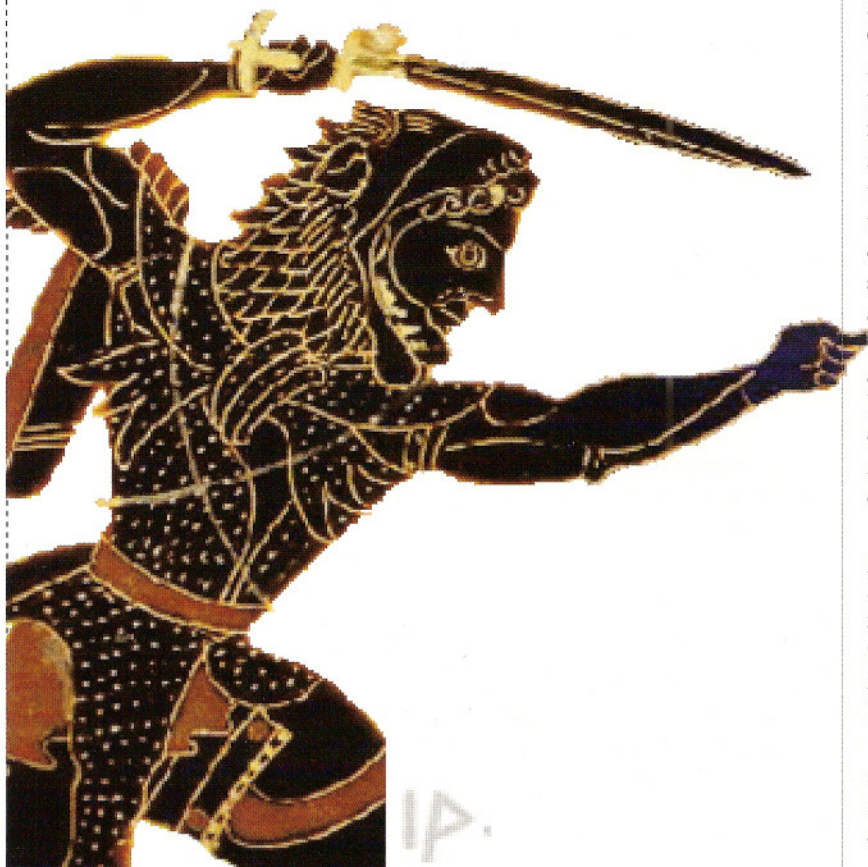


THE LABOURS OF HERCULES

▶ TEXT: MARJATTA PIETILÄ | PHOTO: WÄRTSILÄ

THE AIM OF HERCULES, a co-operative research project led by Wärtsilä and MAN Diesel with multinational teams, was to develop new technology for higher-efficiency marine engines with ultra-low emissions. A paper presented by Wärtsilä describing some of the successful results of the project won the Best Paper Award at the 25th CIMAC World Congress in Vienna.



Even though HERCULES is an acronym formed from the first letters of the words High Efficiency R&D on Combustion with Ultra-Low Emissions for Ships, the reference to Hercules, hero of Greek mythology known for his labours to make the world safer for mankind, is quite possibly deliberate. While that Hercules fought against monsters, the demons challenging the HERCULES research teams are the emissions that endanger our environment.

HERCULES began in early 2004 and was completed in September of this year. Funded by the European Union as part of the 6th Frame Work Programme (EUR 15 million), the Swiss Federal Government (EUR 2.5 million) and participating companies, project's total budget was EUR 33 million. In addition to Wärtsilä and MAN Diesel, the research teams were staffed by people from more than 40 European engine component suppliers, equipment manufacturers, universities, research institutions and shipping companies.

Two major objectives and eight work packages

"The research project consisted of eight work packages which all addressed different areas of the two major objectives – a substantial reduction in exhaust emissions by marine diesel engines and improvements in engine efficiency. Other objectives included the minimization of engine lifecycle costs and achieving increased levels of reliability," says **Klaus Heim**, Vice President Global R&D, Wärtsilä Industrial Operations.

"The trigger for HERCULES was that in the near future, the maritime industry will have to comply with a number of new EU, national and international environmental regulations. One of these is an International Maritime Organisation (IMO) regulation limiting NO_x (nitrogen oxide) emissions. Tier II, the second step of this regulation is expected to come into force in 2011, and will be compulsory for all vessels sailing in international waters. There is currently some uncertainty about the final schedule and scope of the required NO_x reduction. For this reason, it is important that Wärtsilä is prepared to launch compliant engines with suitable environmental technologies as soon as any of the anticipated regulations come into force," says Heim.

A wide range of alternatives

HERCULES involved screening a whole range of different emission reduction technologies with the aim of not only reducing NO_x, but also other emissions such as particulates, oxides of sulphur (SO_x) and hydrocarbons.

"All these technologies were explored to analyze both their potential and their weaknesses in emission reduction. The knowledge and experience gained allows each project partner to further develop their products and technologies accordingly. Our turbocharger supplier, for example, developed the technology for a product which will be useful to us in the future," says Heim.

"For Wärtsilä, other interesting technologies to validate were different ways of using water inside combustion cylinders to reduce NO_x emissions. One of the technologies tested onboard ship was Direct Water Injection (DWI) for two-stroke engines. →

This technology enables NO_x emissions to be reduced by up to 50%. Another application currently undergoing field tests is Werpac H, an intake-air humidification system for our four-stroke engines. In collaboration with A.P. Moller-Maersk Group and Wallenius Lines, these applications have been tested successfully in prototype installations on some of their vessels."

Development of some of the technologies has progressed so well that they will be ready to be introduced to the market within the coming three years. The new applications also allow customized solutions designed to meet specific regional environmental demands. In Sweden, for example, the port fees paid by ferry operators are related to the NO_x emissions by their ferries. By offering these companies technology that reduce NO_x emissions, Wärtsilä can help them lower their operating costs.

Ready for the retrofit market

So far, new environmental regulations have only applied to new products. Discussions are now under way, however, on also making the compulsory IMO Tier I regulations apply retrospectively. This would mean that all older-type marine diesel engines built before 2000 will have to be modified to achieve compliance.

"A regulation like that would be a major cost issue for ship owners," says Heim. "Just in case it comes into force, we have been working on developing retrofit technologies. We want to be sure in advance that our customers can be offered feasible and cost-efficient retrofit solutions."

Costs are the major concern

As environmental regulations become more stringent, the major concerns of Wärtsilä's customers, in addition to complying with the regulations, are the cost of engines and their fuel efficiency – how much they cost to run. The market is not ready to accept significant price increases. According to Heim, it is too early to predict the effect that emission regulations will have on engine prices.

"If we have to achieve a 50% reduction in NO_x emissions, additional technologies such

as water injection or a different turbocharging concept will be required," he says. "Or if the regulations require a substantial reduction in SO_x, this will demand that after treatment be installed behind the engine. All of these will result in increased investment costs. Four European shipping companies participated in HERCULES and tested the technologies onboard their vessels. Other shipping companies have been

following the project with great interest. Wärtsilä's priority is to offer the technology which is most cost efficient, not only in terms of investment but also in terms of lifecycle costs."

"It is a known fact that modification of an engine to reduce exhaust emissions has an adverse effect on fuel consumption. But thanks

to HERCULES and the two-stage turbo charging technology we have developed, it now looks as if it will be possible to reduce NO_x emissions substantially while keeping fuel consumption at the same level as in current engines - or in certain load ranges, even reduce it slightly. This is one of the project's major achievements and a great leap forward from the results achieved in previous work," he says, smiling.

"WE WANT TO BE SURE IN ADVANCE THAT OUR CUSTOMERS CAN BE OFFERED SOLUTIONS THAT ARE FEASIBLE AND COST-EFFICIENT."

HERCULES B scheduled

One result of the first HERCULES project is that Wärtsilä gained a clear picture of the emission reduction potential offered by different techniques, making it possible to develop a final set of technologies that can be offered to customers when new environmental regulations come into force. On the other hand, a number of questions remained unanswered. Wärtsilä and MAN Diesel have therefore proposed a follow-up project to be called HERCULES-B.

In June, the proposal for HERCULES-B was submitted to the European Commission within the framework of FP7 Cooperation Work Programme: Theme 7-Transport. The project's stated aims are to significantly improve the efficiency of marine diesel propulsion systems while also achieving substantial reductions in CO₂ and other emissions. HERCULES-B reaches beyond the current limits set by IMO and if the targets are achieved, should radically reduce the environmental effects of ship transportation. If the project proposal is accepted, the new four-year, EUR 35 million project will be launched at the beginning of 2008. ●



High Efficiency Engine
R&D on Combustion
with Ultra Low Emissions
for Ships