

OceanWorks International



Subsea Technology

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Harald Grob, P Eng Technical Director

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History of Subsea Technology in Vancouver


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International Hydrodynamics (HYCO)



| DSV | Completed | Depth | Crew |
|--------------|-----------|-------|------|
| PISCES I | 1965 | 1,200 | 2 |
| PISCES II | 1968 | 2,600 | 3 |
| PISCES III | 1969 | 3,600 | 3 |
| PISCES IV | 1971 | 6500 | 3 |
| PISCES V | 1973 | 6500 | 3 |
| PISCES VI-XI | 1975 | 6500 | 3 |

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Introduction to OceanWorks

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OceanWorks International



- Formed 10 years ago as part of a management buyout
- Historically came from Can-Dive and International Hardsuits
- Grew and expanded into multiple subsea markets

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OceanWorks International designs, manufactures, and tests innovative subsea technologies

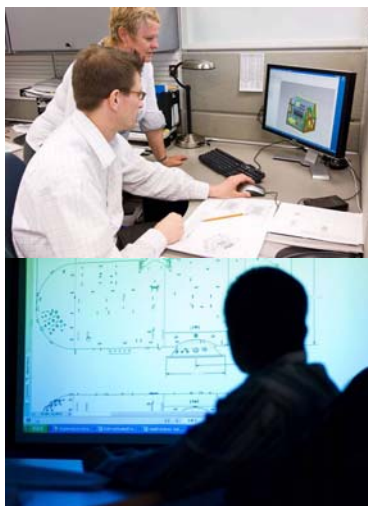
| Projects | Products | Services |
|-------------------------|------------------------|----------------------|
| Technology Development | Standard ROV Tooling | HARDSUIT™ Operations |
| Complex Design/Build | Subsea Cabled Networks | Fabrication Services |
| System Integration | HARDSUIT™ ADS | Engineering Services |
| Sea Trials/Installation | Submarine Rescue | |
| | Softland Connectors | |

- **Markets served:**

-- Oil & Gas -- Military -- Scientific / Environmental

Engineering

- OceanWorks has a mature engineering capability with over 30 degreed engineers on staff in structural, mechanical, and electrical disciplines.
- Engineering Capabilities Include:
 - Mechanical design, 3-D modeling
 - Hydrodynamics
 - Finite Element Analysis
 - Failure mode and reliability analysis.
 - Electrical and electronics design
 - Control system design
 - Software development



Manufacturing Capability

- OceanWorks manufacturing capability includes:
 - ESD safe electrical/electronics assy.
 - Clean room
 - Mechanical assembly
 - Prototyping machine shop
 - High bay assembly area
- As a system integrator, we maintain a well developed network of vendors/subcontractors including:
 - CNC machine shops
 - PCB manufacture
 - Casting and forging suppliers
 - NDT



- Where possible OceanWorks uses proven off-the-shelf technologies in our systems.

Test and Certification

- **Commercial Certifications:**
 - ABS, DNV, Lloyds, Others as Required
- **Military Certifications:**
 - NAVSEA P-9290
 - NAVSEA MAN 010
- **Manned / Unmanned Hydrostatic Testing**

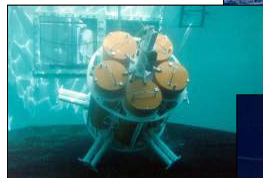
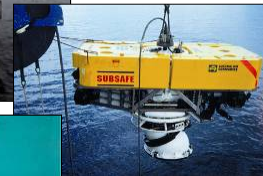


- **ISO 9001 Quality System**
 - 3rd Party Certificate of Registration
 - OWC registered under SAI GLOBAL
 - OWI registered under DNV
 - OWC audited by USN to NAVSEA P-9290 Standards for Manned Submersibles

Military

Submarine Rescue Equipment

- Submarine Rescue Systems
- Emergency Life Support Pod Systems
- Decompression & Ventilation Systems
- Technical, Operations & Maintenance Support



SUBMARINE RESCUE VEHICLE



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- DEPTH - 610 MSW
- PRESSURE HULL – HORIZONTAL CYLINDER
- PERSONNEL CAPACITY – 18 MEN
- HATCHES – BOTTOM HATCH AND END HATCH FOR TRANSFER UNDER PRESSURE WITHOUT SKIRT REMOVAL
- MAIN POWER – 230 HP TOTAL – DUAL HPU
- HOTEL POWER – REDUNDANT SUPPLY
- SPEED - +3 KNOTS
- WEIGHT – 22 TONNES
- CONTROL – DUAL, REDUNDANT TELEMTRY
- FIBER OPTIC
- SKIRT – WEIGHT & DESIGN OPTIMIZED

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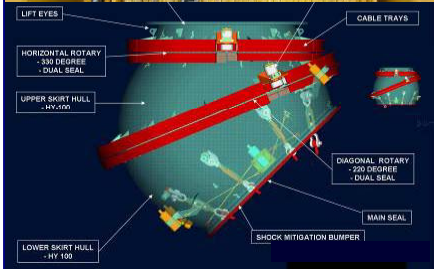

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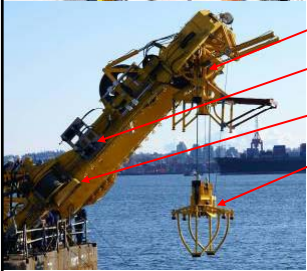
Articulating Transfer Skirt

- Manway to DISSUB
- 2000 ft rated
- 45 degree mating capable
- Detachable for standard transport
- Omnidirectional Approach
- Eliminate complex ballast systems

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Launch and Recovery System


- Active Heave Compensation up to SeaState 4
- A-Frame Assembly
- Overboarding power sheave and Umbilical load Alleviator
- Operator Platform
- Launch Latch Assembly
- Snap Load Alleviator
- Lift Line and Winches
- Cursor Frame

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Atmospheric Diving Systems




- **HARDSUIT™ ADS**
 - QUANTUM 1200
 - HARDSUIT™ 2000
- **Launch & Recovery Systems**
- **ADS Tools and Accessories**
- **Technical, Operations & Maintenance Support**


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| | | | |
|---|--|----------------------|-------------------------|
| DEPTH RATING | 365m / 610m | COMMUNICATION | digital voice over data |
| HEIGHT | 1.9 m (2.2 m) | Hardwire | 25 KHz (8 KHz optional) |
| PILOT ADJUSTMENT | 1.58 m to 1.99 m | Thru-water | |
| WEIGHT (AIR) | 370 kg/600 kg | | |
| WEIGHT (WATER) | 2 to 4 kg | | |
| HULL MATERIAL | aluminum | | |
| PROPULSION SYSTEM | DC Brushless | | |
| Power | 4 x 1.1 HP – 29 kg thrust each | | |
| Foot Control | left - vertical control right - lateral control | | |
| LIFE SUPPORT | | | |
| Oxygen recirculation, fan powered CO2 scrubbing | | | |
| Dual, independent, fully redundant systems | | | |
| Emergency CO2 scrubbing (lung powered) | | | |
| 6 to 8 hr mission, 42 hour back up | | | |
| Atmospheric monitoring | | | |
| Emergency jettisons & systems | | | |

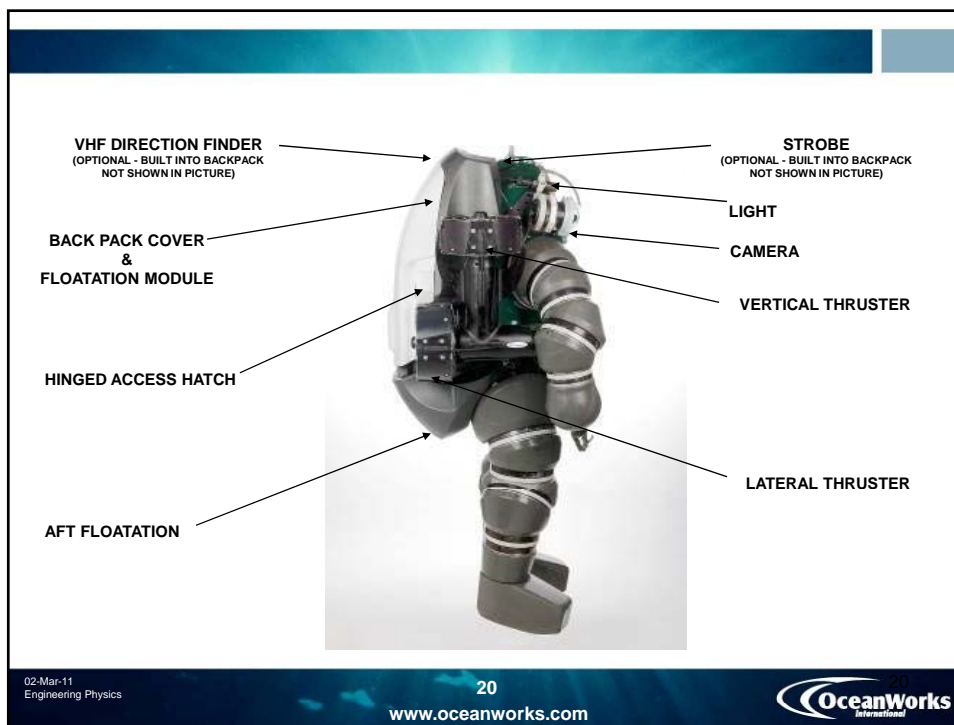
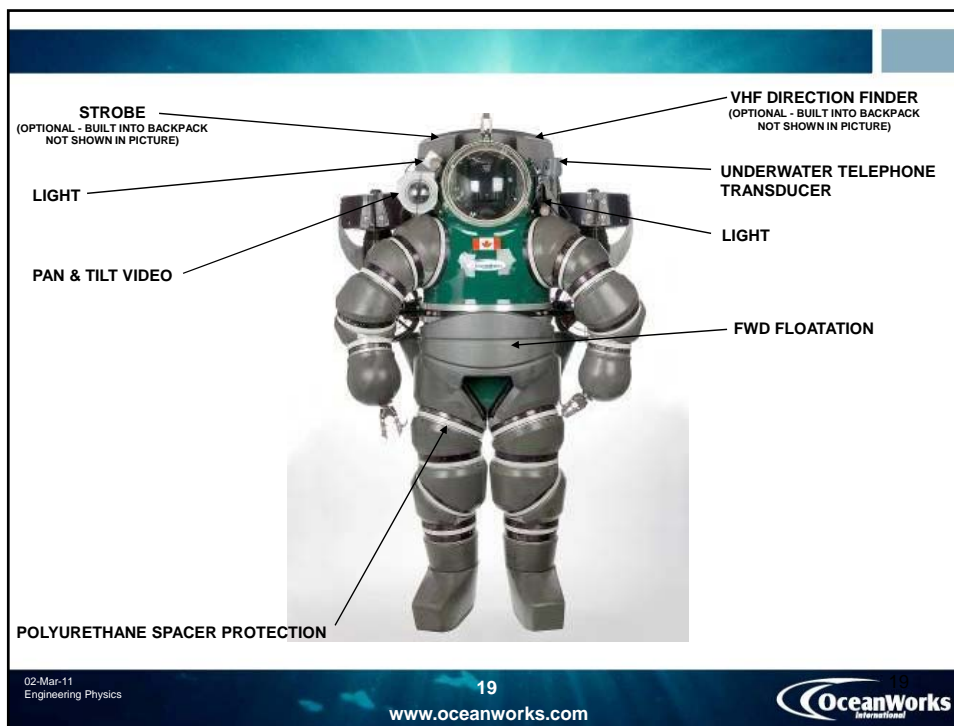


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- Variable Speed – fixed pitch
- 4 x 1.1 HP – 29 kg thrust each
- Variable power setting
- Trim control

DEBRIS SCREEN

WAIST RING & THRUSTER ASSEMBLY

AC TO DC CONVERTER

FOOTPAD CONTROLS

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- Dual dedicated comms lines
- Large screen AMS display
- Mechanical and optional electronic gauges
- Improved, adjustable thruster controls

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Oil&Gas


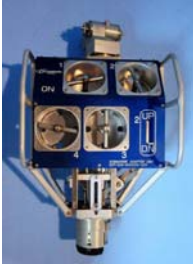
Oil&Gas Custom Projects


- OceanWorks specializes in the design, build, manufacture, and test of complex subsea systems.
- Success of our projects is insured by our extensive subsea and marine experience and established processes in Project Management, Engineering, QA/QC, Manufacturing, Test and Certification.



Oil&Gas Custom Tools


- Custom ROV tooling skids
- Fluid injection skids
- Field development hardware
- Manned submersibles
- Cable and pipeline burial equipment
- Custom launch and recovery equipment
- Special purpose ROV systems
- ROV Stab plates and custom connectors





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Standard ROV Tooling

- Tornado™ Rotary Torque Tool
- Subsea Torque Verification Tool
- ROV Passive Heave Compensation
- Flying Lead Orientation Tool (FLOT)
- Hydraulic Hot Stab
- Well Head Cleaning Tool
- Seal Replacement Tool







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Softland Jumper Connectors

- No running tool required
- Qualified single bolt actuated clamp
- Sizes available from 6"-20"
- ROV powered cylinder extension for removal and reseating
- Hydraulic lines can be cut for one way operation in case of ROV pump/Hot stab failure.
- Misalignment guide of up to 5 deg and 4"
- Integral seal testing capability on mate
- Standard API ROV interfaces



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HARDSUIT™ Operating Services



- OceanWorks offers ADS diving services world wide..
- Four HARDSUIT™ ADS systems with both crane and TMS launch systems available.
- All systems are air transportable, providing rapid and low cost mobilization to any suitable vessel or platform.
- IMCA recognized ADS operations.
- Safe and cost effective alternative to costly saturation diving at depths up to 1200 feet (365 meters).
- Proven track record.

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Scientific



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Subsea Cabled Networks

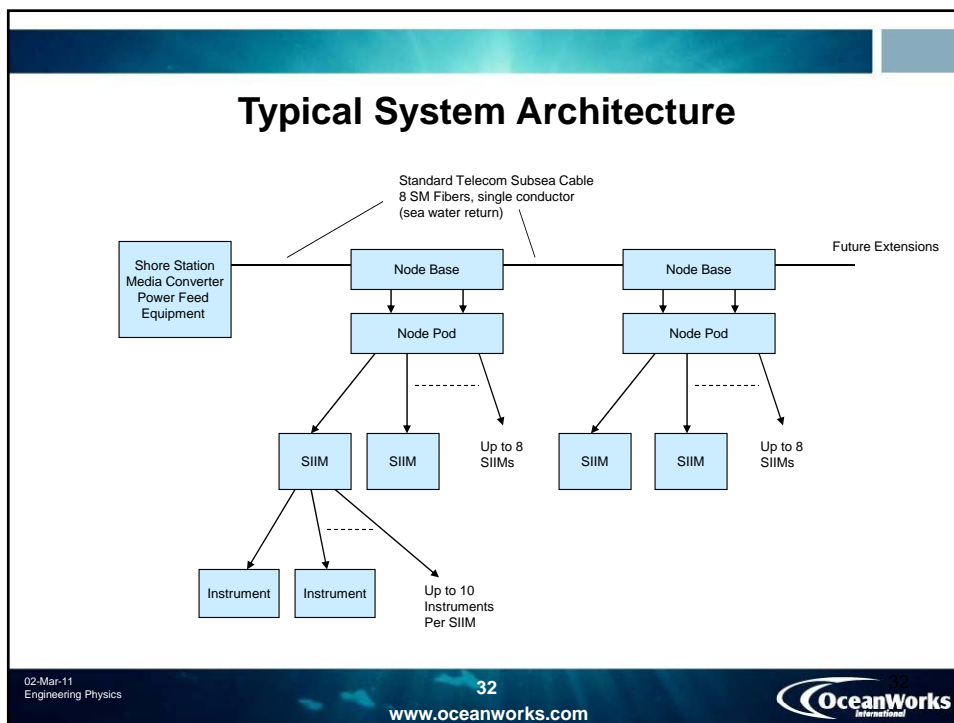
- Since 2005 OceanWorks has been involved in the design and manufacture of high reliability subsea networks.
- Four projects, each building on the capability and experience of its predecessor, have resulted in the development of highly capable subsea networks with proven reliability.
- System capabilities include:
 - Cabled systems with cable lengths on the scale of 100km or greater.
 - High voltage DC power transmission and distribution.
 - Gigabit Ethernet data capability
 - Over 500 qualified instruments for data collection.

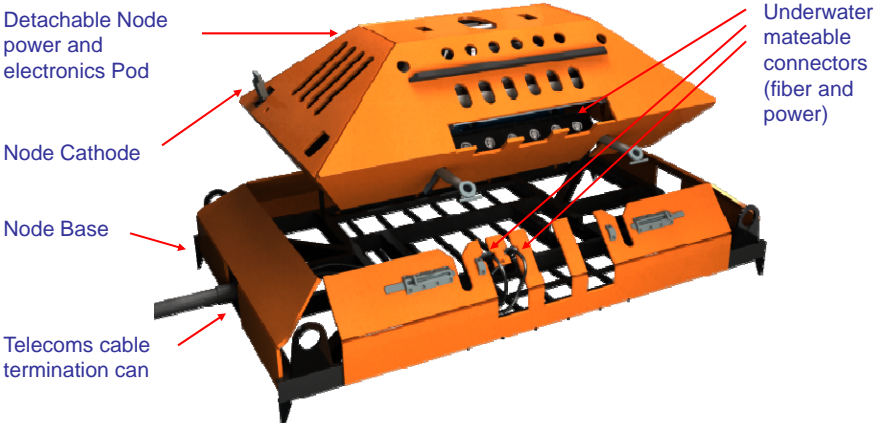
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Node Architecture



Detachable Node power and electronics Pod

Node Cathode


Node Base

Telecoms cable termination can

Underwater mateable connectors (fiber and power)

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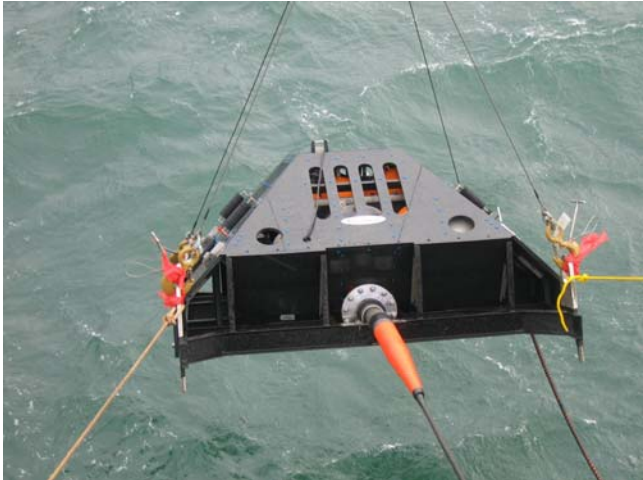


NODES READY FOR DEPLOYMENT

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Node During Deployment


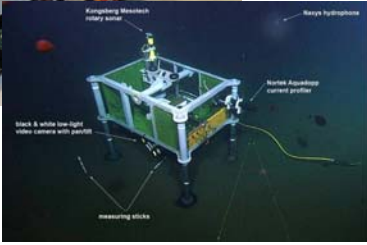
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Science Instrument Interface Module (SIIM)


- 10 instrument connection
- Instrument power distribution to 5.6 kW
- Software configurable ports
 - 8 ports selectable at any voltage between 12-48 VDC at 5amps
 - 2 ports with 375VDC at 5amps
 - Software selectable comms Ethernet, serial 485/422/232
- Ground fault monitoring and isolation
- NTP and PTP compatible
- On board Data logging
- Gigabit uplink and downlink capacity
- 19 Units in operation. Over 200,000 hrs in use. >99.5% availability



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SCIENCE INSTRUMENT PLATFORM WITH SIIM INSTALLED

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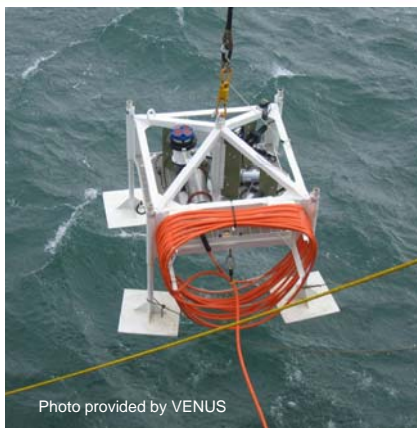


Photo provided by VENUS

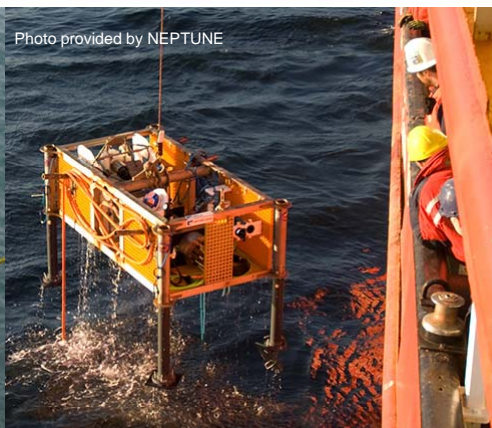


Photo provided by NEPTUNE

SCIENCE INSTRUMENT PLATFORM DURING DEPLOYMENT

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ROV MAKING SIIM CONNECTIONS

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VENUS

- 3 Nodes
- 7 SIIMS
- Depth of 350msw
- First Node installed in Feb 2006
- Strait of Georgia Nodes at 30 and 40km cable lengths
- Up to 1200VDC backpower power supply
- Recoverable electronics pod in Nodes

Photo from VENUS

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NEPTUNE

- 14 SIIMs
- 3000msw rated
- 6kW capable per SIIM
- 10 instruments per SIIM
- Serial or Ethernet Capable on instrument ports
- 12, 15, 24, 48 or 375VDC output to ports
- Over Voltage protection
- 10km from Node
- Sensitive GF monitoring on all ports and inputs
- NTP configured


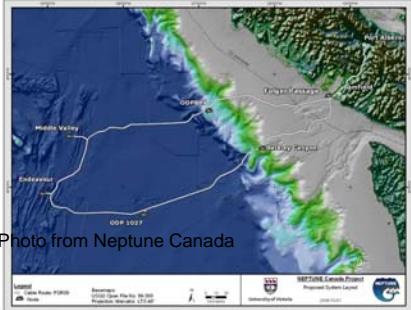




Photo from Neptune Canada

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MCS Harris - TWERC

- 5 Nodes
- 3000msw rated
- 1800VDC backbone voltage
- Up to 65km between Nodes
- 1600W per Node
- 6 ports per Node
- Instrument or SIIM connection available at Node
- Local UPS and data logger
- Skip-a-Node communication infrastructure (single fault tolerant)
- Removal of Node does not affect other Nodes in the Array

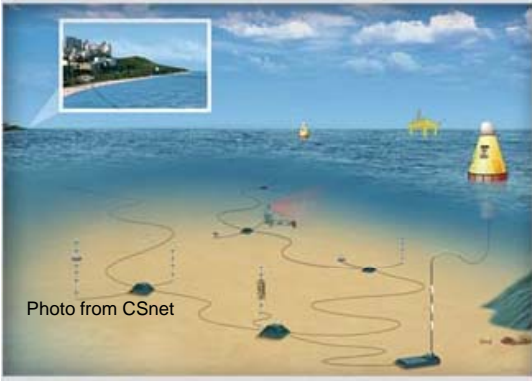

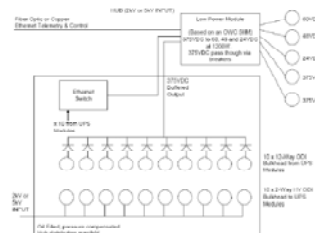


Photo from CSnet

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Subsea UPS

- Allow high power operation on duty cycle.
- Load leveling for operation
- Autonomous power and control for short deployment subsea systems
- UPS modules
 - 150kWh
 - Subsea Charge - 5yr deployment
 - Subsea monitoring and Datalogging - 25yr life
 - Expandable to 1.5MWh
 - Hydrogen Gas production management
 - Military Spec, full qualification testing program



OceanWorks International



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