

## Case note

# ACS 6000 variable speed drive system improves icebreaker's manoeuvrability and operability

The U.S. Coast Guard's icebreaker „Great Lakes“ is equipped with ABB's Azipod® propulsion system.

The propulsion system, which is powered by two 3.25 MW ACS 6000 variable speed drives, improves the vessel's manoeuvrability and operability in heavy ice conditions.



U.S. Coast Guard icebreaker „Great Lakes“ is equipped with ABB's Azipod® propulsion system and ACS 6000 variable speed drives.

### “Mackinaw” U.S. Coast Guard icebreaker

After more than 60 years of operation the U.S. Coast Guard has decided to replace the USCGC MACKINAW with the new multi-mission Great Lakes Icebreaker (GLIB). The vessel's main area of operation is the Great Lakes in North America, spanning more than 1,200 km (750 miles) from west to east.

### Propulsion system

The new icebreaker is equipped with ABB's Azipod® propulsion system, an electric podded propulsion unit capable of unlimited 360-degrees steering. The concept has proven its performance and efficiency on a number of icebreakers and ice-going vessels.

The Azipod® propulsion system is powered by ABB's ACS 6000 variable speed drive, which incorporates PEBB (Power Electronic Building Block) technology.

The variable speed electric drive system improves the vessel's manoeuvrability and operability in heavy ice conditions by providing full torque to the propeller motor from zero to nominal speed in both directions.

### Highlights

#### Azipod® propulsion system

Enhanced manoeuvrability and operability

Design flexibility

#### Powered by ACS 6000 variable speed drive

Smooth and full torque over the entire speed range

Compact and lightweight design

Layout flexibility

High immunity to varying climatic conditions

#### Based on ONR supported PEBB technology (Power Electronic Building Blocks)



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ACS 6000

The ACS 6000 medium voltage drive with its modular concept best suits the requirements of this modern propulsion scheme.

The compact construction resulting in a small footprint and lightweight design gives more flexibility to ship designers and makes more space available for other needs.

Smooth torque over the entire speed range provided by state-of-the-art Direct Torque Control (DTC) reduces noise and vibration levels, which minimizes mechanical stress.

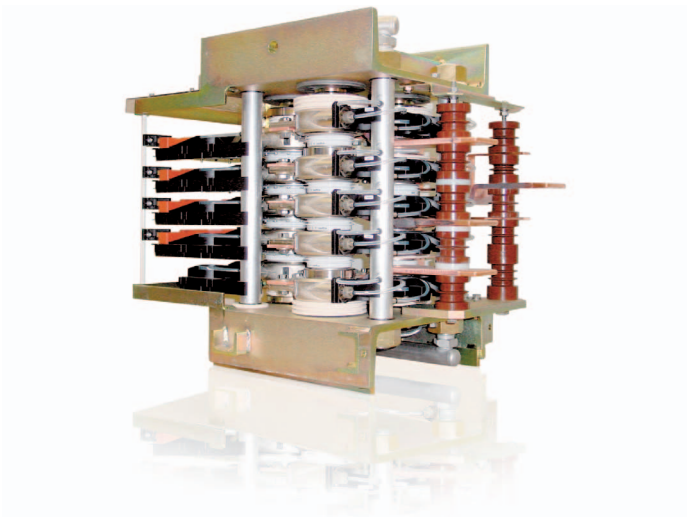
The modular ACS 6000 drive platform provides solutions from 3 MVA single drives up to fully redundant configurations of more than 28 MVA. In addition, it enables the design of a new type of multi-motor drive, which leads to more cost effective ship design.

The ACS 6000 incorporates a technology known as PEBB.

PEBB

PEBB refers to a system built around a packaging concept that replaces complex power electronics circuits with a single multi-function device, which is intelligent and / or programmable. Depending on the application, a PEBB might be configured to act as an AC to DC rectifier, DC to AC inverter, variable speed drive etc. PEBB is sometimes referred to as the second electronic revolution, which brings the advantages of modularization and standardization to power electronics.

A high power PEBB incorporates one phase leg of a three-level Voltage Source Inverter (VSI) topology. The main power semiconductor used in the PEBB is the IGCT (Integrated Gate Commutated Thyristor).



9 MVA PEBB (Power Electronic Building Block)

Benefits

Highest reliability

Due to the use of the IGCT it has been possible to reduce the number of parts to a minimum in order to improve operational reliability.

High power density

The very high power density of this PEBB is based on the use of IGCT technology enabling reduced part count and a tight arrangement. As a result the size for a given power rating has been reduced by 50 percent compared to conventional solutions.

Reduced noise and vibration levels

The ABB PEBB permits a very high switching frequency, resulting in reduced noise and vibration levels. This is made possible by lower losses and the reduction of switching restrictions. The control system operates with a cycle time of 25 µs. If necessary, the IGCT can be switched to a new state after every 50 µs.

Office of Naval Research (ONR)

ONR coordinates, executes, and promotes the science and technology programs of the United States Navy and Marine Corps. In 1994 ONR initiated the Power Electronic Building Block (PEBB) project under the Dual Use Science and Technology (DUST) program to leverage the wide range of commercial applications for the benefit of military use. The project's goal is to reduce cost, weight, size and time required to produce power electronic modules.

ABB participated in the ONR-funded PEBB program. Among other products, this resulted in ABB's ACS 6000, the first PEBB-based variable speed drive.

Key data of ACS 6000 family	
Inverter type	Three-level Voltage Source Inverter (VSI)
Converter cooling	Water cooling
Power range	3 - 27 MW
Output voltage	3.0 - 3.3 kV (optional: 2.3 kV)
Maximum output frequency	75 Hz (higher on request)
Converter efficiency	Typically >98.5% (incl. all auxiliaries)
Type of motor	Induction, synchronous and/or permanent magnet motor
Special feature	Available as single or multidrive

For more information please contact:

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