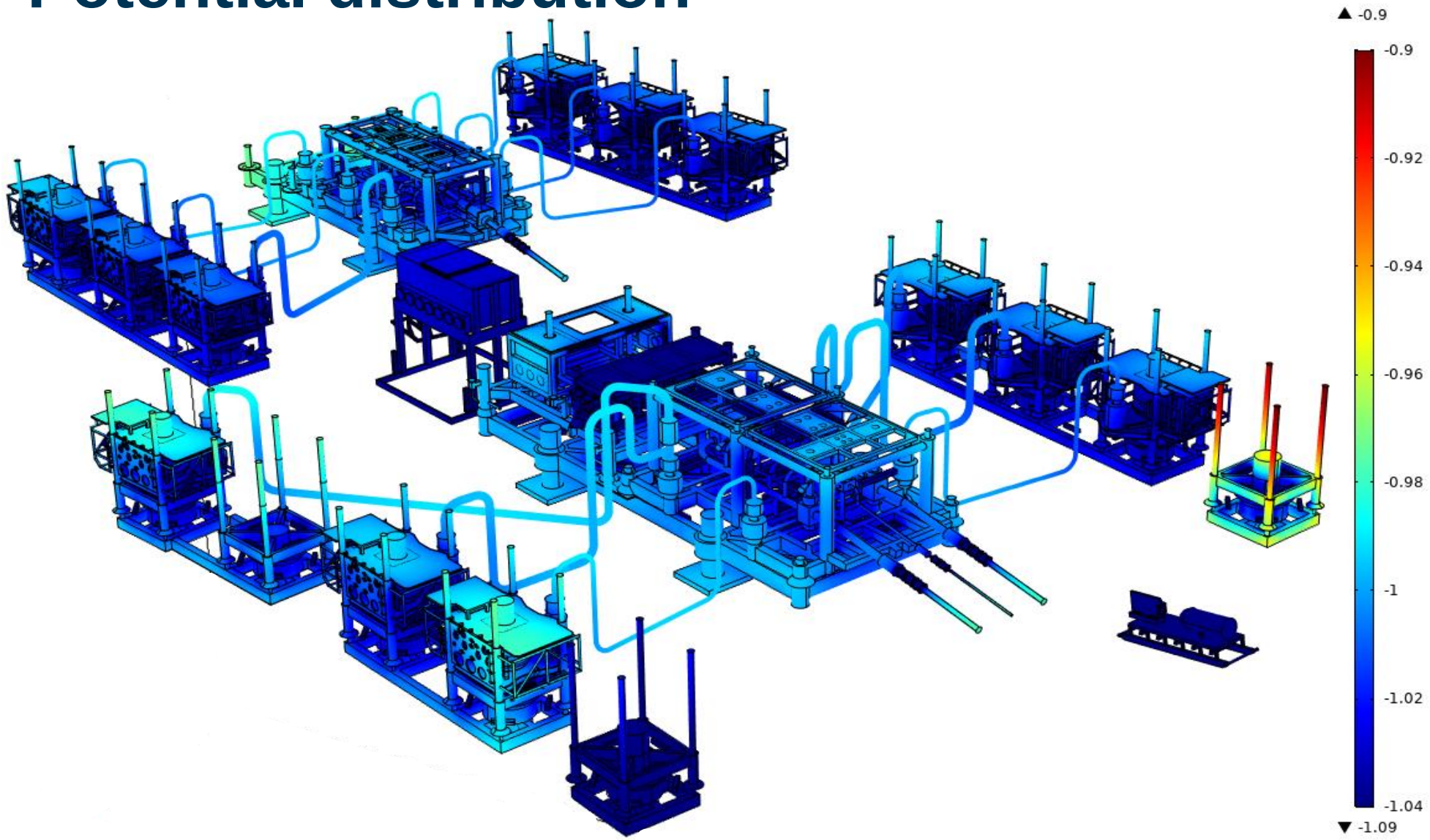
- Full integrity assessment
- Focus on high risk areas / hotspots
- Optimize inspection frequency
- Increase safety, Predict risk, Reduce cost
- Environmentally friendly, lower carbon footprint

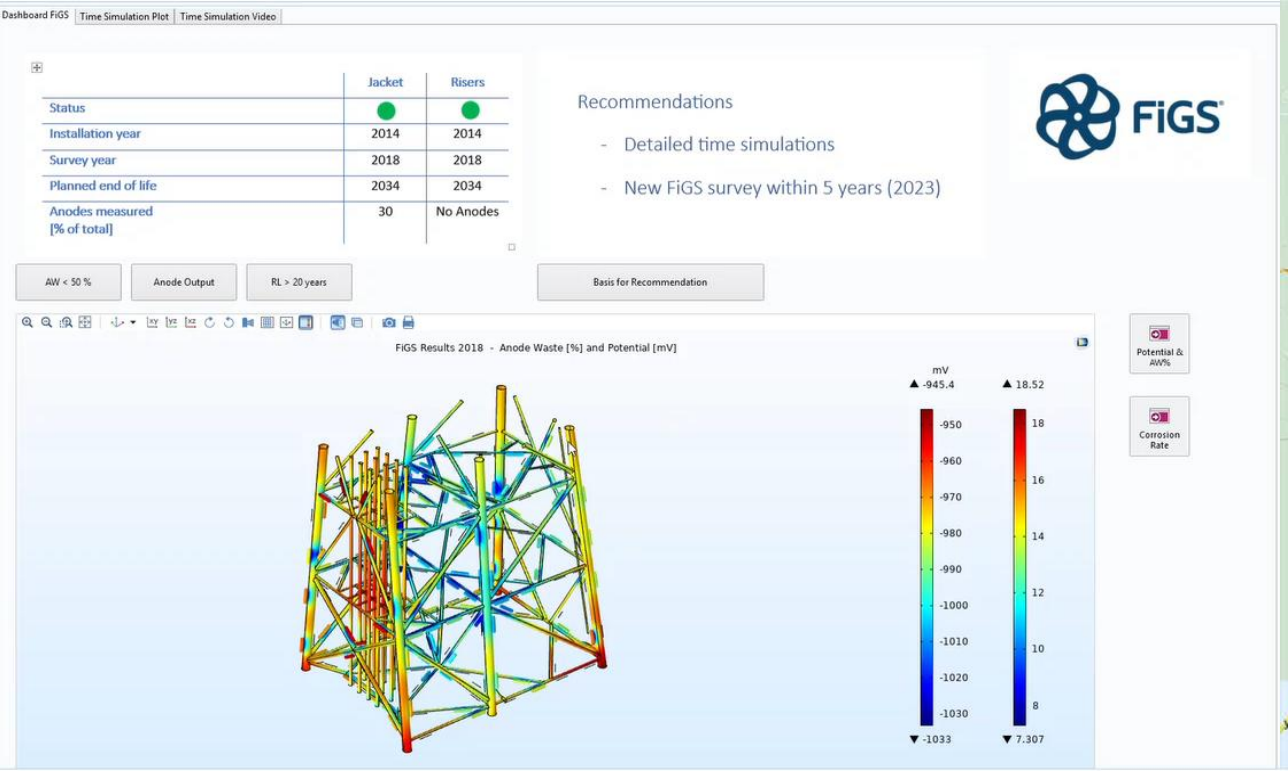


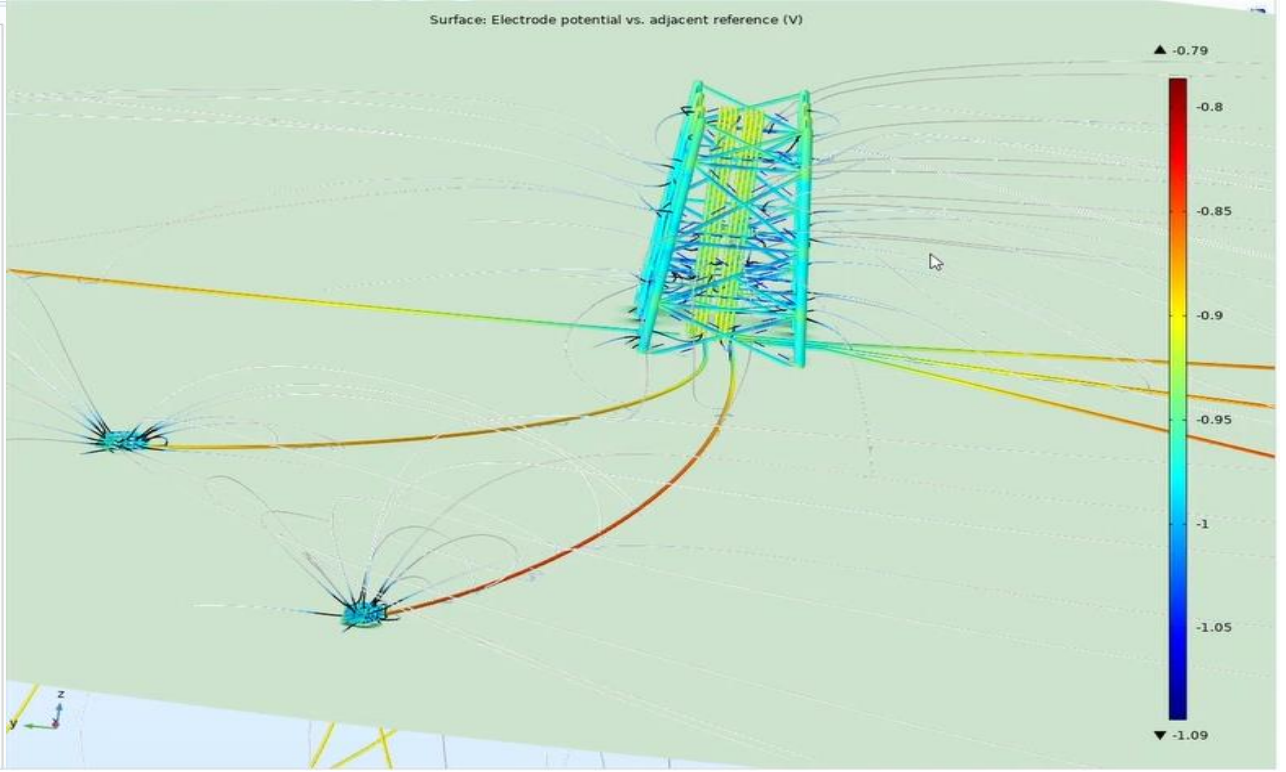
SeaCorr™ CP model calibration (FG)



Potential distribution



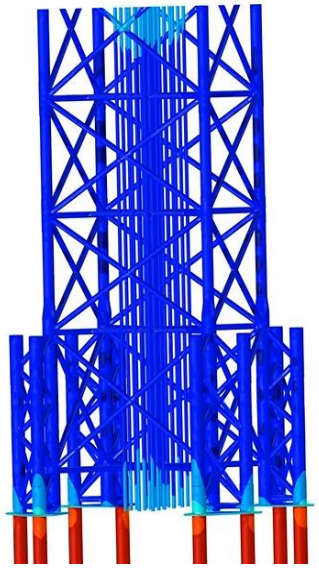




Structures and Pipelines

Total assets

- Live dashboard with status reports
- Updated 3D models with analyzed data
- Detailed overview of condition
  - Time to next inspection
  - Fit for purpose
- Life extension



Time-based simulations
Future predictions

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Track record

Special thanks to

for financial support through Demo 2000 programme

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Global Technology Approval “Proven Technology”

Global Operator
Awaiting confirmation

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REDUCE COST

INCREASE SAFETY

PREDICT RISK

CP SURVEY OF SUBSEA PIPELINES & STRUCTURES

No divers reduces HSE risk

More value with less cost

Speed up the survey

Predict service life

No need for excavation