Programme Area: Heavy Duty Vehicles

Project: HDV Flettner

Title: HDV Flettner Rotors Project Commissioning Basis

Abstract:

The basis for the ETI's decision to comission the Flettner Rotors project

Context:

This project uses Flettner Rotor data gathered from the M/V Estraden, to validate models built by UCL and BMT Defence Services Ltd. The validated models will be used to predict performance of Flettner Rotors on a tanker.

EC/2014/12/xx
Stage Gate Zero
HDV Programme, Marine, Flettner Rotors.
Edited (removing commercial confidential info) for publication

Introduction

Stage Gate Zero (SG0) is a key part of the ETI's process to assure that all appropriate activities and considerations are in place ahead of project definition and commissioning activities.

The HDV Marine phase 1 project (lead by Rolls-Royce) identified wind assisted propulsion as an area that has significant potential to reduce fuel use in shipping. The phase 1 study considered three potential wind assisted technologies;

1. Flettner Rotors
2. Wing sails
3. Soft-sails

This led to Flettner Rotors being identified as the technology with the greatest potential for fuel consumption reduction.

We are currently (2014) talking to potential suppliers of technology and shipping companies to understand the level of maturity, with the aiming of defining a suitable HDV Marine Phase 2 project. This project definition activity may lead to a phase 2 technology project to bridge the gap between the current technology and the requirements identified in the phase 1 project. A likely focus for a phase 2 project would be making the technology 'whole life' cost effective.

There are no commercial suppliers of Flettner Rotors, although they are fitted to some vessels. The technology is not new; rotors have been demonstrated on ships since the 1920s. Very limited information is available in the public domain on actual rotor performance and the phase 1 work placed the technology at TRL 4. (during scoping we subsequently identified Norsepower has having supplied prototype Flettner Rotor to Bore Shipping for M/V Estraden).

Some information is provided in the background section on how Flettner Rotors work.

The ETI Programme Manager has earmarked £xm to £ym (commercial confidential) in the HDV marine programme budget. The actual cost will emerge from the project definition activity that will follow a SG0 pass.

The phase 1 project set a target cost, after technology development, for the procurement of four rotors for a 10,000 dwt demonstration vessel at £xxm, (commercially confidential) plus fitting. We believe this is achievable, but will require a reduction from our current estimate of Flettner Rotor costs.

Once a potential project has been defined, the ETI governance process will be used to ask permission to start commissioning.

Action

The Executive Committee is asked to:

Stage Gate Zero

1. Provide a Stage Gate Pass or Fail based on the information within this document
2. Agree that the ETI starts work to define a potential Flettner Rotor project as part of the already agreed Marine HDV programme. This will require out interest in the topic to become public.
3. Agree to the public discussion of this project

Project Overview

Project Aim and Scope

The project scope will be established during the project definition stage. A likely focus would be making the technology whole life cost effective.

Project Outcomes

The full project outcomes will be established during the project definition phase. The technology devolvement needed to supply Flettner rotors to a demonstration vessel will form part of the project. Other outcomes will be defined in the project definition stage.

ETI Value Statement

The ETI will gain value from strategic insights, which can use to inform ESME analysis. In addition, the project will develop Flettner rotors sufficiently for them to be used in a large, ocean going, vessel demonstration. There is also the potential of a revenue stream from future Flettner rotor sales.

Expected Key Deliverables

The key deliverables will be established during the project definition phase.

Budgeted Cost and Duration of Project

- Project definition: Q4 2014 to Q1 2015
- Project commissioning Q1/Q2 2015
- Contract negotiation Q2/Q4 2015
- Contract signature Q4 2015
- Project duration: TBC during project definition phase

Summary against ETI Investment Criteria

1. Meeting UK 2020 and 2050 energy and climate change targets cost effectively
   - Currently EMSE includes a set amount of Vessel based emissions with no technology options for abatement. Independent Modelling and analysis of Flettner rotors in phase 1 has shown that they can generate cost competitive CO2 abatement (when compared to other EMSE technology selections in 2050).
   - This project seeks to create a technology cost that will be market attractive. I.e. the market selects and funds the technology based upon future fuel savings.
2. Additionality of ETI investment (finance and capability)
   - There are some potential players in the Flettner rotor market, these include Norse Power, THIINK, Magnuss and Enercon. However, at scale demonstration and cost effective technology are seen as the barriers to wide spread deployment at this point. The ETI needs to engage with the developing supply base to assess maturity and ETI additionality.
3. Impact and inter-relationship of project with policy development
   - Current policy is centred around the IMO (International Maritime Organisation) with their EEDI (Energy Efficiency Design Index) and their EEOI (Energy Efficiency Operational Indicator). However, these are not sufficiently stringent to drive the level of efficiency targeted by the ETI HDV Programme. By demonstrating market economic abatement technologies such as Flettner rotors the ETI would seek to inform the IMO of the cost / benefit trade-offs such that they may be considered for future limit setting.
4. Risk
   - Risks, and their mitigations, will be established during project definition and commissioning. They will be report as part of any contract approval request.

Background

The Magnus Effect

The Flettner rotor uses a physical phenomenon first demonstrated in an experiment carried out in 1852 by German physicist, Heinrich Gustav Magnus. A spinning cylinder in a moving airstream creates a lateral force perpendicular to the direction of the airstream which, when used on ships, helps propel the ship. The overall behaviour is similar to that around an aerofoil, although in the case of the Flettner rotor, circulation is generated by mechanical rotation rather than by aerofoil action. In many ball sports, the Magnus effect is responsible for the curved motion of a spinning ball.

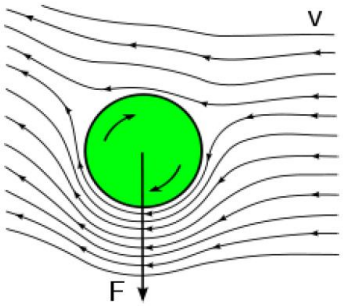

Figure 5.3.1 – Illustration of the Magnus Effect

State of the Art, TRL and Potential for ETI Contribution

Until very recently, research in Flettner rotors was primarily directed at their use on micro air vehicles in a very different Reynolds number regime and for lifting rather than propulsion purposes. In 2010 the German wind turbine manufacturer Enercon GmbH launched the E-Ship 1, a wind turbine transport vessel with four Flettner rotors (picture below). Since then there has been little progress in the development of Flettner rotors for marine vessels.

Although Flettner rotors have been used in a marine environment before, there has been no independent validation of the technologies performance. This situation could change if Enercon were to publish performance data from the E-ship. Until such data is made publically available, the Flettner rotor is at TRL 4 for the purpose of Marine propulsion of large vessel.

There are currently no commercial suppliers of Flettner rotors and thus the ETI has the opportunity to further the technology and promote the wide spread adoption of it to the market. Developments which address the reefing and visibility issues, as well as more data on the fuel burn reduction potential of Flettner rotors would greatly reduce the barriers to acceptance of the technology by the wider marine industry.