



**Project no.: TST3-CT-2003-506154\_NG2SHIPI/F**

**Project acronym and title: NG2 SHIP I/F**

**3<sup>rd</sup> Year Management Report  
(November 1, 2005 to October 31, 2006, with extension till April 30, 2007)**

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**Last Periodic Activity Report**

**Deliverable D6**

Period covered: from November 01, 2005 to April 30, 2007

Date of preparation: April 2007 to January 2008

Start date of project: November 01, 2003

Duration: 3 years

Project coordinator name: Emmanuel VIALON

Project coordinator organisation name: Snecma



# Publishable executive summary

**The goal of this project** is to improve the effectiveness of LNG transportation from exporting countries to receiving ones.

Many interfaces are used throughout the LNG voyage, such as:

- ✓ loading arms to load – unload the liquid gas,
- ✓ on-board pipes to transfer LNG from tanks to shore,
- ✓ specific submerged pumps and electrical system to operate it
- ✓ high insulated tanks of LNG carriers.

**The project purpose** is to improve this LNG transfer chain through the following studies:

- ✓ Improve LNG cargo pumps, by an increase of their unloading capacity, and the use of variable speed to optimise the system,
- ✓ Improve piping thermal performance by using new foam formulation, insulating the whole transfer lines, which is not state of the art (on-board lines as well as loading arms insulation to be studied).
- ✓ Reduce the cost of the on-board cargo piping system, thanks to the use of pre-insulated pipes including other pipes and services, and using new pipe support technology.
- ✓ Reduce the excess boil-off gas naturally produced during ship voyage thanks to the use of argon in replacement of nitrogen for the insulation of insulation volumes.
- ✓ Creation of a new power interface which goal is to use Diesel electric propulsion systems when the ship is at anchor in order to provide the shore with this electricity, either to sell it or to use it for the LNG transfer process.

**The companies involved in this project are the followings:**

	Snecma	Converteam - Alstom Power Conversion (**)	Mikroma	Wroclaw University of Technology	FMC	Logstor	Saitec (*)
Cargo pump	X						
Cargo pump variable speed	X	X					
Cargo pump submerged electrical motor	X	X	X	X			
Loading arms insulation					X	X	
On-board transfer lines insulation						X	
Tank insulation	X						X(*)

(\*) Saitec company left the consortium after 1.5 year, then Snecma took over the remaining work originally dedicated to them.

(\*\*) Alstom Power Conversion changed its name to Converteam in April 2006. The new company logotype is shown here after.



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## Work performed in this project:

The cargo pump scale 1 prototype has been designed, mounted, shipped to the US for its first series of tests, whose goal is to assess its hydraulic performances. After this successful first campaign, the second phase consisted in the specific tests of the new electrical motor designed by Wrocław University of Technology and made by Mikroma, which took place end of March 2006. The tests were successful and showed perfect correlation compared to simulations made at design stage. Pump and motor expertise after test confirmed the good pump and motor behaviour.

The design of a powerful variable speed system for this type of pump has been deeply studied thanks to the use of dedicated models. Conclusion is that it is possible to integrate pump variable speed systems on-board LNG carriers at low cost, using propulsion VFD systems, taking into account the different networks and unloading scenarios.

Argon filled foam insulation tests have been carried out, but did not show expected results. The study has been moved on tests and studies with argon filled perlite insulation system, whose results are positive, as they present a 10% reduction in thermal conductivity when using argon. Simulations carried out by Sintef for the different insulating boxes match well the tests results and confirm the influence of the plywood thermal coefficient. Finally the argon supply system preliminary study has been performed, starting with a trade-off between various solutions. A closed argon supply system (ASU) based on liquefied argon storage and argon/ CH<sub>4</sub>, argon/ nitrogen cryogenic separation has been selected on the basis of economical and environmental considerations. This solution is easily applicable for new or existing LNG carriers.

Loading arms insulation studies have shown interesting gains by using double wall and vacuum insulated pipes, solution that has been manufactured and tested with positive results.

Use of pre-insulated valves was studied, but it was soon realized that this technical solution could not be finalized with a commercially satisfying result and the work was discontinued.

Instead all efforts were used to finish the two remaining tasks:

- A new and more flexible PUR foam formulation
- New lighter and more cost effective pipe support design.

The power interface study has been completed, leading to a high potential gain by using power interface either by selling electricity to the grid when the ship is processing, or by using the grid as power source in case of maintenance of the ship engines, or for environmental issues.

