

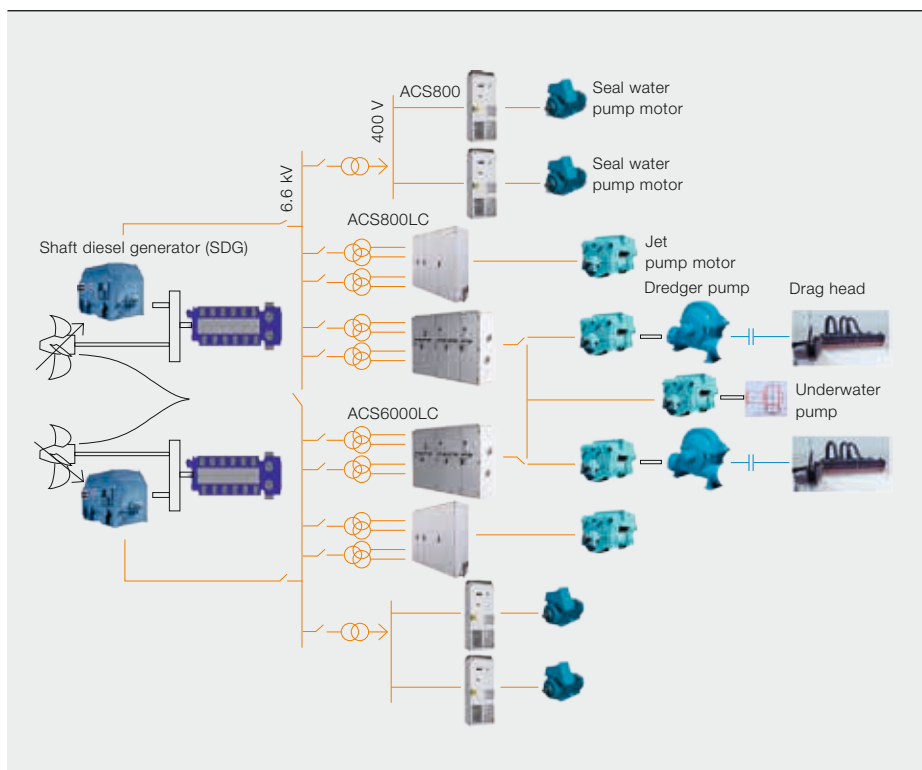


In control

ABB's dredger drives control unit provides a more reliable and integrated control platform for dredging motor systems

DAVID-BINGHUI LI, EVAN-FEI E, VISTA-HAO FENG, WEIWEI LONG – Programmable logic controllers (PLCs) are the backbone of automating electromechanical processes. Designed for multiple I/O arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact, they are well adapted to a wide range of automation tasks. Almost any production line, process or machine function can be greatly enhanced by using this type of control. ABB has taken its own PLC system to a new level, having developed an advanced PLC to control, protect and supervise all dredging consumers and systems working within trailing suction hopper dredger vessels. Its uniqueness lies in the fact the new dredger drive control unit (DreDCU) simultaneously controls multiple drive chains. ABB has successfully installed the unit in three vessels.

1 Typical configuration of a hopper dredger



A trailing suction hopper dredger (TSHD) has large, powerful pumps and engines that enable it to suck up sediments from the ocean or riverbeds. One or two suction pipes run from the vessel to the sediment floor. A drag head is attached to the end of the pipe and lowered to just above the sediment floor, making it possible to regulate the mixture of sand and water that it takes in. A TSHD generally stores the dredged material in its own hopper and discharges the leftover water overboard. The material can be discharged through hatches in the bottom of the ship or by pumping for land reclamation or beach nourishment.

Because a TSHD is used in a wide range of applications, and can dredge and transport material over long distances, it is often referred to as the workhorse of the dredging industry.

A typical TSHD electric drive system has a number of diesel engines running generators to supply electrical power to the main frequency convertors that drive all the relevant dredging consumers → 1.

Title picture

ABB's highly sophisticated dredger drives control unit brings significant fuel efficiency to trailing suction hopper dredgers.

These consumers include motors for the dredger mud, jet water, underwater and seal water pumps. Each drive chain includes a drive transformer, drive and motor.

Adjusting needs

Even as recently as five years ago only a few of the dredging consumers, such as the jet water pump, were controlled by a frequency converter, with simple control and protection based on the product level. The other large dredging consumers were still driven by diesel engines with separate control systems. Therefore

complicated. For instance, an additional changeover function between a mud pump and an underwater pump must be controlled, or a master/follower function between two dredger pumps must be overseen. However this need for increased cooperation between different drive chains and protection for each chain from the system level does not become a problem due to the sophistication of the DreDCU.

Development process

ABB already offered a sophisticated PLC unit for single-drive systems used for propulsion and thrusters.

Yet in order to accommodate the complicated and multiple drives specific to dredger applications, a new control unit needed to be developed.

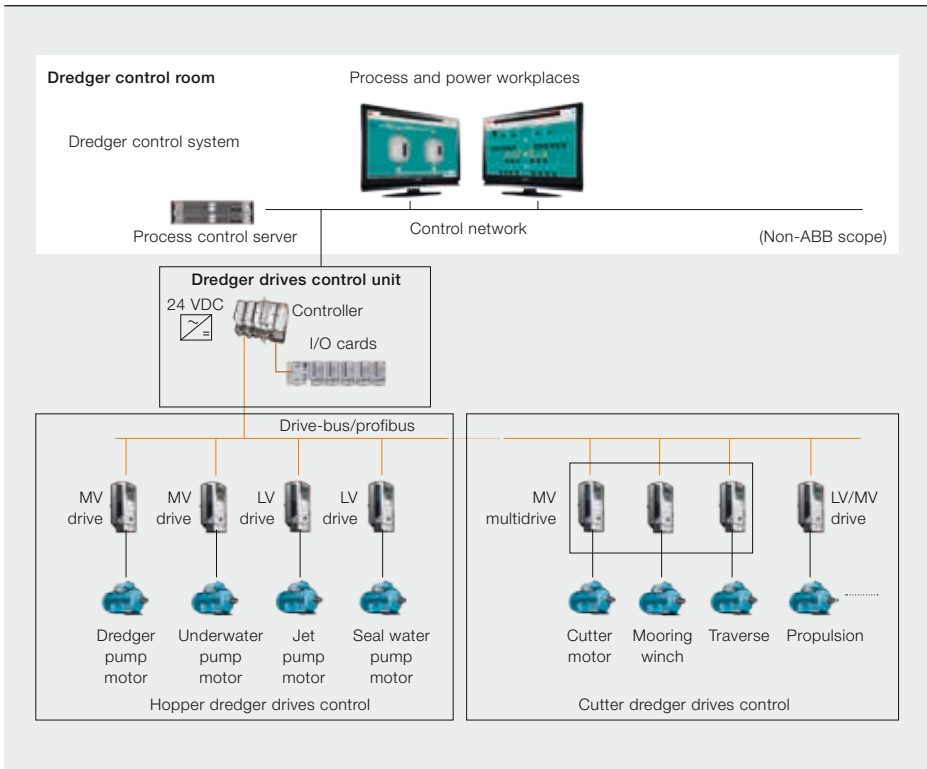
The company utilized one of its existing controllers as a base for the DreDCU.

The DreDCU easily handles the need for increased cooperation between different drive chains.

the drive control was simple and easily handled by the drives firmware.

Yet it became clear that significant fuel efficiency could be gained by having further dredging consumers controlled by frequency convertors. Adding additional consumers to the drive control clearly makes the control process much more

ABB's Extended Automation System 800xA family of controllers, communication interfaces and I/O modules have been meeting the needs of today's most sophisticated plant automation systems. The flagship controller of System



The current DreDCU application software is a standardized and scalable software package based partly on the existing software library of the AC 800M.

800xA, the AC 800M, is a modular process PLC with communication functions as well as full redundancy and support for a large range of I/O systems. It can integrate various networks, fieldbuses, serial protocols and I/Os, providing seamless execution of advanced and unhindered process control strategies as well as functional safety, electrical, quality control, and power management applications. It can deliver automation solutions for small and large applications.

The DreDCU is made up of an AC 800M hardware platform with embedded application software, communication modules and modems, I/O modules and power supplies → 2. An optional local

Adding additional consumers to the drive control makes the control process much more complicated.

panel provides an alarm list and displays detailed information for each activated alarm.

- One unit controls up to 11 drives
- Interface to remote control and integrated automation system (supports PROFIBUS and Modbus)
- Optional local panel
- Optional interface to remote diagnostics support
- Optional interface to advisory system
- Meets main class society requirements

The hardware is located in the DreDCU cabinet (alternatively a part of the converter cabinets), which is placed in the frequency convertor room on the vessel.

As the DreDCU is designed for a specific vessel type with specific functions and relationship with ABB drives, it is available as part of an entire electric system package → 3. The multidrive control aspects have been tweaked to handle dredger applications. The current DreDCU application software is a standardized and scalable software package that is based partly on the existing software library of the AC 800M. The existing library was adjusted to shift from a propulsion application to a dredging application. A changeover function between a mud pump and an underwater pump had to be developed, special mud pump interfaces added and the start/stop procedure changed according to the dredger application. A process panel software was also developed for the mud pumps on which information for all drive chains can be checked.

The new control software is adapted to the project-specific configuration by means of parameterization due to different dredging applications. The DreDCU software offers standard control for

dredger consumers such as sequence start/stop control, emergency stop and ramp accelerate. Optional control types include master/follower, duty overload running and

changeover. The software monitors and protects all relevant dredger drive chains, sends alarms to an integrated automation system and implements auxiliary control for main dredger consumers. In



TongTu

Builder: Guangzhou WenChong shipyard
 Owner: CCCC Tianjin Dredging Co. Ltd.
 Designed by 708 Designed Institute,
 classified by CCS, delivered in 2011

ABB scope of supply:

- 2x 10,000 kVA shaft generator
- 1x MSB (Main switchboard)
- 4x 1,150 kVA jet pump transformer
- 4x 3,450 kVA mud pump transformer
- 2x 2,000 kVA distribution transformer
- 2x 110 V / 30 A DC-UPS
- 2x ACS 6000 mud pump converter
- 2x ACS 800LC jet pump converter
- 2x ACS 800 sealed pump converter
- 2x 6,000 kW mud pump
- 2x 2,000 kW jet pump
- 1x DCU cabinet



No9 XinHaihu

Builder: Guangzhou WenChong shipyard
 Owner: CCCC SDC Waterway Construction Co., Ltd.
 Designed by 708 Designed Institute,
 classified by CCS, delivered in 2012

ABB scope of supply:

- 2x 7,200 kVA / 1,500 rpm / 6.6 kV generators
- 2x earthing resistors
- 1x 6.6 kV / 50 HZ MV switchboard
- 2x 1,725 V / 5,200 kVA, mud pump transformers
- 2x 710 V / 1,650 kVA, jet pump transformers
- 2x 400 V / 1,600 kVA, distribution transformers
- 2x 3.3 kV ACS 1000 drive
- 2x 690 V ACS 800 drive
- 2x 4,500 kW / 1,500 rpm mud pump motors
- 2x 1,000 kW / 1,500 rpm jet pump motors
- 2x softstarters
- 2x DC UPS



No8 XinHaihu

Builder: Zhenhua Changxin shipyard
 Owner: CCCC Shanghai Dredging Co., Ltd.
 Designed by 708 Designed Institute,
 classified by CCS, delivered in 2012

ABB scope of supply:

- 2x 7,200 kVA / 1,500 rpm / 6.6 kV generators
- 2x earthing resistors
- 1x 6.6 kV / 50 HZ MV switchboard
- 2x 1725 V / 5,200 kVA mud pump transformers
- 2x 710 V / 1,650 kVA jet pump transformers
- 2x 400 V / 1,600 kVA distribution transformers
- 2x 3.3 kV ACS 1000 drive
- 2x 690 V ACS 800 drive
- 2x 4,500 kW / 1,500 rpm mud pump motors
- 2x 1,000 kW / 1,500 rpm jet pump motors
- 2x softstarters
- 2x DC UPS

Simultaneous monitoring of the status of all dredging operation equipment allows for more efficient operations.

the dredger drive control unit on a second type of dredging vessel, the cutter suction dredger. The end goal is to install the drive control unit on a wide range of special vessels including supply vessels, heavy lift vessels, crane vessels and installation support vessels.

2012 ABB installed the unit in three vessels → 4.

Making headway

The benefits of the DreDCU solution are multifold. It increases the reliability of dredging operations by monitoring dredger consumers' conditions and harsh working environments, thus reducing the risk of downtime due to power loss. Simultaneous monitoring of the status of all dredging operation equipment allows for more efficient operations. Implementing a standard platform enables easy interfacing with other ABB products. Smaller cabinets provide flexibility for equipment location. Development continues with the next goal being to install

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