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 an array of low voltage equipment instruments to provide continuous acquisition of real-time data in one of the world's most inaccessible, difficult-to-study environments.

Technology Overview

Central to the technology within the power conversion node is DTI’s high voltage, solid-state switch. Enabled by the patented ability to series and parallel semiconductor devices in large numbers such that no single device is subjected to full voltage, DTI's solid-state switches are capable of directly

Subsea MVDC Power Converter. This 18" diameter pressurized module (foreground) resides within 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)

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 kV high voltage power supplies run in parallel.

Regional Scale Nodes Power Converter | Product Specification
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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
switching voltages up to 200 kV and currents up to 10 kA. This allows for drastically improved system reliability, efficiency, and performance. The RSN switches can withstand 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 lifting as much as several miles of cable off the seafloor (reconnection must be done dry). Accordingly, the nodes were designed for extreme longevity and resilience, with 90% probability of operation for 25 years (or a mean time between failures (MTBF) of approximately 2.2 million hours).