Development of Methods for Attaching Cable Protective Tubes and Laying Cables, As Well As the Foundational Technologies Development for New Cable Laying Vessels

Multi-purpose and Multi-terminal Transmission System,
HVDC, subsea cable protection, cable laying/jointing/burial vessel

Overview

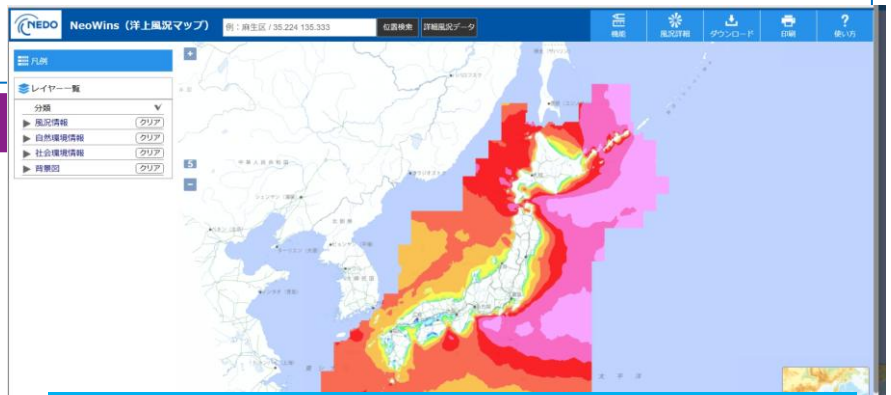
Developing Multi-Terminal HVDC Technology for a Resilient Energy Future

To achieve the government's target of sourcing 40–50% of energy from renewables by around 2040, we are advancing multi-terminal high-voltage direct current (HVDC) technology. This innovation supports the large-scale integration of renewable energy and enhances the resilience and stability of energy supply.

Background

Challenge: Long-Distance Power Transmission from Offshore Wind

Promising sites for offshore wind power—expected to expand significantly in the coming years—are often located far from major demand centers. This creates a pressing need to enhance transmission infrastructure. In particular, floating offshore wind, seen as a key to expanding renewable energy, requires advanced long-distance subsea transmission technologies to deliver power to the onshore grid. Projects such as the planned 800 km interregional HVDC link from Hokkaido and Tohoku to Niigata highlight the importance of developing robust and efficient transmission systems.



NEDO NeoWins (Offshore Wind Power Potential)

Societal Issues

Technical Challenges in Subsea Cable Installation

Japan's complex seabed conditions—such as rocky areas where burial is difficult—pose significant challenges for subsea cable installation. In such regions, protective casing is often required, leading to longer construction periods and higher costs. To address these issues, it is essential to develop cost-effective cable protection methods, as well as specialized cable-laying vessels and outfitting systems tailored to Japan's unique marine and weather conditions.

NEDO Project

Research and Development of a Multi-purpose and Multi-terminal HIGH Voltage Direct Current Transmission System

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Renewable Energy Department
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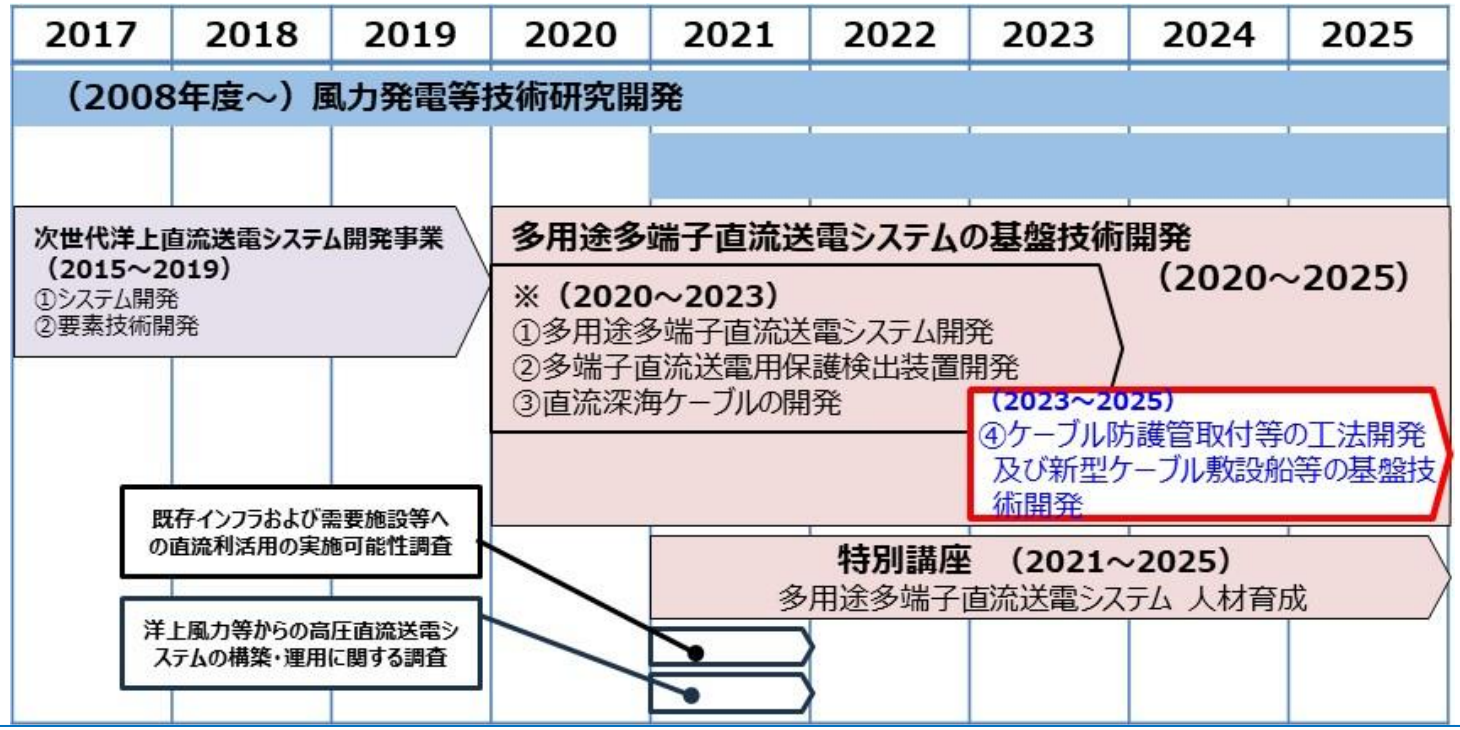
NEDO Projects

Advancing Subsea HVDC Cable Installation for Long-Distance Power Transmission

Subsea high-voltage direct current (HVDC) transmission is a promising solution for delivering large amounts of power over long distances. To make this approach more practical and cost-effective, we are developing advanced cable protection methods and specialized cable-laying vessels. These innovations aim to reduce construction time and lower overall project costs.



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Development of Deep-Sea HVDC Submarine Cables for Long-Distance Transmission

Developing Cables to Meet Demanding Environmental and Technical Conditions

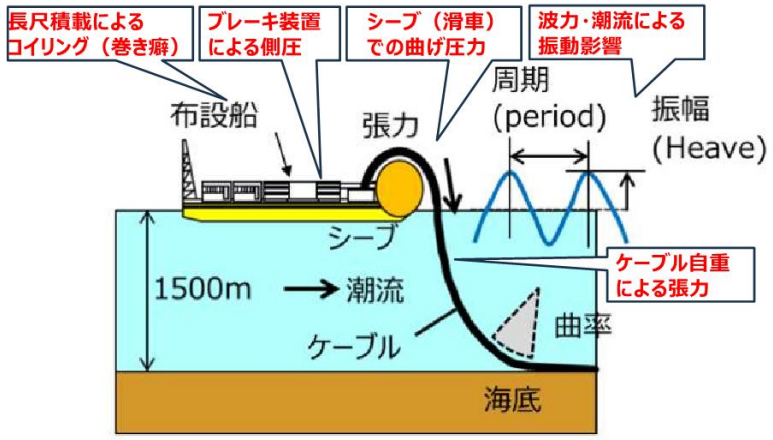
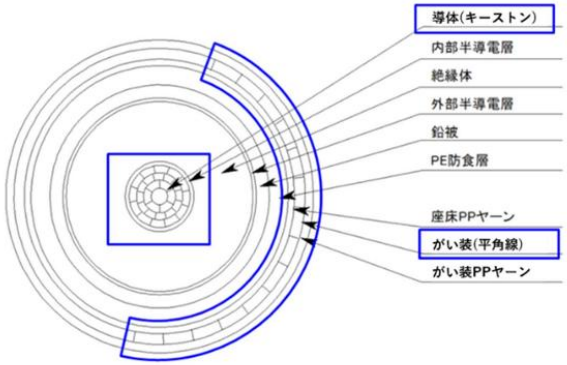


Exhibit:Cross-Section Model of a Submarine HVDC Cable

Single-Core HVDC Cable for 1500m-Class Deep-Sea Deployment

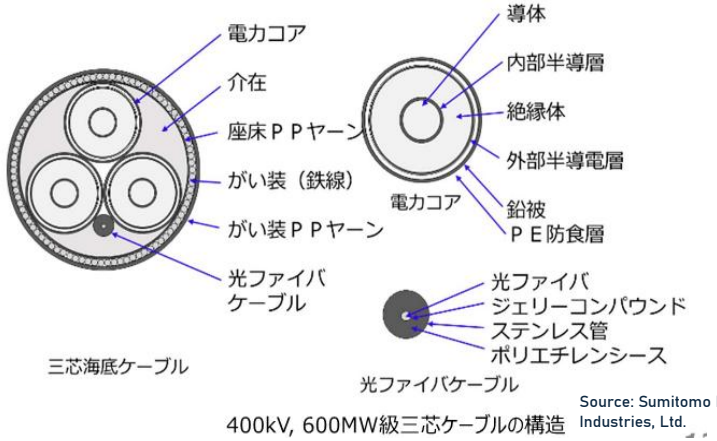


525kV,1GW級単芯ケーブル構造
（キーストン構造素線）

Source: Furukawa Electric Co., Ltd.

- ✓ Reduced Conductor Diameter through Enhanced conductor packing efficiency
- ✓ Weight Reduction through Aluminum Conductors
- ✓ Optimized Sheath Design via Installation and Structural Analysis

Three-Core HVDC Cable for 500m-Class Subsea Applications



400kV, 600MW級三芯ケーブルの構造

Source: Sumitomo Electric Industries, Ltd.

- ✓ Higher Voltage with Reduced Diameter and Weight
- ✓ Application of Single-Layer Steel Wire Armor
- ✓ Structural Optimization through Tension Distribution Analysis
- ✓ Improved Installation with Integrated Three-Core Design

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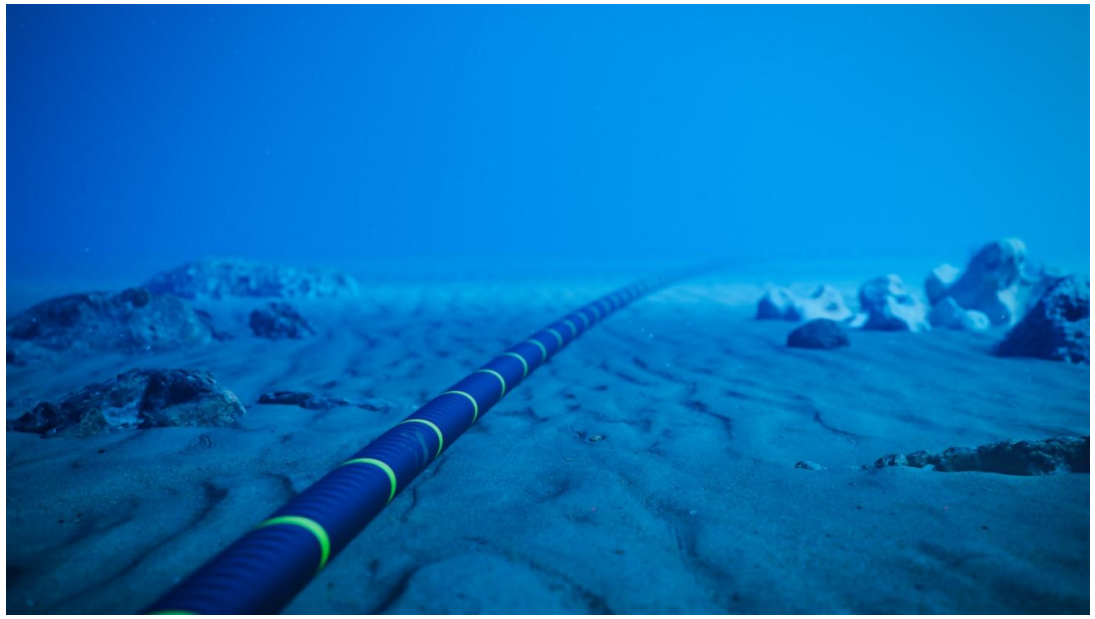
Development of Cable Protection Methods

Protecting Subsea Cables from External Damage

We are developing multiple cable protection methods such as cable burial, rock placement and protective conduits to prevent damage from ship anchors, fishing gear and other external factors.

These methods are tailored to various marine conditions and help ensure the long-term safety and reliability of subsea power transmission.



https://oecops.com/

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Development of Rapid Protective Conduit Installation

Conventional Methods

Traditional methods of attaching protective conduits to subsea cables required extensive manual labor and significant time. This labor-intensive process increased construction periods and costs.

Exhibit: 1/5 Scale Model of Protective Conduit

Source: Sumitomo Electric Industries, Ltd.

Development Results

Automated High-Speed Conduit Installation with Optimized Protective Conduits and Specialized Installation Equipment
As a result, the new system achieves three times the installation speed compared to conventional methods, while significantly reducing labor requirements.

(Video)

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Development of a Rock Placement System for Deep-Water Applications"

We are developing a method to cover cable joints—typically vulnerable points—with rock to protect them from damage caused by anchors, fishing gear, and other external factors. This method is being designed with the assumption that the joints may be located on the seafloor at depths of up to 300 meters.

Source: Furukawa Electric Co., Ltd.

Exhibit: Miniature Model of the Crushed Stone Placement Device

Ocean Validation Trial off the Coast of Matsumae(Video)

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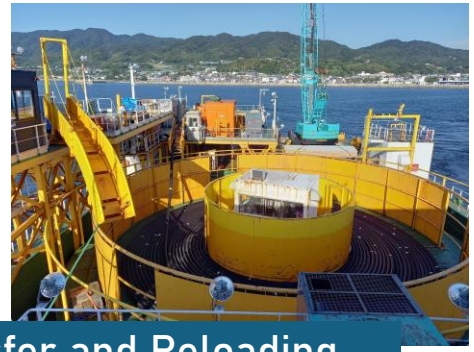
Verification of Cable Laying Accuracy



Cable Transfer and Reloading

Cable Line

Cable Tensioner

Stern Sheave

ケーブル敷設精度の検証を
淡路島沖の海域にて実施しました

Towing of the Barge

Monitoring of Cable Laying Conditions Using an ROV(Video)

ROV

Source: Sumitomo Electric Industries, Ltd.

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Development of Vessels for Cable Laying, Jointing and Burial Operations

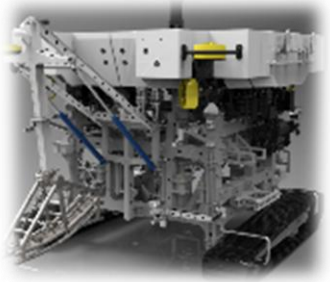
We aim to establish a standardized specification for the basic design of work vessels (including outfitting and equipment) that can accommodate Japan-specific oceanographic and meteorological conditions, as well as the required cable installation methods—such as protection, jointing, and laying control—and are capable of handling cables from multiple manufacturers.

Source: :NYK Line

Source: Mitsui O.S.K. Lines, Ltd.

Burial Vessel

Cable Burial Machine



Cable-Laying Vessel

Cable Capacity: 7,000 tons (approximately 70 km)
Crew: Approximately 100 personnel
Station-Keeping: Dynamic Positioning System (DP System)

Jointing Vessel

Cable Capacity: 2,500 tons × 2 reels
Crew: Approximately 90 personnel
Station-Keeping: Dynamic Positioning System (DP System)

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Development of Vessels for Cable Laying, Jointing and Burial Operations

We conducted a water tank test using a scale model of the cable-laying vessel to validate the design feasibility.

To confirm and refine the vessel design, a 1/30 scale model (about 5 meters long) was tested in a 300-meter-long towing tank with wave generation, allowing observation of its motion and performance.

(Video)

Source: :NYK Line

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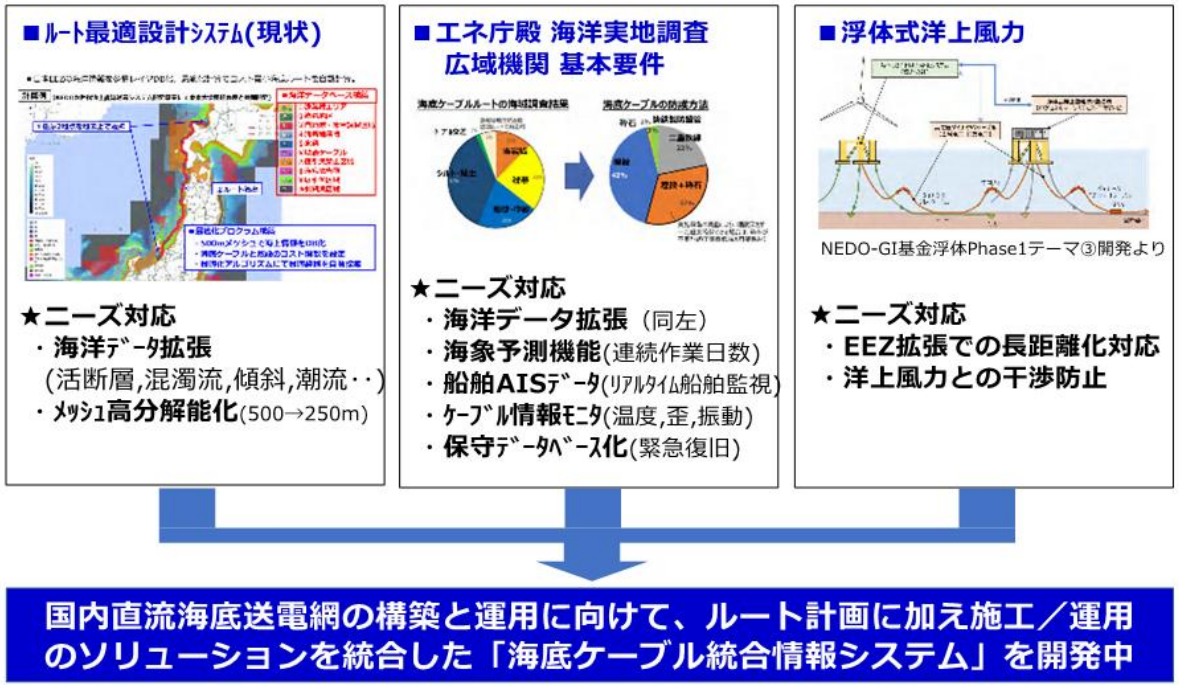
Development of Unified Cable Route Management System



Information Display Currently Under Additional Development

Vessel AIS Information
- Vessel Name
- Longitude / Latitude
- Speed Over Ground (SOG)
- Course Over Ground (COG)
- Destination
- ETA (Estimated Time of Arrival)
- Track

10-Day Oceanographic and Weather Forecast Data
- Wave Height
- Current Direction and Speed
- Wind Direction and Speed
- Weather, Atmospheric Pressure, Temperature,
- Precipitation Visibility Range

Demo in Progress

Source: Sumitomo Electric Industries, Ltd., “Initiatives and Challenges of Future Wide-Area Networks in the Era of Large-Scale Renewable Energy Integration,” 2025 Electric Power Council Research Conference

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Initiatives for Domestic and International Expansion and Future Adoption

- Currently, planning processes are underway for the wide-area interconnection systems in the eastern and central-western regions of Japan. The outcomes of this development are expected to contribute to the future expansion of offshore wind power and the realization of grid enhancements based on the national master plan.
- As floating offshore wind and renewable energy in island regions continue to grow, we aim to promote the application and implementation of multi-terminal HVDC (High Voltage Direct Current) transmission systems as an efficient infrastructure solution. This will be achieved through active communication and promotion of our development results to relevant stakeholders both domestically and internationally.
- In Europe, subsea cable damage incidents have occurred frequently, and with the anticipated increase in submarine power transmission cables in Japan, there is a growing need to enhance technologies for maintenance, inspection, operation, and restoration. A feasibility study (FS) is planned to assess the business potential of addressing these needs.
- NEDO is committed to supporting the social implementation of HVDC transmission systems to contribute to the expansion of renewable energy—particularly offshore wind power—toward achieving carbon neutrality by 2050.

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