



An Overview of Lockheed Martin Marine Systems



**US Navy Cathodic Protection Conference
January 17 & 18, 2007
Town & Country Convention Center, San Diego, CA**

**Presented by: Dan Stephens, Project Manager
Lockheed Martin Marine Systems**



- **Introduction**

- **Lockheed Martin Marine Systems; San Diego, CA**
- **Provide Design, Manufacture and Support Services for Manned & Unmanned Vehicles, and Subsea Equipment**
 - **US Navy Deep Submergence Rescue Vehicle (DSRV)**
 - **Land-Air Transportation Systems**
 - **US Navy Dry Deck Shelter (DDS) Engineering Support**
 - **Underwater Mateable Connectors & Cables**
 - **Corrosion Protection Products and Services**



Kearny Mesa Offices



Harbor Island Facility (Circa 1970)

- **Lockheed Martin Marine Systems**

- **US Navy DSRV Support**

- In the early 1960s, Lockheed built the submersible Deep Quest to demonstrate to the Navy the capability to produce a manned submersible.
- In early 1970s, Lockheed built & delivered two DSRVs to the US Navy. Lockheed (now Lockheed Martin) continues to provide Operation & Maintenance Services for DSRV and Submarine Rescue Program today.



Deep Quest



DSRV Loading onto Mother Sub

- Lockheed Martin Marine Systems
 - Land-Air Transportation Systems



**DSRV
LTV**



**Mark 5 Special
Operations Craft
Transporter**

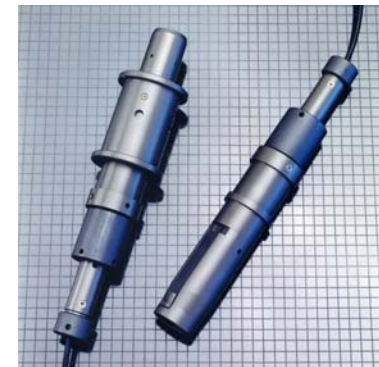


**Space Cargo
Transport System**

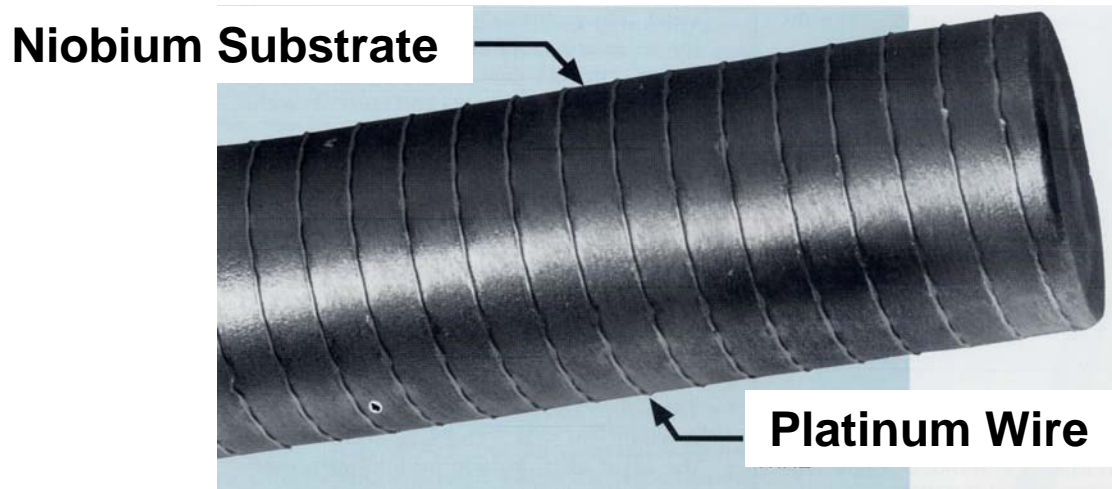
- **Lockheed Martin Marine Systems**
 - **Dry Deck Shelter (DDS) Engineering Support**
 - **Teamed with Oceaneering**
 - **Field Technician Support for Maintenance & Overhauls**



- **Lockheed Martin Marine Systems**
 - **Underwater Mateable Connectors & Cables**
 - **Wetmate Connectors (LM Patents)**
 - True Coax Electrical Wetmate
 - Lockheed CM100 Series; 1980's
 - Electrical Wetmate
 - LM CM 2000 Series; 1997
 - Fiber Optic & Electrical Hybrid Wetmate
 - LM HydraLight Series; 1997
 - **Underwater Cables and Harnesses**
 - Mechanical Terminations
 - Cable Bend Restrictors
 - Rubber & Polyurethane Molded Harnesses
 - Pressure Balanced Oil Filled (PBOF) Harnesses



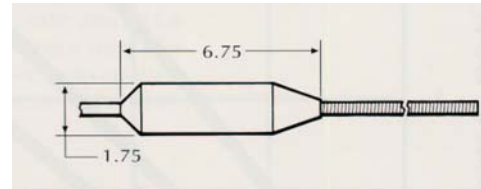
- **Lockheed Martin Marine Systems**
 - **Corrosion Protection Products and Services**
 - **Started at Lockheed Aircraft Services in the early 1960s**
 - ICCP using Lead-Platinum Anodes (1960's)
 - ICCP using Stitch-Welded Platinum-Niobium Rod Anodes
 - Patented in 1970; Still in production today
 - Allows flexibility & reduces inventories
 - Can be configured into many shapes and output currents



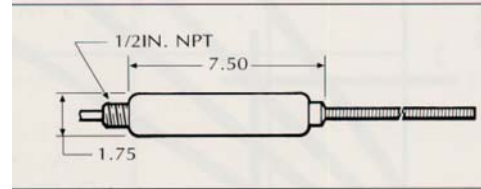
- Lockheed Martin Marine Systems
 - Corrosion Protection Products and Services

ICCP Rod Anode Configurations

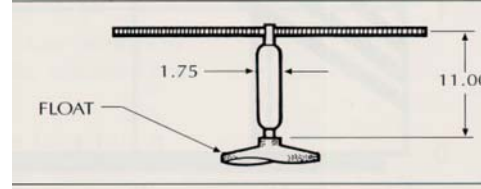
Retractable



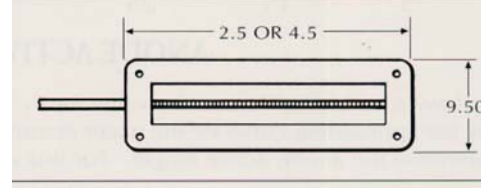
Pier & Pile



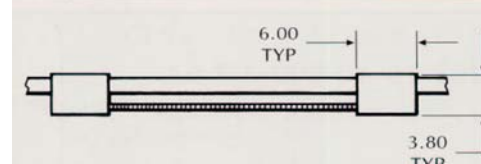
Floating



Ship Hull

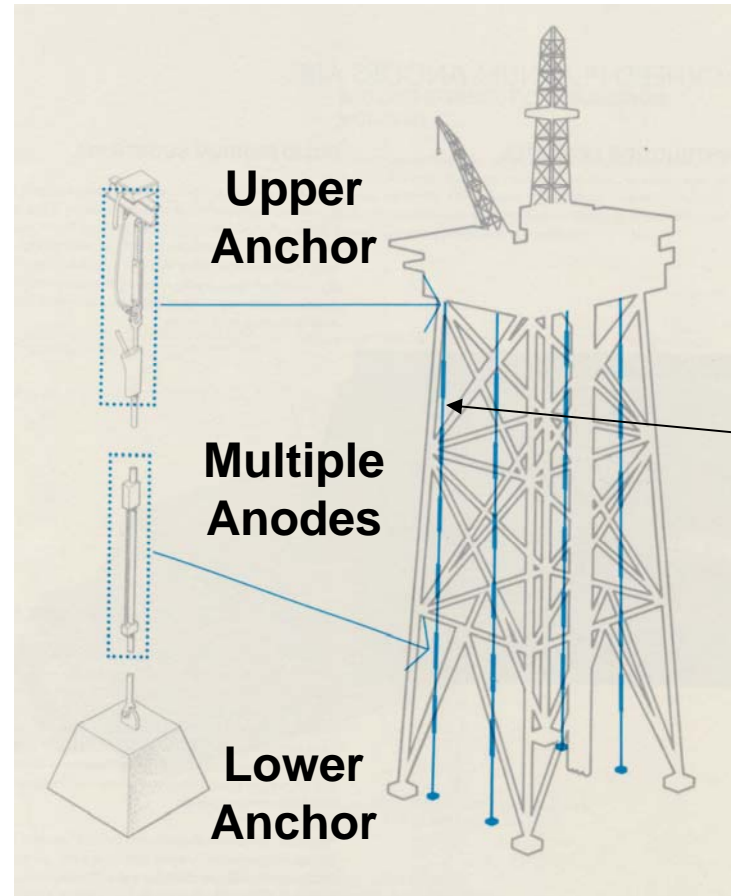
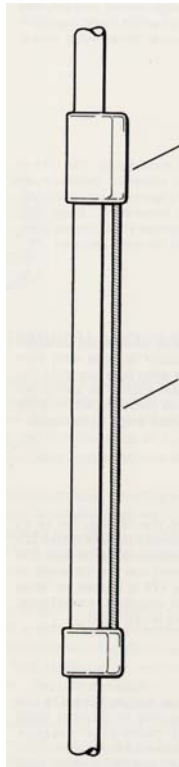


Vertical Tension

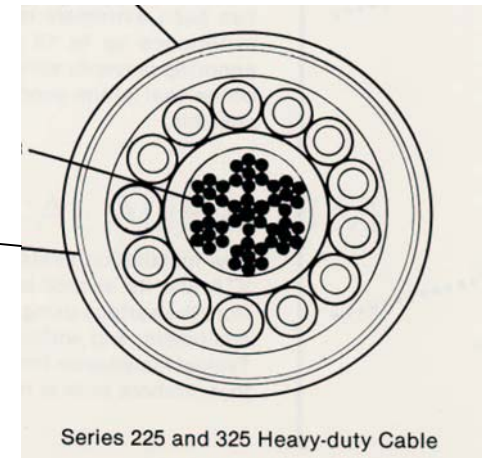


- Lockheed Martin Marine Systems
 - Corrosion Protection Products and Services
 - ICCP Vertical Tension Anode (VTA) Strings

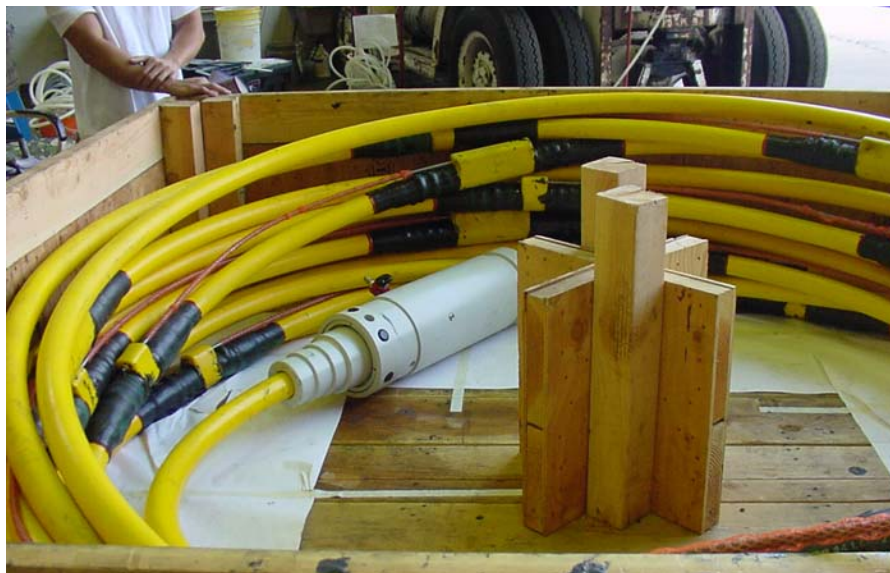
Typical Rod Anode



Suspension Cable



- **Lockheed Martin Marine Systems**
 - **Corrosion Protection Products and Services**
 - **Vertical Tension Anode (VTA) Strings**

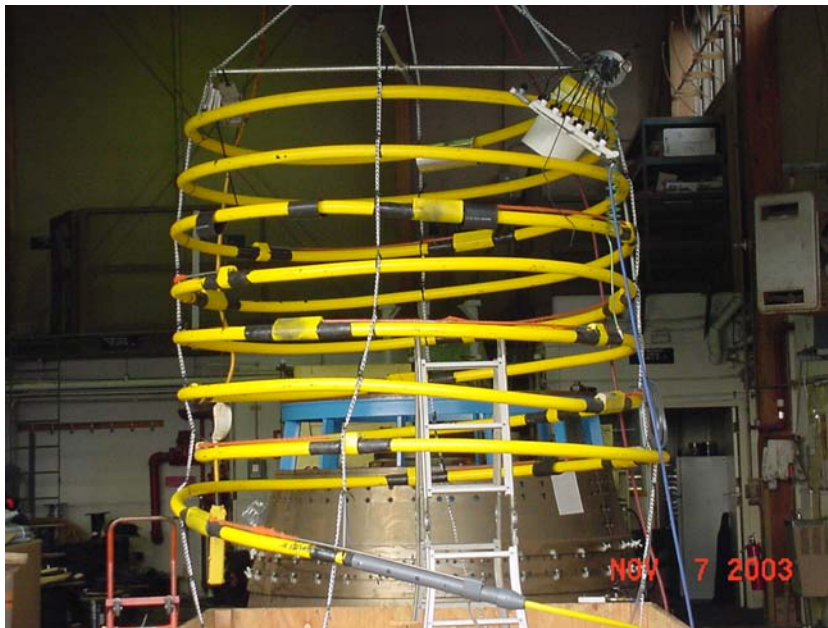


VTA String Boxed For Shipping



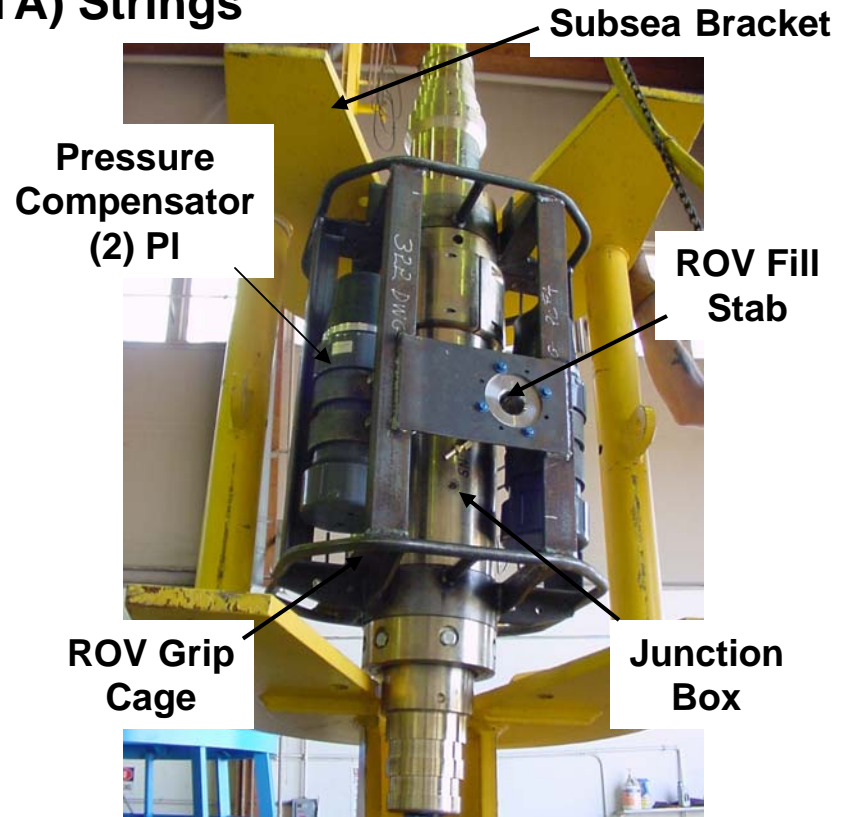
VTA Tension Test Setup

- Lockheed Martin Marine Systems
 - Corrosion Protection Products and Services
 - Vertical Tension Anode (VTA) Strings



Oil Filling of VTA for Pressure Compensation

January 2007



Integrated Power Cable To VTA Junction Box

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- **Lockheed Martin Marine Systems**
 - **Corrosion Protection Products and Services**
 - **Silver/Silver Chloride Reference Cells**
 - Lockheed developed a commercial method for production of Silver/Silver Chloride Reference Electrodes in the mid 1960's
 - LM developed Reference Cell Assemblies with underwater replaceable element in early 1990's for use on SEAWOLF class submarines; same basic design is used on VIRGINIA class submarines
 - LM has continued improvement and refinement of the Plating Process; NRL tests judged LM reference cells performed best over numerous other candidate assemblies

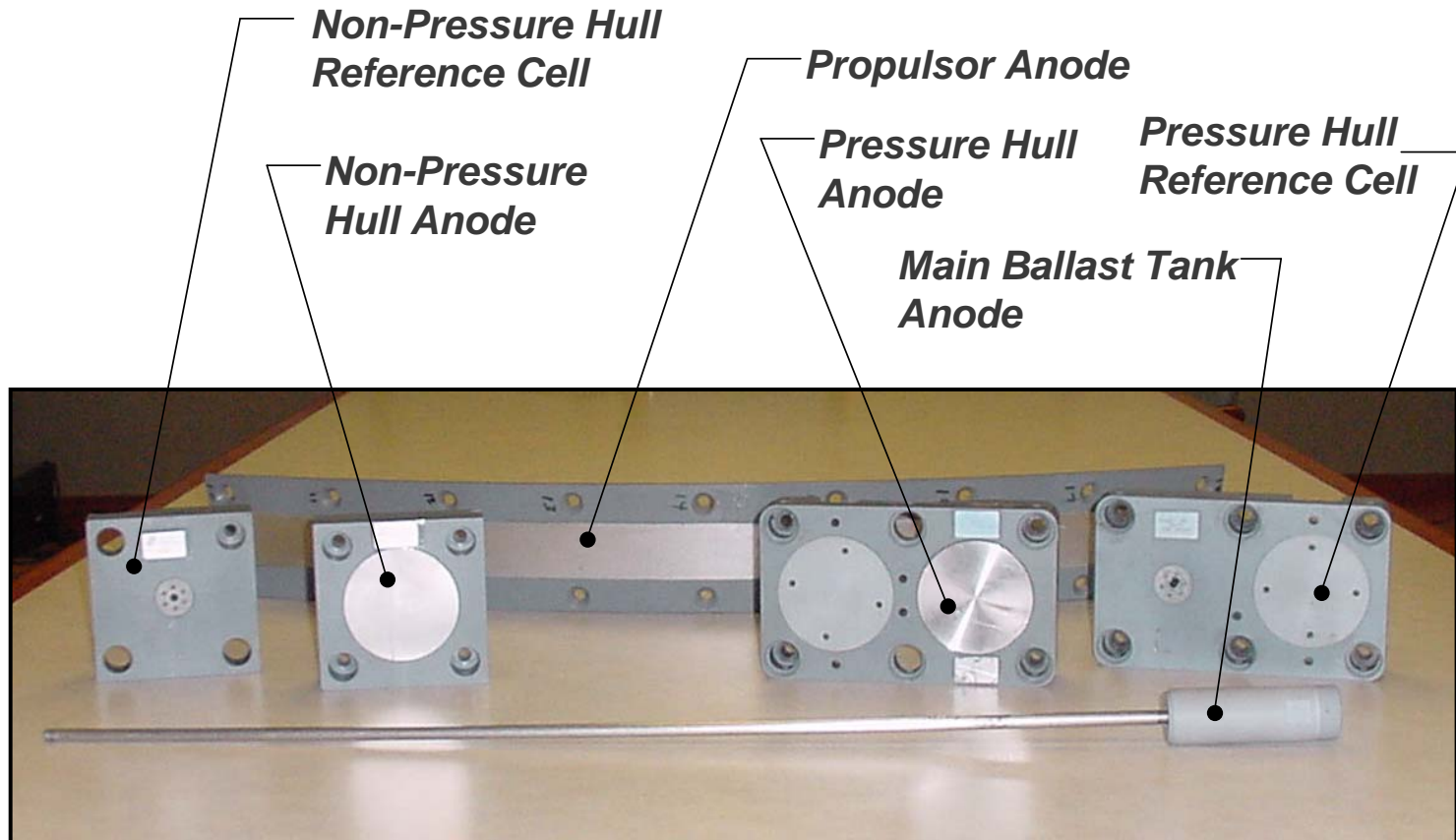


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- **Lockheed Martin Marine Systems**
 - **Corrosion Protection Products and Services**
 - **US Navy ICCP Plate & Rod Anodes**
 - **LM designed and built prototype Hull Anode Assemblies in the early 1990's for NRL development tests on USS MIAMI**
 - **LM designed, qualified and built Hull & Propulsor Anode Assemblies for SEAWOLF class submarines**
 - **LM designed, qualified and built Hull & Propulsor Ballast Tank Rod Anode Assemblies for VIRGINIA class submarines**



- **Lockheed Martin Marine Systems**
 - **Corrosion Protection Products and Services**
 - **VIRGINIA Class ICCP Hardware Production**
 - **Five Ship-Sets of Hardware Delivered; Ship-Sets #6 through #10 Currently in Production**
 - **Non-Pressure Hull Anodes (NPHA)**
 - **Pressure Hull Anodes (PHA)**
 - **Rope Guard Anodes (PA-x)**
 - **Main Ballast Tank Anodes (MBTA)**
 - **Non-Pressure Hull Reference Cells (NPHR)**
 - **Pressure Hull Reference Cells (PHR)**
 - **Outer Structure Outer Diameter Anodes (PAO)**
 - **Outer Structure Inner Diameter Reference Cells (PIR)**
 - **Outer Structure Outer Diameter Reference Cells (POR)**

- **Lockheed Martin Marine Systems**
 - **Typical VIRGINIA Anodes & Reference Cells**





- **Lockheed Martin Marine Systems**

- **Conclusion**

- **LMMS has designed, developed, manufactured and maintained a wide variety of Subsea equipment, not just ICCP equipment**
 - **Our diverse experience allows us to understand the design requirements for ICCP equipment needed to survive the harsh subsea environment**