



GALVO-STRING

HANGING GALVANIC ANODE RETROFIT SOLUTION

CAPABILITIES STATEMENT

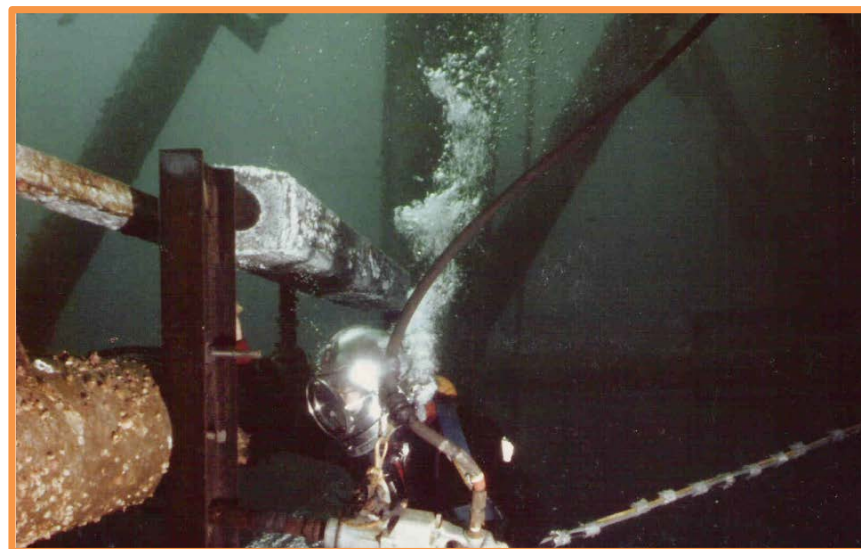
In collaboration with **ECS**



WHY GALVO-STRING ?



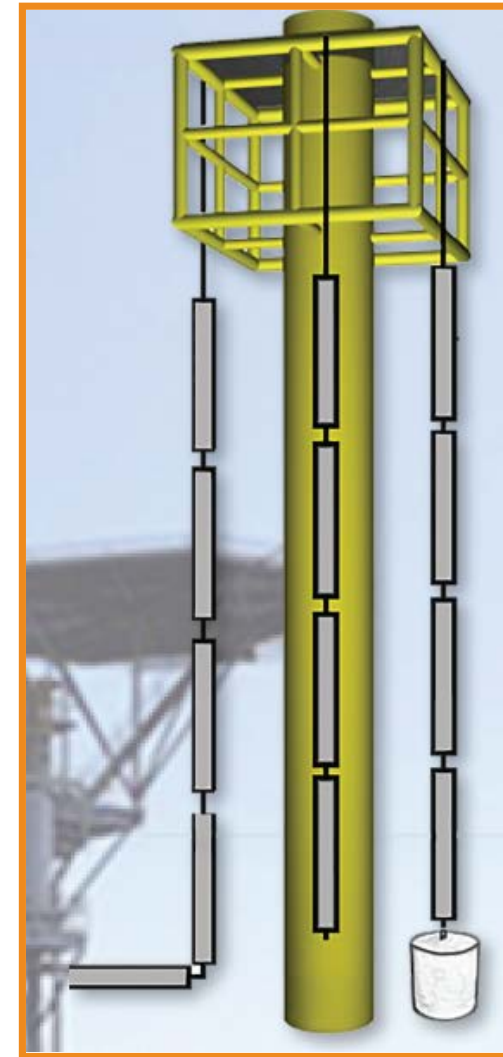
- Average design life of sacrificial anodes is 20 years and as operators extend life of offshore platforms, it is essential that the life of the cathodic protection system is also extended.
- Traditional methods of CP life extension such as anode retrofit clamps or sleds usually require intervention by divers or ROV, a costly subsea operation.
- Galvo-String was developed to **remove all underwater intervention** and rely only on riggers/welders to deploy the anodes, thus **eliminating vessel-based ROV or diving operation**, and downtime associated with subsea services.
- Galvo-String offers savings in excess of 50% compared to conventional methods and is part of the **DIVERLESS CP RETROFIT** solutions offered by the **Galvotec-IEV Strategic Alliance** to operators of offshore structures



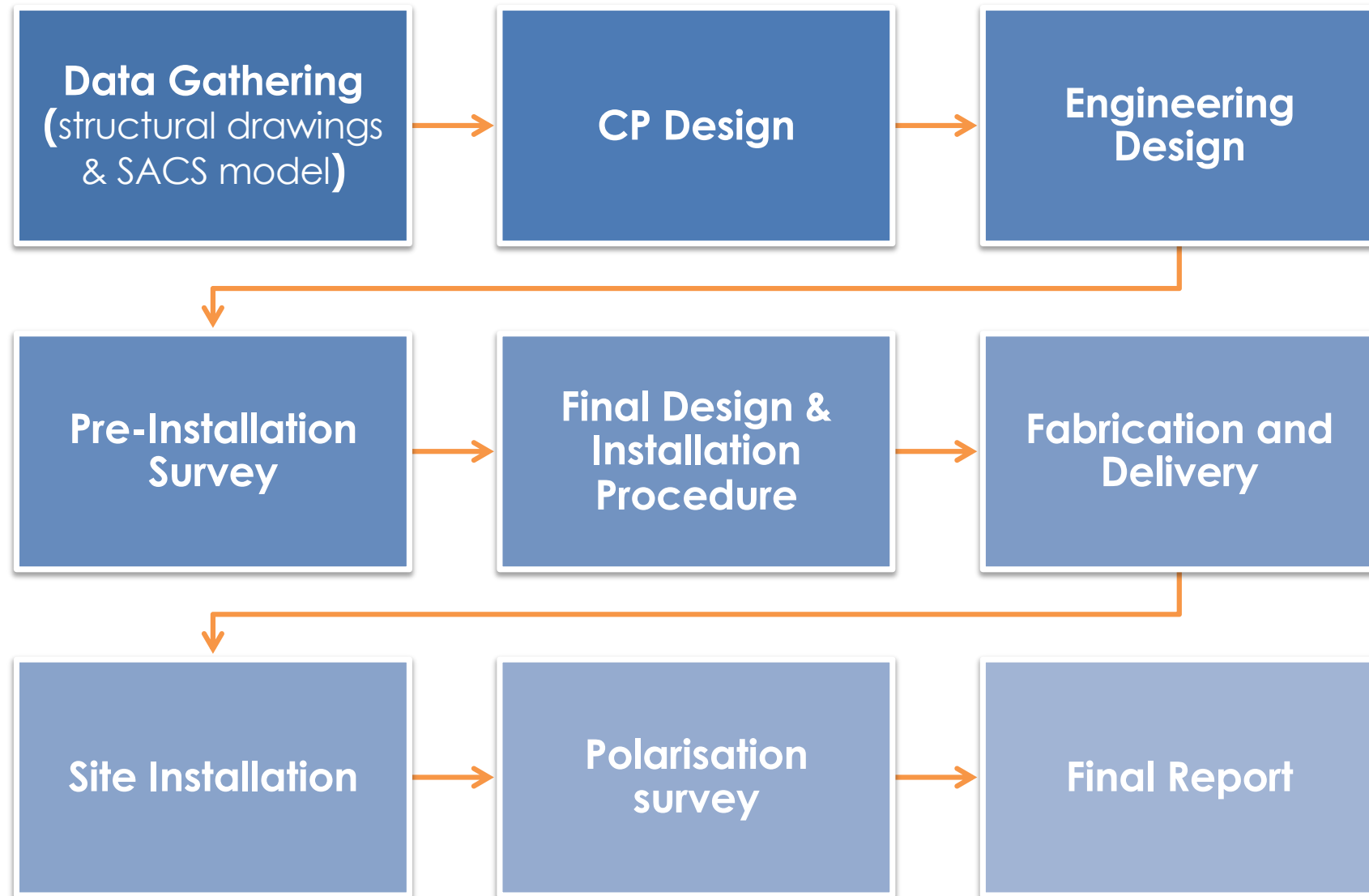
WHAT IS GALVO-STRING?



- The GALVO-STRING is a **hanging galvanic anode retrofit solution**.
- GALVO-STRING anodes are simply **shackled** together and **lowered to a desired installation** depth and can be attached to a structure with either a weld-on or clamp-on bracket.
- An ideal system for structures in water depths of **3 meter (10 ft) to 100 meters (330ft)**.
- Also ideal for short life extensions **of 5 to 10 years** duration.
- **No divers or ROV** required for installation.



GALVO-STRING PROJECT PROCESS FLOW



ANODE DESIGN



- Client supplies **drawings** for anode calculation. In the absence of detail drawings, line drawings from diver surveys can be used, or estimations can be made based upon other similar structures.
- Certain design parameters that are based upon client preference, such as **design life and desired installation type**, while other parameters are based upon the engineering design analysis of the structure.
- Current requirements are determined from the analysis of the structure using **DNV or NACE design standards**.
- Once the current requirements are determined and the design life has been confirmed, the **total anodic mass can be calculated**.
- Drawings of the **proposed Galvo-String** are made along with the **anode locations** and submitted to the client for approval.

ENGINEERING DESIGN



OPERATING LIMITS

- Stringent structural engineering calculations are carried out to define the operating limits of the standard Galvo-String in differing **combinations of water depth and wave height**. Specific designs are carried out for applications outside the standard operating envelope.

STRING LOAD ANALYSIS

- Maximum load acting on the pad eye and attached member is computed using **ORCAFLEX**.
- Pad eye fatigue analysis can be carried out for known specific site conditions.
- **Member Unity check** is performed for all members with attached anode strings. Joint fatigue can also be carried out for specific site conditions.

ENGINEERING DESIGN



STRING DEFLECTION ANALYSIS

- Deflection is calculated throughout the length of the anode string.
- This information is used to **position** anode strings on structures and **avoid contact** between the string and adjacent members at all horizontal bracing levels under storm conditions.

CLUMP WEIGHT MOVEMENT ANALYSIS

- Analysis is carried out to calculate possible **movement** of clump weight under extreme storm conditions.
- Clump weight design is performed to not only optimise its weight but also **eliminate any possible movement, especially for shallow water structures.**

PRE-INSTALLATION SURVEY



A **Pre-Installation Survey** is conducted to ascertain the following;

- **Water depth** soundings/video survey at installation locations
- Condition and location of the **crane lifting capacity**
- Material and Equipment **storage locations** on upper deck.
- Lower level layout and **requirements for access**
- Identify **rigging** locations for pulleys and blocks needed to lift anode string sections



GALVO-STRING FABRICATION



- The Galvo-Strings are fabricated into **segments** comprised of a certain number of anodes
- This keeps Galvo-String in shorter segments to **reduce dis-assembly** to facilitate **easier handling**
- Assembling segments before shipping **reduces the installation time** once on-site.
- The pad-eyes and suspensions are also **pre-shackled together** to facilitate faster installation times.





NOTABLE PROJECTS

NOTABLE PROJECTS



**Eugene Island
307A (66m)**



Pelto 10-17 (12m)



High Island



**Main Pass 298B
(67m)**



SMI 27 A (2018)



**CHEVRON THAILAND
LONG-TERM AND
MULTIPLE-PLATFORMS
PROJECT
(STARTING FROM 2019)**



IEV & GCS - CASE STUDIES



CASE STUDY
FREEPORT MCMORAN
HI A531A

8-Pile Structure in 58m Water Depth

GALVO-STRING CALCULATION



After Calculating Underwater Surface Areas and Mud Penetration Area, plus Adding 3 Amps per Well Conductor, the Total Current Requirement Can be Calculated and Number and Size of Anodes Determined as Per **DNV PR-B401**.

Required System Life:

5 Years

Anode Mass Required:

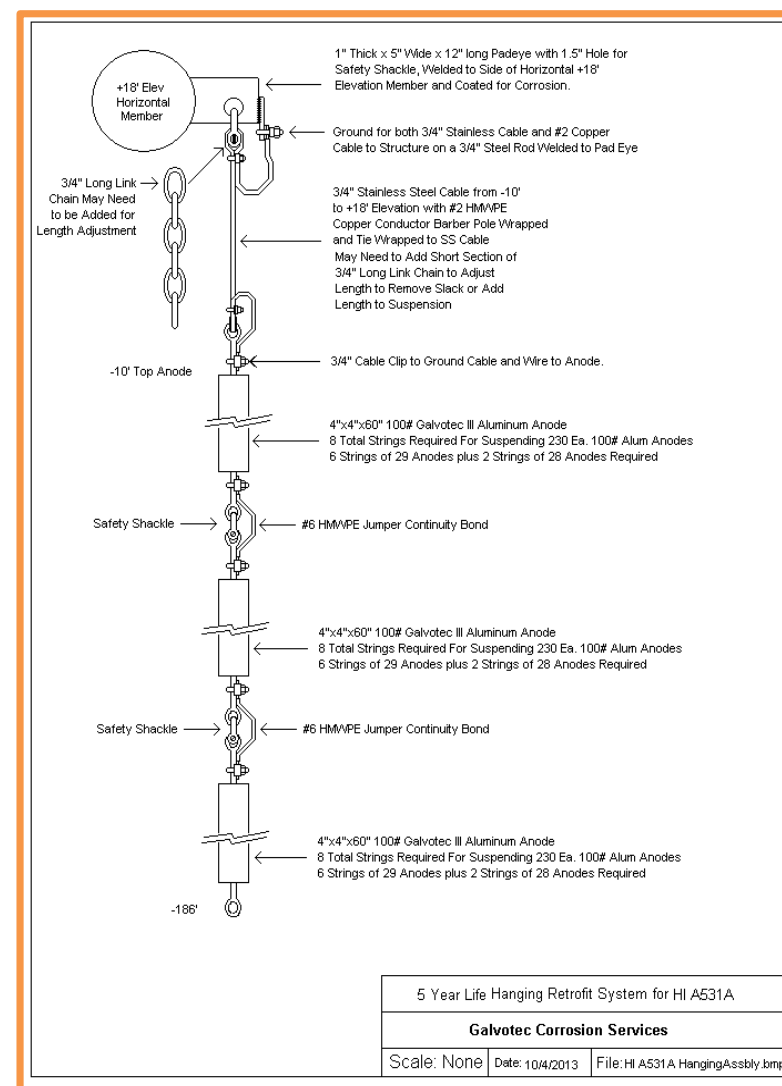
10,350 kg of Galvotec III Aluminum Anode Alloy

Configured as:

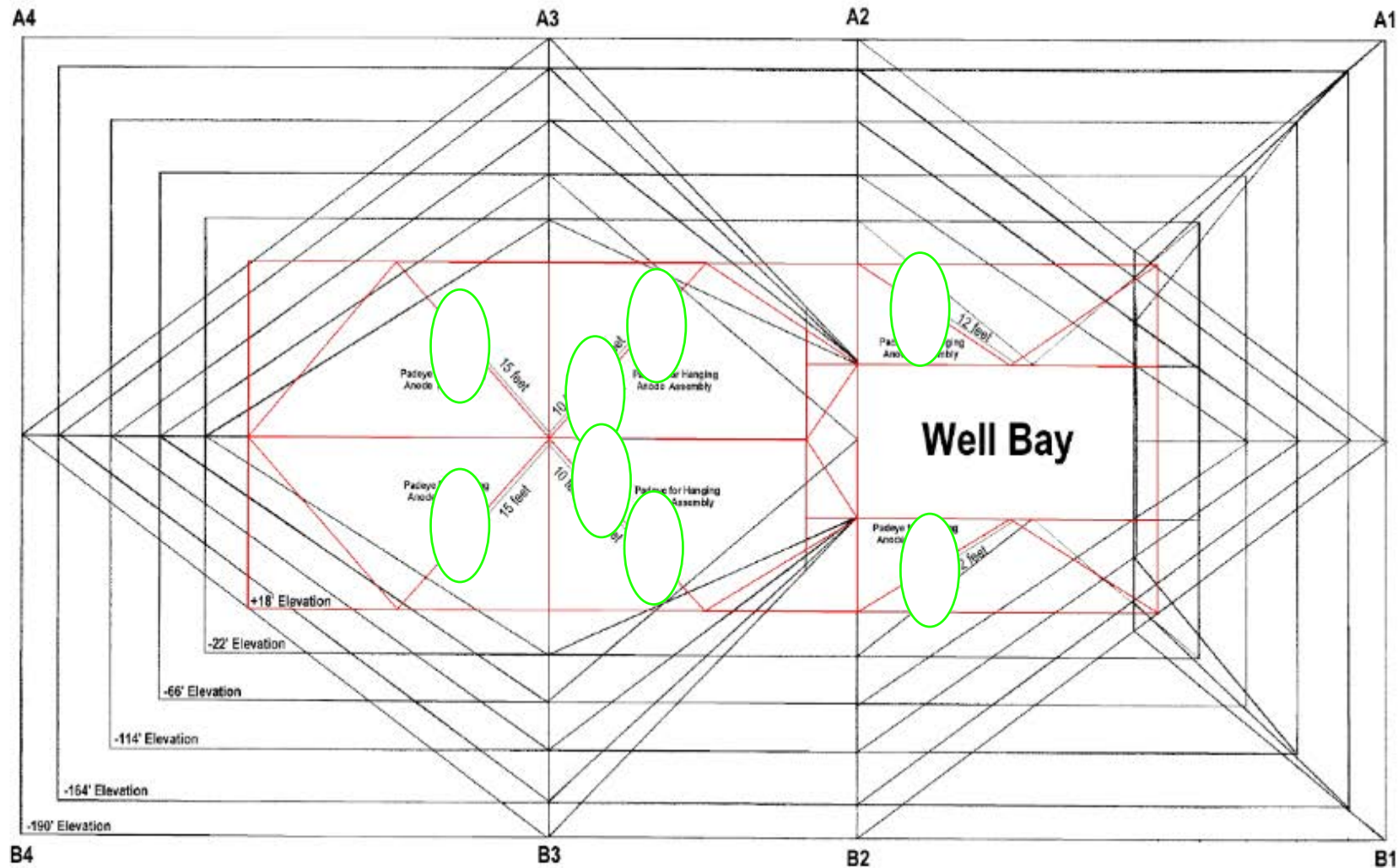
230 Anodes of 45 Kg weight each with a 1.52 m length

Installed as:

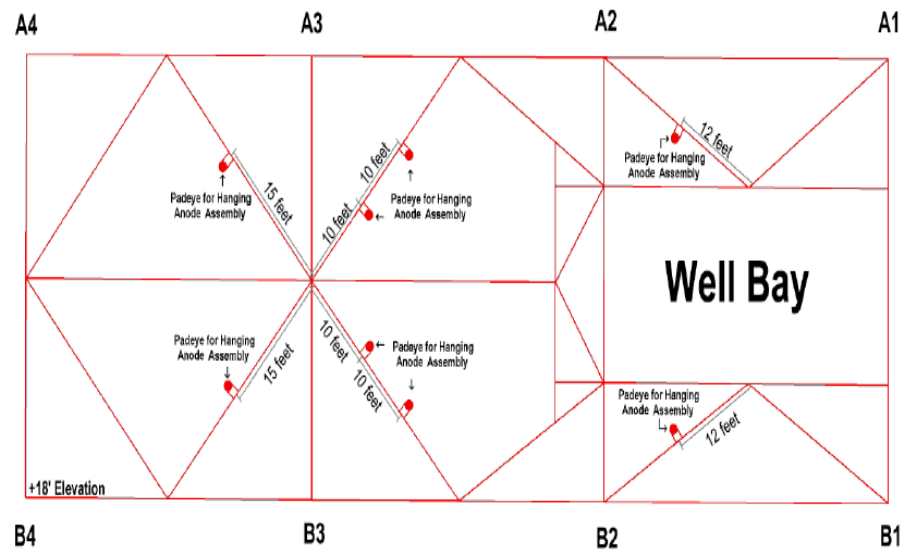
- 8 Galvo-String Anode Assemblies
 - 6 each Strings of 29 anode
 - 2 each Strings of 28 anodes



GALVO-STRING LOCATION



GALVO-STRING INSTALLATION



Installation of Pad Eyes at Predetermined Locations on +5m Elevation

GALVO-STRING INSTALLATION



- Galvo-String is shipped as a complete string on a pallet with suspension and pad eye and all hardware required for installation of the string. Anodes are pre-connected in lengths 5 anodes.

GALVO-STRING INSTALLATION



- *Each section connected to pad eye as next section is connected to it, and then released from Pad eye to be lowered deeper into water.*

GALVO-STRING INSTALLATION



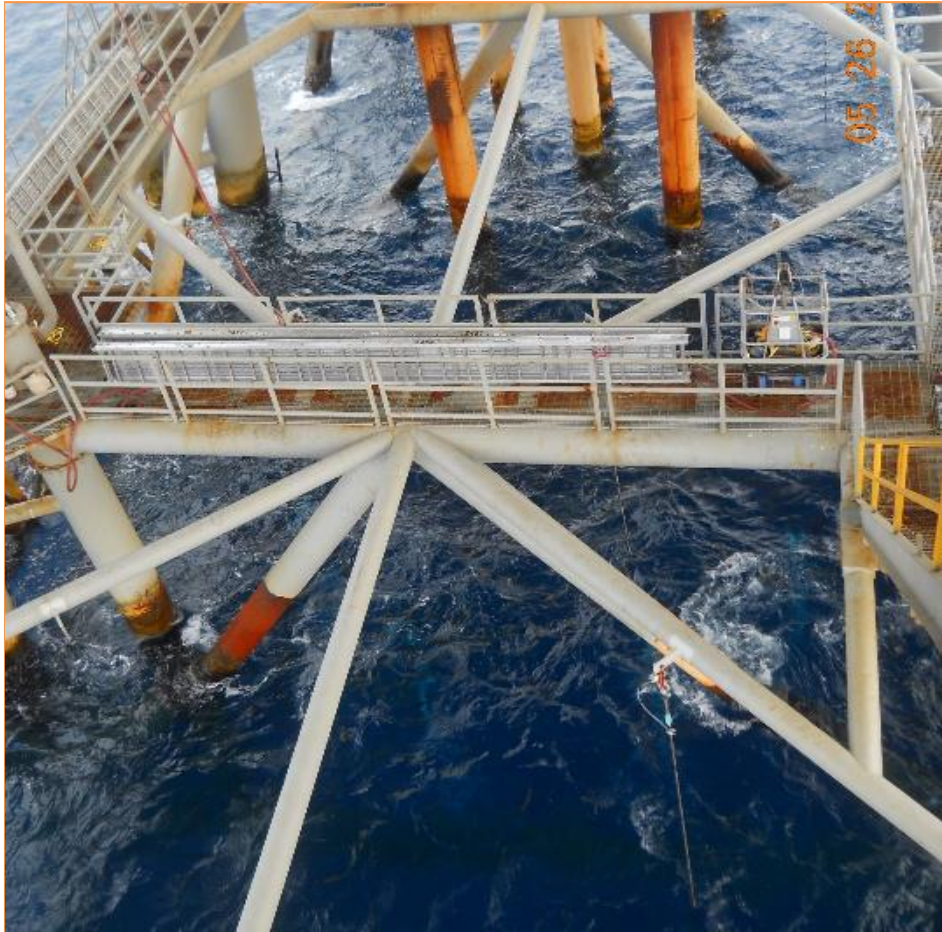
- Connecting string sections together to form total length of string and then connecting the top suspension of string to the +5m pad eye

GALVO-STRING INSTALLATION



- Top of Anode String Connected to Pad Eye To Complete Installation of Galvo-String Assembly
- Connect top of suspension to pad eye and connect cable and wire end to rod on pad eye

GALVO-STRING INSTALLATION



Pre-Installation Survey:

- Cathodic Protection Potentials: - .720 v. to -.788 v.

Post Installation Survey:

- 1 Day after survey - Cathodic Protection Potentials: -.851 v. to -.888 v.
- After 3 weeks - Potentials Continued to Polarize to -.950 v.

All Potentials:

- Silver/Silver Chloride Reference Electrode

- All 8 Galvo-Strings Installed on Jacket +5m Elevation on this 58m Water Depth 8-Pile Jacket

WHY IEV-GALVOTEC ?



We deliver our projects **on time and within budget**

We **combine** experienced **CP design and fabrication** with in-depth **structural analysis** and offshore installation services.

We deliver **disruptive engineering solutions** to offer significant cost savings

We offer a **Complete Product**, from Design to Fabrication, Installation and Commissioning

QHSE is our **main priority** and culture

We provide **detailed operation and installation procedures and reports** as standard

We take part in your planning meetings to ensure **full project participation**

We have **proven capabilities** in diverless CP retrofit

We make use of **local resources** for installation services

We meet all **international standards** for both CP and API.

“COMBINING DISRUPTIVE TECHNOLOGIES AND PROVEN ENGINEERING CAPABILITIES”



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