



**SUBSEA PIPELINE CP RETROFIT
GALVO-ARRAY**

FLASHBACK - ORIGINAL CP SYSTEMS



- Galvanic Anodes On New Lines are Standard System
- 20 – 40 Year Life Systems Normal
- Installed by Thermite Welding or Pin brazing
- Primary Corrosion Prevention System is the Coating
- Anodes for 2% – 5% of Pipeline Surface Area (Holidays)
- Anodes usually installed about 155m (500') apart on average and in the fabrication yard



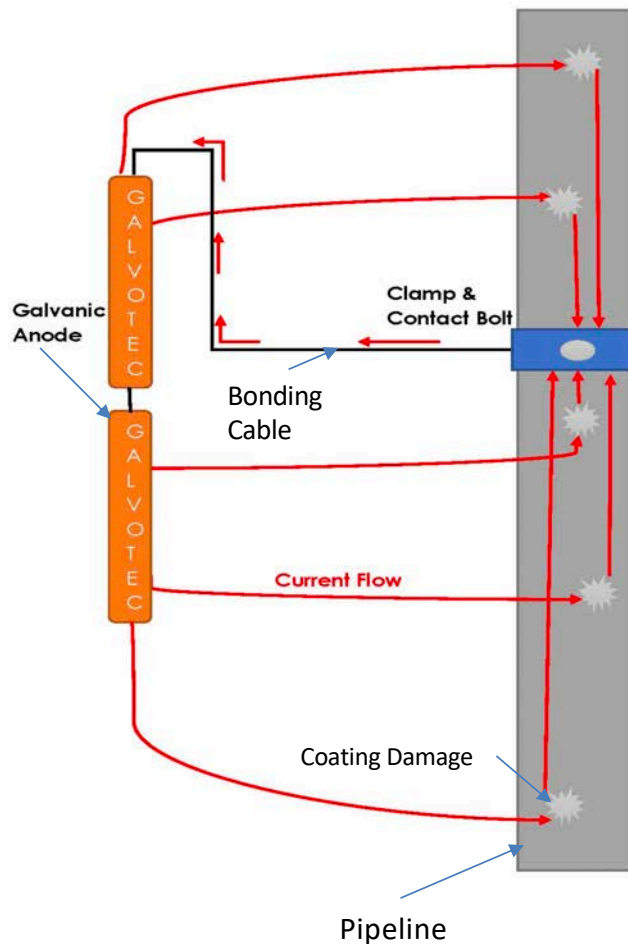
FLASHBACK - ORIGINAL CP SYSTEMS



- Anodes are bonded to pipeline via thermite welding or pin brazing



GALVO-ARRAY CURRENT FLOW DIAGRAM



- No. of anodes and Galvo-Arrays are designed according to **DNV-RP-F103** to suit current demand of pipeline.
- The distance between Galvo-Arrays is determined from the **Attenuation Study** of the pipeline.
- The location of Galvo-Array can be determined from the pipeline CP survey.
- Choice of clamp is selected to suit deployment method, i.e. divers or ROV.
- Galvo-Array is normally designed for a 20-year CP protection.
- The Galvo-Array can be buried for shallow water applications.

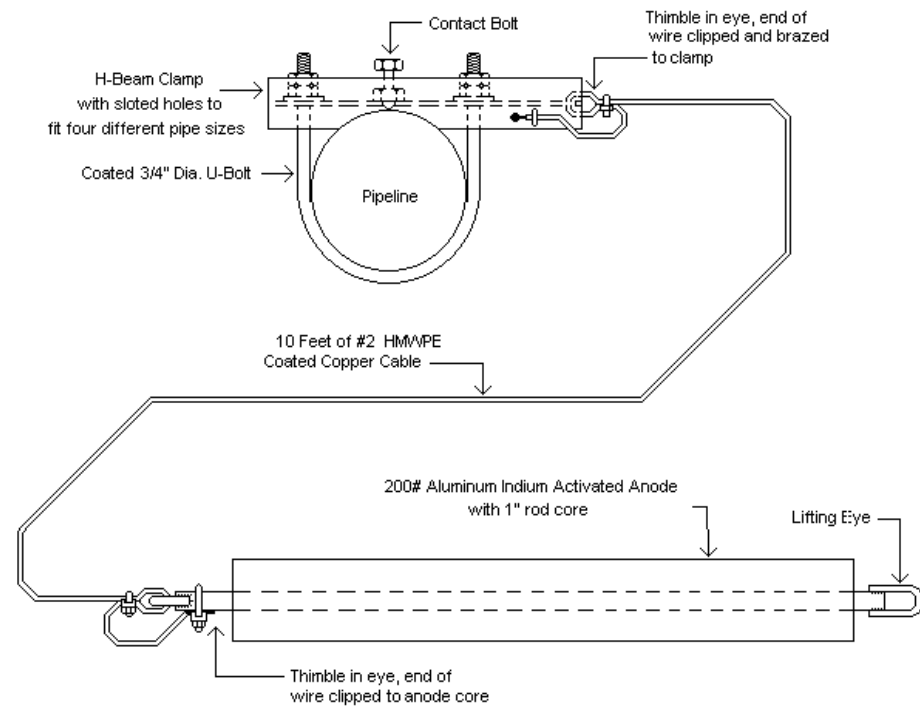
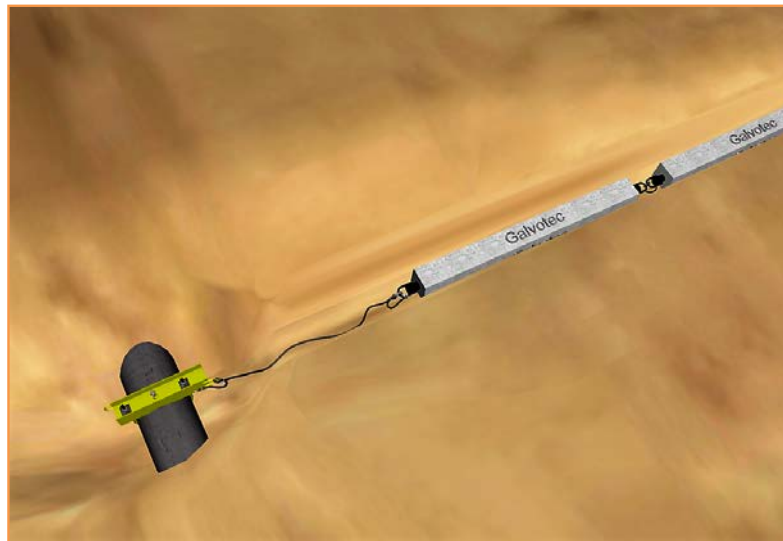
GALVANIC GALVO-ARRAY SYSTEM



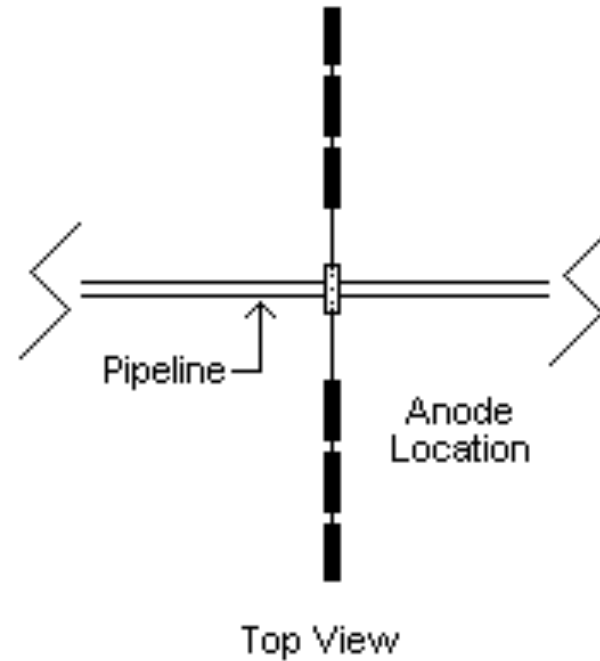
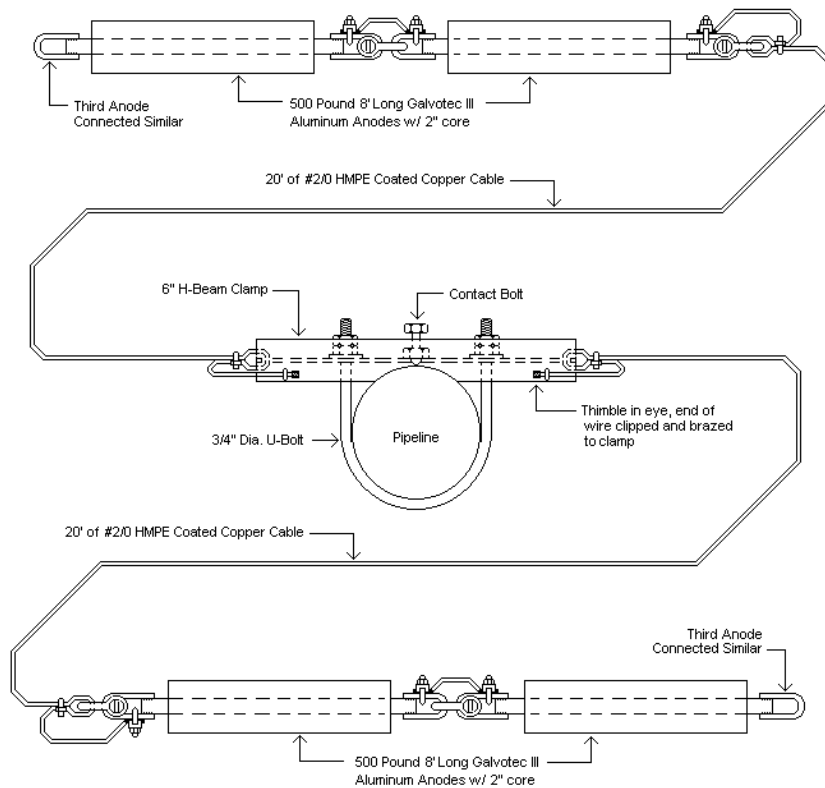
- **Attenuation Study is performed** so Galvo Array Anodes can be Installed **350m to 1km apart**, depending on the Line Diameter and Wall Thickness.
- CP design follows **DNV-RP-F103 - Oct 2010**
- Average design life is **20 years**.
- Anodes 3m long for high current output.
- **U-bolt Clamp** is normally used on **shallow water pipeline** and installed by **divers** while **INMENCO clamp** is used on **deeper water pipeline** and installed by **ROV**.
- A very large number of Galvo Array anodes have been supplied to and installed on pipelines in the Gulf of Mexico over the years for operators including Shell, Chevron, Texaco, Tennessee Gas, BP, Penzoil etc..



SINGLE ANODE ASSEMBLY 3" & 4" lines)



MULTIPLE ANODES ASSEMBLY (For larger lines and greater spacing)



SHIPMENT TO CLIENT SITE



Many GalvoArrays Ready to Ship to Major Pipeline Operators in the Gulf of Mexico.



GalvoArray Retrofit Pipeline Anodes being Readied for 8" Pipeline for a major Pipeline Company. The number on the Anodes is the Line Segment Number the Anodes are to be Attached.



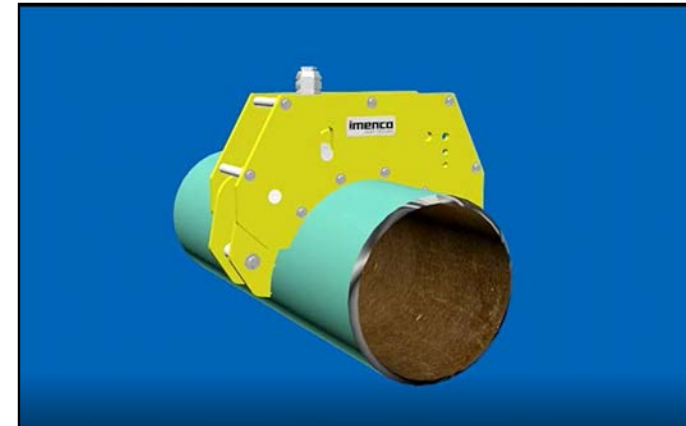
MULTIPLE ANODE ASSEMBLY OPTION



DEEP OCEAN 6-ANODE SLED (> 1,000-meter Depth)



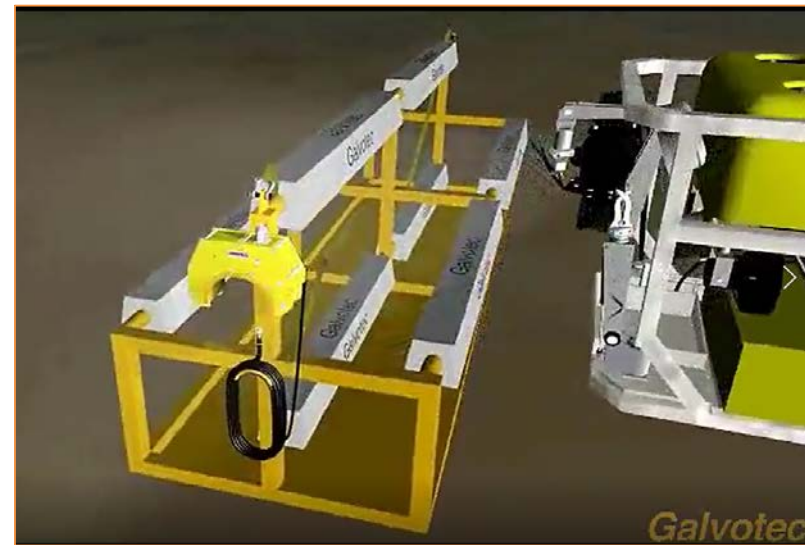
- Galvo-Array Anodes Installed with Imenco Clamp by Diver if gas diving or ROV if deeper



DEEP OCEAN 8-ANODE PIPELINE SLED



- ROV installation of a **Galvotec B Anode Sled** on a deep pipeline using **Inmenco Bonding Clamp**.



TRACK RECORD



Tennessee Gas Pipeline
Company, L.L.C.
a Kinder Morgan company



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