

## Armada República de Colombia Modernization Project: New Power for Colombian Navy “Padilla” Class Frigates



**Who:** Colombian Navy

**What:** Four Almirante Padilla class frigates fitted with new main propulsion engines, on-board power gensets and electronic monitoring systems.

**Why:** Modernization of fleet

**Where:** COTECMAR Naval Dockyard, Cartagena de Indias, Colombia



South America



Colombia

**The four frigates “Almirante Padilla”, “Caldas”, “Antioquia” and “Independiente” first went into service with the Colombian Navy at the beginning of the 1980s. Each of the vessels was powered by four of MTU’s proven Series 1163 engines. Today, almost 30 years later, the ships are still operating successfully and the Navy plans to keep them in service. As part of a comprehensive program of modernization, the frigates have been fitted with new main propulsion units, new on-board power systems and a new monitoring and control system, all specifically tailored by MTU for the vessels’ future missions.**

Cartagena de Indias, Colombia – The Almirante Padilla class frigates play a special role in the Colombian Navy. They patrol Caribbean and Pacific waters in order to safeguard national resources and to counter piracy, smuggling and terrorism. Built by the Howaldtswerke-Deutsche Werft GmbH (HDW) in Kiel, the Colombian Navy (Armada República de Colombia [ARC]) vessels were launched between October 1983 and July 1984. The four 20-cylinder MTU main propulsion units on each ship underwent major overhaul in the mid-1990s and at the end of 2008, the Colombian Navy decided to re-power its Almirante Padilla fleet with new MTU engines – a prudent, long-term decision for a number of reasons. Especially with well-maintained ships in this class, it makes solid sense to fit the propulsion systems with state-of-the-art engines which

come with a longer TBO. In contrast to a repeat overhaul, which could take up to a year, the re-power option means that vessels can be back on duty after just a short time.

As part of the modernization program, the four 20-cylinder Model 1163 TB 82 engines on each ship were replaced by four 16-cylinder Model 1163 TB 73L units. The work was carried out at the COTECMAR Colombian Naval Dockyard. Thanks to their compact design, the new engines fit perfectly into the engine room. “The Colombian Navy wanted to get the most out of the existing facilities,” said Javier Diaz, Captain and Project Leader for the Colombian Navy. “And the same engine series in a similar configuration represented the ideal option. Additionally, the Colombian Navy has been satisfied with the engines’ perfor-

Javier Diaz, Captain and Project Leader for the Colombian Navy

“We have been satisfied with the engines’ performance in the past. That’s why we decided to replace them with MTU Series 1163 once again.”



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The ARC “Antioquia” (FM 53) during the installation of the new Series 1163 engine.

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The powerful, high-speed units in this engine series have been in service in frigates and corvettes for many years and their reliability, high power density and outstanding acceleration mean that they are among the most frequently used engines in the naval sector. Weighing in at 22.8 tons, Series 1163 engines have always offered an unbeatable power-to-weight ratio in their performance class (3.1 kilogram per kilowatt [kW]) and the same applies to their power-to-volume figure of over 200 kW/m<sup>3</sup> – a major advantage for the Almirante Padilla-Class frigates which depend on speed and maneuverability during operational missions.

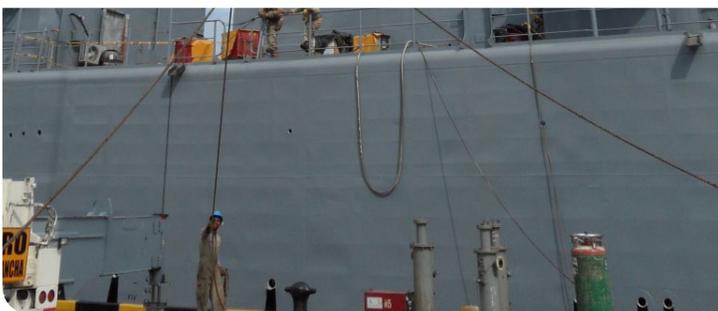
#### Benefits of repowering

Alongside the repowering project, the propellers, shafts and gearboxes were overhauled and updated. Because gearbox and propeller load acceptance remained unchanged, MTU engineers reduced engine power from 5,200 kW (at 1,230 to 1,280 rpm) to 4,290 kW (at 1,160 to 1,200 rpm) in order to achieve the best possible alignment with the vessels’ requirements.



The repowering exercise also increases the time between major overhauls from 9,000 hours with the previous engines to 24,000 hours with the new units. “That means the engines will only be due for a complete overhaul in around 20 years’ time when the vessels are at the end of their lives so that we avoid the complex business of having to remove them earlier,” explains Captain Diaz.

Performance capabilities will also be significantly greater in future, especially in the partial load range. Greater power and higher torque make it possible to reach and maintain the same speed with less fuel. In addition, lower average consumption increases the fleet’s operational range.



The acoustics have also been optimized by the introduction of a resilient mounting system which reduces structure-borne noise by 20 decibels (dB-A) as compared with the previous system. Water-cooled exhaust lines and sequential turbocharging reduce the level of airborne noise, making it more difficult to detect the frigates. “For engines in dynamic applications, we have designed the turbochargers so that they produce adequately high charge-pressure whilst also covering the widest speed range possible,” explained Markus von Albedyhl, Project Manager at MTU Friedrichshafen GmbH. “We have utilized the principle of sequential turbocharging to achieve even greater dynamic power output.” The resulting power increase at the lower end of the speed range and the reduction in fuel consumption in the various propulsion modes were among the major reasons behind the Colombian Navy’s decision in favor of an MTU engine.

The crew likewise benefits directly from the new engines: lower surface temperatures, less vibration and lower noise levels result in a more pleasant work environment and improved safety during day-to-day operations.

#### Diesel engines for on-board power generation

As well as the propulsion systems, the Colombian Navy also replaced the frigates’ on-board power generation systems. The four 8-cylinder MTU Series 396 units which had so far powered the vessels’ on-board gensets gave way to 8-cylinder Series 2000 engines. These meet IMO (International Maritime Organization) emissions regulations and will produce the current needed to power the galley, radar, communications and electric pump drives. Here, too, the Colombian Navy will see benefits in terms of space and fuel efficiency. The compact design of the new gensets produces significant space savings as well as weight reductions of up to 20 % which have a positive influence on displacement. The new

The frigates “Almirante Padilla”, “Caldas”, “Antioquia” and “Independiente” were fitted out with new MTU engines at the Colombian Naval Dockyard COTECMAR.



Four 16-cylinder Model 1163 TB 73L engines provide the propulsion needed to take the frigate up to a maximum speed of 27 knots (50 kph). Thanks to their compact design, the new engines fit perfectly into the engine room.



On board the frigates, four gensets based on 8-cylinder Series 2000 engines deliver the power needed to supply all of the electrical consumers.



MTU integrated all automation system components for the bridge and engine control room in control panels. After thorough tests, MTU shipped the units to the Colombian shipyard COTECMAR for installation in the frigates.

solution for on-board power generation also means quieter operation as the single mountings on the previous units have been replaced by double resilient mounts which reduce structure-borne noise disturbance by up to 40 %. Improved fuel consumption will also mean savings of up to 5 % at full load as compared with the previous engines.

#### Flexible monitoring and control system

When the frigates go out to sea, the technology on board must function reliably, safely and efficiently under all prevailing conditions. To ensure this happens, all four ships were fitted with MTU's Callosum, an integrated, intelligent and intuitively operable automation system for monitoring and controlling all areas and functions of the vessels' technology. This involved more than doubling the number of measuring points to produce a dense network of sensors capable of registering and evaluating several thousand data parameters simultaneously. The integrated monitoring and control system is thus able to deal with the frigates' propulsion plants each of which incorporates two engines linked with a controllable-pitch propeller via a multi-engine gearbox (CODAD system) and propeller shaft. Here, Callosum ensures optimum alignment of acceleration and operational response with the prevailing requirements. Callosum also makes sure that ship-side operational technology such as on-board gensets and various different areas of the vessel – such as tanks and bilges as well as heating, ventilation and aircon systems – continue to function reliably. If irregularities or malfunctions are identified, the crew is able to limit potential damage in advance and clear the

fault independently – a major advantage, especially during extended periods at sea.

#### Efficient on-site support

To ensure that the modernization project runs as efficiently as possible, MTU supported the Colombian Navy and COTECMAR by providing expertise and systems documentation for main propulsion engines, on-board gensets and electronics systems. Two MTU engineers were on site for over two years, providing support during installation, trials (Harbor and Sea Acceptance Tests) and commissioning. MTU also worked closely with the on-site service team. "MTU really selected the service personnel very carefully," said Captain Diaz. "Previous assignments in Cartagena meant that the technicians were very familiar with local culture, the language, the dockyard and the Navy."

#### MTU Friedrichshafen GmbH

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MTU is a brand of Rolls-Royce Power Systems AG. MTU high-speed engines and propulsion systems provide power for marine, rail, power generation, oil and gas, agriculture, mining, construction and industrial, and defense applications. The portfolio is comprised of diesel engines with up to 10,000 kilowatts (kW) power output, gas engines up to 2,150 kW and gas turbines up to 35,320 kW. MTU also offers customized electronic monitoring and control systems for its engines and propulsion systems.



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