

SHIP-TO-SHIP AUTOMATED MOORING: A CAVOTEC FIRST

Global engineering group Cavotec recently completed a series of at sea demonstrations (ASDs) of the innovative US Navy Advanced Mooring System (AMS) for novel ship-to-ship mooring applications. Following successful Factory Acceptance Testing (FAT) at Cavotec USA in North Carolina, and System Integration Testing (SIT) at project partner Oceaneering's facility in Maryland, the ASDs were conducted at US Naval Base Coronado in California.

The system is now clear for the next phase of its development. We take a look at this exciting new evolution of a technology that promises a fundamental improvement in offshore mooring operations; one that has considerable potential for use in commercial applications.

A LONG-TERM PARTNERSHIP

Cavotec began working with the US Navy on concepts and potential specifications for a ship-to-ship mooring technology in 2006 through principle contractor, Oceaneering International Inc. (OII), a leading subsea engineering and applied technology group.

"While Cavotec has a proven track record in commercial MoorMaster applications, which tend to have relatively shorter lead times, Cavotec has adapted well to the longer, more involved processes needed to develop AMS," Group Product Manager, MoorMaster™, Mike Howie says.

The Cavotec team – combining R&D expertise from its Centre of Excellence in New Zealand with its US manufacturing capabilities – has continually developed AMS: from concept, engineering and manufacturing, through to factory and integration testing, and most recently ASD.

Following two phases of concept development and extensive bench testing, Cavotec was awarded a contract to produce the designs for a prototype system. The resulting prototype was fine-tuned to produce a revised and improved design model during the engineering phase. Cavotec was subsequently awarded the contract to manufacture an initial batch of six units.

All six units completed FAT during December 2015 and January 2016 at Cavotec USA in Mooresville, North Carolina. SIT, incorporating all six units, was successfully conducted in January at OII's facility in Hanover, Maryland.

SIT was an important stage in the development of AMS, because it was the first time that all six AMS units had been tested simultaneously. "Testing the entire system helped us ensure performance optimization," explains Cavotec USA Project Manager, Scott Dunbar. "We were also able to conduct dynamic testing of the scanning and tracking system. Using a crane and a mock hull, simulating a target vessel, we were able to actuate the "hull shape" up and down to test the AMS obstacle avoidance system."

These tests replicated hull motion of a typical US Navy aluminum hulled Expeditionary Fast Transport (EPF) catamaran, to detect rub rails at different velocities.

A MILESTONE FOR MOORMASTER™

In preparation for ASD, the AMS modules were shipped to Naval Base Coronado in San Diego, California, where they were installed on a Roll on Roll off Discharge Facility (RRDF). For the ASD, the target vessel was a barge specially adapted to incorporate the specific hull characteristics of the EPF.

ASD began with pier side testing, before the two vessels were moved into protected waters within the confines of the harbour, where a total of between 40 and 50 mooring operations were conducted over the course of several days. On March 14, the team performed a series of ASD for a number of guests, including representatives of the US Navy, US Marine Corps, and the Office of Naval Research.

"Given the interest from the Navy in this At Sea Demonstration, we are looking forward to future large ship-to-ship at sea demonstrations," adds Dunbar. In anticipation of future AMS Sea Trials involving large US Navy vessels, Cavotec



A MoorMaster unit used at a ferry application in Norway.

plans a number of software and hardware upgrades to develop the overall robustness and capabilities of AMS.

EXPANDING THE SCOPE

The AMS employs MoorMaster automated vacuum mooring technology, developed by Cavotec to control vessel movement and eliminate the need for conventional mooring lines. MoorMaster units typically deploy and detach in less than 30 seconds.

Until now, MoorMaster units have been mounted on the quay face, mounted onto the berth surface, or in the case of the St. Lawrence Seaway, built into lock walls – all of which are shore-based applications. AMS is the very first version of the technology specifically designed for use at sea and for ship-to-ship mooring operations.

Shore-based MoorMaster units have performed more than 175,000 mooring operations to date at ferry, bulk handling, Ro-Ro, container and lock applications worldwide, dramatically improving safety, operational efficiency, and in many cases enabling ports to make infrastructure savings.

With AMS, MoorMaster units, (MoorMaster MM200E60), are integrated into bespoke structurally reinforced 20 foot ISO shipping containers, for installation on RRDF or other US Navy vessels to enable “sea-basing” operations for transfer of personnel and materiel while at sea.

Sea-basing provides the capacity to conduct ‘Over-The-Horizon’ naval tasks and logistical functions at sea. AMS promises to expand the operational window of sea-basing by allowing offshore mooring in conditions of up to and including Sea State 3 (wave heights up to 1.25 metres, day or night in all weather conditions).

AMS units also incorporate a three-stage telescopic boom, fitted with four bespoke vacuum pads, each with a capacity of 50kN on an articulated end effector. The four pads are used to enable attachment to a non-planar hull surface – in contrast to conventional MoorMaster systems that utilise single or dual vacuum pads each with a capacity of 200kN, and that typically can only attach to flat sided hull forms. For ADS, the ‘target’ vessel was an EPF, although AMS could be employed for other vessel combinations, albeit in alternative AMS configurations.

AMS employs a similar telescopic design used in the Norled passenger and vehicle battery- operated (ROPAX) ferry application in Norway – the world’s first

An AMS MoorMaster unit prior to shipping for ASD.



combined automated mooring and shore power charging system – which has been in operation since early 2015.

Furthermore, Cavotec has developed an advanced scanning and tracking system, incorporating a light detection and ranging (LIDAR) sensor. The system detects and accurately identifies protrusions on the vessel hull, evaluating their position using algorithms programmed into the AMS software. This ensures that the vacuum pads are correctly positioned on the hull in-between the rubbing stakes present on the EPF.

Cavotec developed AMS for use in the exceptionally demanding, dynamic environments germane to this application, and the Cavotec Group owns all the intellectual property and patents related to MoorMaster for this project.

To mount the system to its host vessel, the shipping containers are simply attached to the RRDF using conventional twist locks, as they would be on a container ship. This makes the units readily transportable by road, rail or sea – a specific requirement of the US Navy.

In this application, the complete system comprises six AMS units – three towards the stern of the vessel, and three towards the bow. Additionally, there were two auxiliary modules, one supplying hydraulic power, the other a command and control module.

CONSIDERABLE COMMERCIAL POTENTIAL

Since Sea Trials concluded, any US corporation or port that is interested in

operating the AMS on a trial basis may contact Cavotec for further information. Although a commercial system would likely be subtly different, the key technologies that have been developed to enable ship-to-ship mooring would remain.

Although AMS has been developed specifically for military sea-basing applications, it opens up an entirely new sphere of opportunities employing MoorMaster technology. Work in parallel with the AMS project has incorporated studies for explosive atmosphere rating (Ex) applications, thereby ensuring that MoorMaster can, if required, meet ex-requirements. MoorMaster also offers substantial safety and operational benefits for the oil and gas and bulk handling markets.

ABOUT THE ORGANISATION

Cavotec is a global engineering group that manufactures power transmission, distribution and control technologies that form the link between fixed and mobile equipment in the Ports & Maritime, Airports, Mining & Tunnelling and General Industry sectors.

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Media & investor contact: Michael Scheepers
Group Director, IR & Corporate Communications michael.scheepers@cavotec.com or +41 795 024 010