Digging into the archives

ABB technology on an expedition in the Artic Ocean

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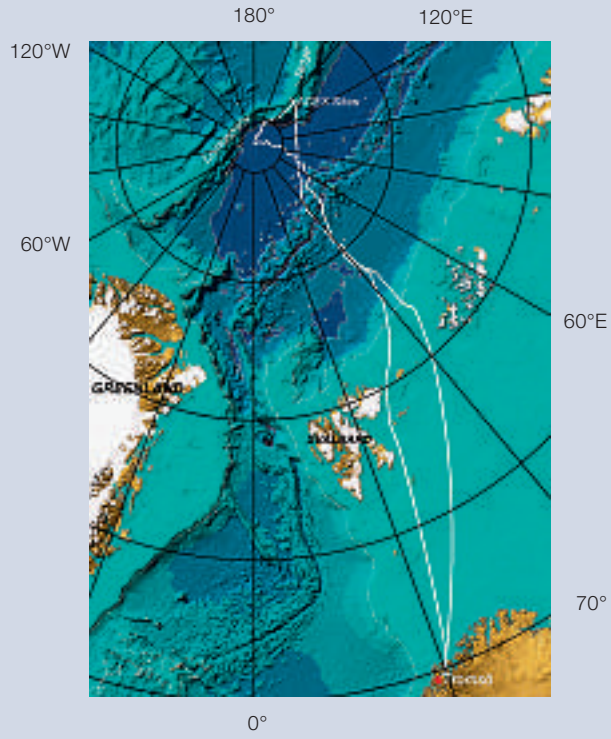
Expeditions to what are considered the most inhospitable places on the planet enable scientists to piece together the past and predict what the future may bring.

A vital part of the technology required to help scientists reach these places and gather vital information is supplied by companies like ABB.

This was the case during a recent trip deep into the heart of the Artic circle. A sophisticated ABB control system was onboard the Swedish icebreaker "Oden" when it participated in a high-profile research mission in 2004. For a period of five weeks, Oden was positioned together with a drill ship and a Russian nuclear icebreaker in the Arctic Ocean, about 250 km from the North Pole.

1 The Russian ship, Sovetskiy Soyuz, broke large ice floes into "bergy bits" while Oden then crushed these into even smaller pieces.

2 The Lomonosov ridge in the central Arctic Ocean.



Without an explorer's sense of curiosity, we learn little about our planet and many of the variables that influence climate change. The Artic Ocean seabed, for example, is a minefield of information and the deeper into the seabed explorers can go, the further back in time they can see.

Thanks to advanced drilling techniques, boring 450 m into the seabed at a water depth of 1200 m to gather valuable data is no longer as complex as it once was. This was the mission of the Arctic Coring Expedition (ACEX). The sediment cores obtained will be used to reconstruct the environmental history of this part of the Artic over the past 56 million years.

Drilling vessels alone cannot gather the required data. Deep-sea drilling from a ship is problematic because the two to three meter thick sea-ice cover is in constant motion. Once the drill string reaches the bottom, the drill ship must keep its position over the borehole to within a few tens of meters. Supporting ice-breakers are needed to ensure the vessel can get to where it is going and that it stays in position when it gets there.

This is where "Oden", Sweden's largest icebreaker, and the nuclear driven Russian icebreaker "Sovetskiy Soyuz" enter the story. Both were used as support vessels to the drilling vessel "Vidar Viking".

Oden operated as the command ship, and Sovetskiy Soyuz worked upstream relative to the general direction of the drifting ice. Because of the variations in ice thickness (first-year ice is only one to two meters thick, while older multi-year ice is considerably thicker and tougher), both ships had to work around the clock. The Russian ship broke large ice floes into "bergy bits" with an approximate width of five meters. Oden then crushed these into even smaller two to four meter thick pieces - the size the drilling ship could withstand while it was working 1.

Voyage of discovery

ACEX drilled 450 m, between 87 °N and 88 °N, into the sediment sequence covering the crest of the Lomonosov ridge in the central Arctic Ocean 2. This 450 m long core of sediment will take scientists back some 55–65 million years in time to the beginning of the Cenozoic period. The sediment will allow them to study the climate change that has taken place in the region during the period, which incidentally extends right up to the present day.

On first inspection on-board the ship 3, the thickness of the different layers allowed scientists to determine the rate of sediment deposition: 1 to 3 cm/1000 years. In one of these layers, freshwater fern spores were discovered, suggesting the presence of fresh water for a brief period or surface water with reduced salinity. At a depth of 380 m, the core samples show that the Arctic Ocean experienced 20 °C surface temperature.

Detailed studies of the various sediment cores extracted during the expedition are being carried out at Bremen University. As well as verifying the above-mentioned discoveries, scientists will try to determine the precise environmental history of this region while it was undergoing the transition from hothouse to icehouse conditions.

Out with the old and in with the new

Oden, owned by Hornet a daughter company of the Swedish ship owner B&N, has traveled to the Arctic six times. Prior to its departure as part of the ACEX mission, the control equip-

3 Inspecting a section of the extracted core sediment.

4 Visiting the tranquil North Pole and time for a group photograph.

Technical data for Swedish icebreaker, Oden

Length o.a	108 meters
Length b.p	96 meters
Displacement	14,000 dwt
Propulsion machinery	4 Sulzer Straight 8 cylinders, 16 liters, 6,250 hp, total 25,000 hp
Fuel consumption	70,000 liters/24 hours of operation
Fuel type	Preheated low sulfur thick oil
Electrical system	24 V/220 V
Power	5.4 MW generated by four 6-cylinder diesel engines with one additional emergency unit
Upgraded controls	ABB ■ 2 AC 450 marine certified, 3 operator stations ■ 2 operator X-clients, 5 AC 70 controllers ■ Generator automation – ABB Genoa ■ Fiber optic communication ■ All systems duplicated and redundant
Reused	■ 6 Masterpiece M 200/i ■ 2 Master View MV 800/i ■ S100 I/O, 3,000 channels
Installation	ABB Luleå, Sweden YIT Luleå, Sweden

ment was upgraded. The original ABB system, installed in 1987, had become both sensitive to excess vibrations and temperatures. In addition, it desperately needed a modern communication platform.

The new ABB control system is akin to a large industrial plant. It monitors and controls many different functions components on the ship – everything from the four giant engines (a combined total of 25,000 hp) to cooling, heating, ballast tanks, water pumps, ventilation, electrical supply, power generation and lighting. Computing power was upgraded with two AC450 marine specified controllers, five new operator stations with new displays, generator automation and an alarm panel.

Hornet's Claes Benson describes the new control system as "the best purchase of control equipment ever for the company's icebreakers". He adds that the upgrading process was problem free and the ABB solution allowed Hornet to save costs to the tune of 40%.

These savings were largely due to the reusability of the S100 I/O system (and cabling) together with the application software.

Supreme test

The five-week, 24-hours-a-day operation among sizable ice floes – with severe vibrations and sudden thumps – created very difficult operating conditions for all the on-board equipment. With such difficulties to contend with, the ABB control system – according to Dahn Joelsson, chief engineer and technical supervisor on Oden - functioned perfectly during the entire journey.

On one occasion a six-meter thick ice floe approached the drilling ship and Oden had to deal with it before it seriously interfered with the drilling process.

The only option available was to drive Oden onto the ice and the speed needed to do this meant the ship was lifted two meters into the air. According to Thomas Strömnäs, second officer and one of the participating crew members, "the forces at play when Oden hit the ice and then fell onto it were enormous. ABB's equipment survived this episode while other equipment on the ship did not."

On the return trip after the completion of the core drilling, Oden and the other two vessels briefly stopped at the tranquil North Pole (at latitude N 90°) to allow the crew and scientists step onto the ice 4.

Discovery to reveal climate change

The polar ice sheet together with layers of sediment is an archive containing information about atmospheric composition and climate change going back millions of years. To predict the future it is necessary to determine how the global climate has responded to past variations in environmental parameters. Correlating this data with data from similar studies from the region might help scientists predict if a new hothouse period is imminent.

ABB technology has helped scientists collect this very important data. In the harsh conditions of the Artic Ocean, the upgraded control system has more than proven its worth in terms of mechanical and electrical integrity. Impressed by its total reliability and fault-free operation, Dahn Joelsson has awarded the system top marks, which in his own words "is the best possible grade".

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