Systems In Action

Subsea MVDC Power Distribution

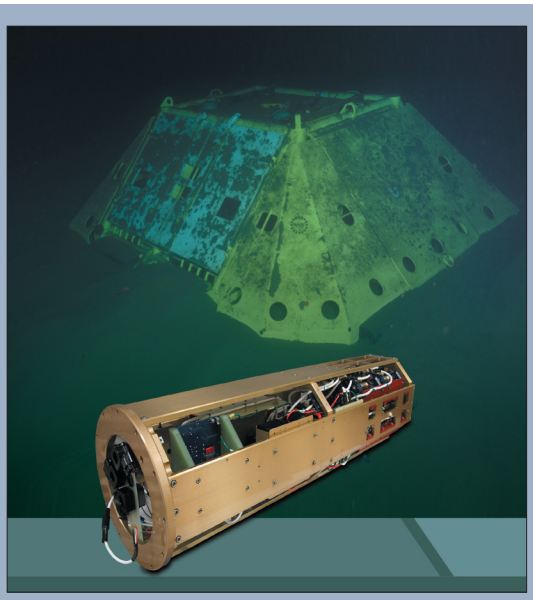
The Regional Scale Nodes (RSN) project is an ambitious effort to provide unprecedented power (10 kW at 10 kVDC) and bandwidth (10 Gbps) to each of several scientific hubs on the seafloor. Led by the Consortium for Ocean Leadership and the University of Washington, and part of the greater NSF Ocean Observatories Initiative, the network consists of a shore station located in Pacific City, Oregon, ~900 km of undersea high power and high bandwidth cable, and seven underwater power distribution terminals. These terminals, called Primary Nodes (sidebar), are located at depths up to 3500 m (2.2 miles) and house DTI power conversion technology, which enables power transfer at 10 kVDC to an array of instruments, providing continuous acquisition of real-time data in one of the world's most inaccessible, difficult-to-study environments.

Data is publicly-accessible at: https://ooinet.oceanobservatories.org/data_access/.

Technology Overview

The core technology within the power conversion node is DTI's high voltage, solid-state switch. Our patented ability to series and parallel semiconductor devices enables DTI's solid-state switches to directly switch voltages up to 200 kV and currents up to 10 kA. This allows for drastically improved system reliability, efficiency, and performance. The RSN switches operate at up to 100 A peak at 10 kV and operate in a full bridge configuration at high frequency (20 – 25 kHz) to minimize the size of the system, while providing sufficient bandwidth for load regulation.

Beyond pure functionality, the most important specification of the converter is reliability. Repair requires not only bringing the converter to the surface, but also lifting several miles of cable off the seafloor (since reconnection must be done dry). Accordingly, the nodes were designed for extreme longevity and resilience, with 90% probability of failure-free operation for 25 years (or a mean time between failures (MTBF) of approximately 2.2 million hours).



Subsea MVDC Power Converter. This 18" diameter pressurized module (foreground) resides within a titanium pressure vessel inside the Primary Node (background) at depths up to 3,500 meters. It converts 10 kVDC to 375 VDC directly on the seafloor for use by a wide range of specialized electronics.

(Photo Credit: NSF Ocean Observatories Initiative, University of Washington, Canadian Scientific Submersible Facility (NSF-OOI/UW/CSSF)

Regional Scale Nodes Power Converter	Product Specification
Input Voltage	10 kV, negative polarity
Output Voltage	375 VDC +/- 5%
Nominal Output Power	10 kW operating, 20 kW designed
Upstream Cable Length	200 - 600 km
Operating Depth	3500 m
Design Life	25 years
Reliability	> 90% over 25 years

Power Feed Equipment for the MVDC Conversion and Transmission System. This system is shore-located and is housed in two 20-foot ISO containers and powered by two 200 kW high voltage power supplies run in parallel.

DIVERSIFIED TECHNOLOGIES, INC.®

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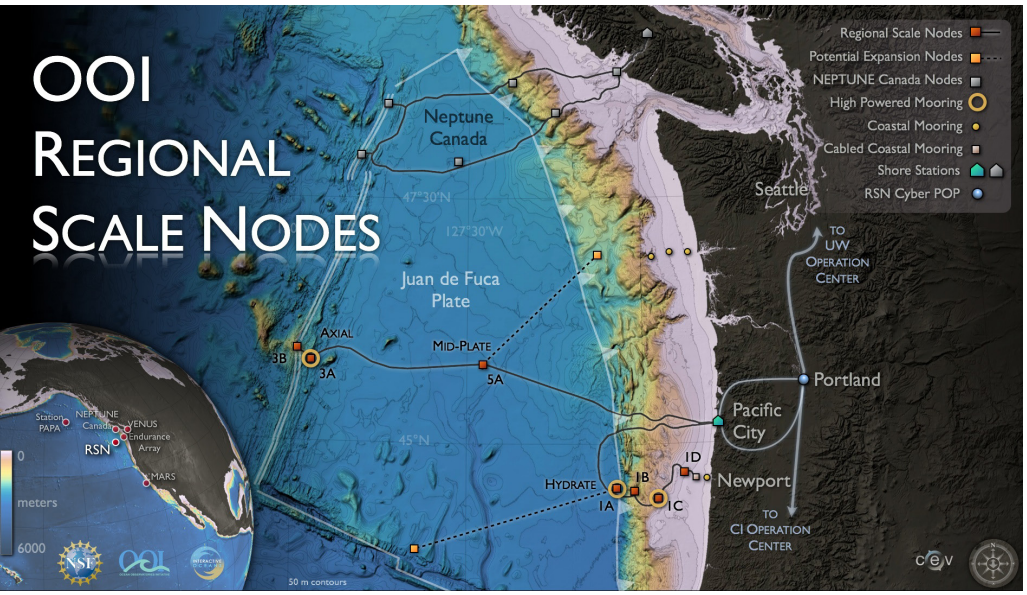

Ocean Observatories Initiative Regional Scale Nodes Network. The ~900 km network provides unprecedented power and bandwidth to the subsea environment.

(Photo Credit: OOI Cabled Array program and the Center for Environmental Visualization, University of Washington.)

DTI has recently developed and patented a Medium Voltage DC (MVDC) Power Branching unit that operates from a telecom-class 10 kV undersea cable, providing power to locally connected cables or systems at any point on the cable.

Systems In Action

PowerMod™ High Voltage Solid-State Switches. Consisting of IGBTs in series, DTI's patented technology is inductively driven to ensure that the stack acts as a single switch. Each IGBT is fixed to a heatsink which visibly extends from the plate.

Located in Greater Boston, DTI employs a dynamic team of electrical, mechanical, and aeronautical engineers, physicists, and system analysts with decades of experience designing and developing multi-megawatt solid-state power supplies, modulators, and advanced military radar systems.

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