Close and Return



# Installation of HVDC submarine cables in harsh environments: Focus on Strait of Belle Isle Marine Cable Crossing for the Lower Churchill Project, Canada

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## ABSTRACT

*In 2016, Nexans successfully installed submarine cables across the Strait of Belle Isle between Labrador and Newfoundland in Canada. Given the combination of environmental challenges (ice, icebergs, pack ice, sea currents, cold temperatures), geological challenges (rock sea bottom, ledges and steps, large water depth changes), external influences (fishing and vessel traffic) and environmental sensitivities , the crossing is one of the most technically challenging seabed crossings globally.*

## KEYWORDS

Strong currents, Ice Bergs, Cold Temperature, Polar Low Pressures, long pull-ins, submarine cable installation.

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## GENERAL

Nalcor Energy awarded Nexans Norway AS the contract of production, transport and installation of 3 submarine cables for the Strait of Belle Isle Marine Cable Crossing (SOBI) project. SOBI is a component in the Labrador Island Transmission Link as part of the Lower Churchill Project located on the East Coast of Canada. The marine crossing consists of three high voltage DC (HVDC) cables from Shoal Cove, Newfoundland, to Forteau Point, Labrador.


**Figure 1: Strait of Belle Isle**

This link has been on the drawing board for over 50 years.

Some of the challenges for completing the Project include ice berg movements in the area, short installation windows and weather conditions.

## ICE BERGS

The Strait of Belle Isle is close to Greenland. Polar currents drive ice bergs southward during spring and well into the summer. There is a natural ridge on the seabed that restricts the ice berg depth to about 60m.

To protect the cable against grounding ice bergs, conduits were installed from shore, with seabed exits at around 75m depth. The cable route was designed so that the cable was further protected from ice bergs by using natural ridges.

The Rock Installation cable protection in itself will not protect against the forces of a drifting grounded ice berg. Any ice berg shallower than 60 metres are still free to pass through the strait, but the statistics showed the probability of such ice bergs to be decreasing to near zero in the selected route.

## PULL-INS

As a consequence of the conduit exit depths, the conduits were up to 2,100 metres long. Also, the depth requires an interface intervention that can be operated without using divers.

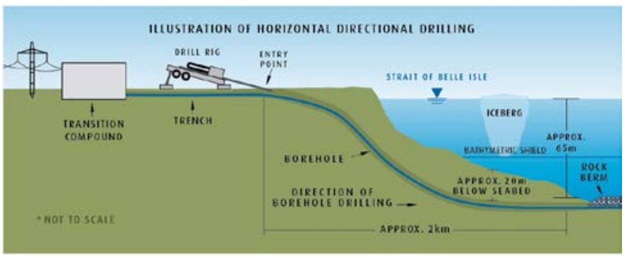


**Figure 2 Conduit trajectory**

Each conduit end was fitted with an adapter to a temporary bend restrictor. This operation was performed by an installation ROV. The cables could subsequently be pulled through the bend restrictors in order to be laid safely down to the seabed.

Significant effort, friction testing and analysis went into ensuring that the pull-ins could be performed within the tension limits of the cable. The solution was a combination of coated conduits and lubrication of both cable and conduit. As a consequence of this early effort, the cable tensions were well within the limits.

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## CURRENTS

The tidal and weather induced currents are strong in this area, up to 3 knots at most. This is a challenge both for surface vessel station keeping and for ROV operations, as well as for vortex induced vibrations fatigue and cable stability and had to be accounted for in the planning.

## TEMPERATURES

The sea temperature in the area during summer may be as low as below 0°C. For a Mass Insulated cable, this presents a challenge. The cautionary approach of a 5°C limit on bending the cable means that whenever a cable was lifted from the seabed, it had to be warmed in the water column before it could be taken to the vessel deck for jointing.

## WEATHER

The proximity to Greenland and the Arctic means that the area is exposed to Polar Low Pressures. This differs from the weather systems further south in that the low pressures form and develop much faster.

The temperatures, weather and Ice risk also meant that the installation window was narrow, only from early July to September.

## HARSHNESS

An index was created by Greg Fleming P.Eng and Keith Drover P.Eng to compare the harshness to other known areas. The Fleming-Drover harshness index is defined as:

$$HI_{F-D} = 6 \times \frac{C_6}{350} + \frac{2.5 \times H_{S4}}{110} + 1.5 \times (12 + 2 \times \log_{10} AD)$$

Where:

- $HI_{F-D}$ - Fleming-Drover harshness index
- $C_6$ - Mean annual number of days with a sea ice concentration greater than six tenths
- $H_{S4}$ - Mean annual number of days with a significant wave height greater than four meters
- $AD$ − Mean annual open-water iceberg density

Figure 2 compares the index of the Strait of Belle Isle (HI = 2.06) with other areas.

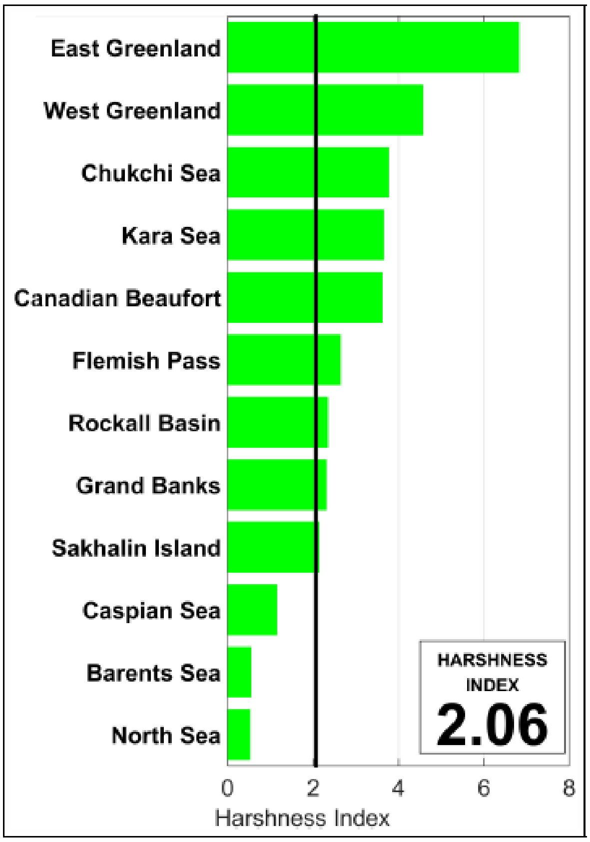


**Figure 3 Fleming-Drover harshness index comparison**

## OFF SHORE CABLE JOINTING

The aggregate of the challenges known during the planning phase meant that it was not possible to perform safe 2nd end pull-ins. A total of 6 1st end pull-ins and 3 off shore cable joints were necessary.

## CHALLENGES FACED DURING INSTALLATION

Careful planning mitigated most of the risks involved. The remaining risks were related to ice and weather. These were monitored by air and sea reconnaissance and weather monitoring.

During installation, a few ice bergs drifted towards the installation vessel during jointing operations. The solution to this was to hire another vessel to tow the ice bergs off course.

Also, a storm formed during jointing that was not forecast at the start of jointing. The cable was not cut, and further 3D modelling and analysis showed that the cable was not damaged.

### GLOSSARY

**HVDC:** High Voltage Direct Current
**SOBI:** Strait of Belle Isle