



Mid-term summary report v2

Work on the HYMAR project in the first 18 months has delivered a large amount of new technology and data of value in the design and operation of open architecture, hybrid propulsion systems for small vessels.

The Malo 46 test boat which is based at the Malo boat yard in Kungsviken Sweden, has been fully instrumented including shaft thrust, torque and fuel consumption. Comprehensive data logging equipment has been installed, simultaneously monitoring the NMEA 2000 CAN bus plus multiple digital and analogue channels. Automatic post processing of the logged data produces readily manageable summary files.

Extensive practical test data has been obtained by ESP over two summer seasons using the Malo 46 with a conventional diesel drive. Specific fuel consumption, engine and propeller efficiencies have been determined for a wide range of fixed, furling and feathering propellers. This will be used as reference data for comparison with electric propulsion.

Malo Yachts have provided all of the practical engineering resources necessary to manage the continual and ongoing reconfiguration of the test boat.

A prototype permanent magnet DC generator has been built to the HYMAR specification by Homewood Products and tested with a Steyr diesel engine on Steyr's dynamometer in Austria. A full fuel and electrical efficiency map has been produced.

Energys have tested multiple battery chemistries and geometries using a comprehensive test programme with both single battery blocks and higher voltage strings. A number of challenging regimes have been used to determine the best compromise between fuel efficiency and battery cyclic life.

Energys have recommended the TPPL 12V 100Ah FT battery for electric operation of the Malo 46 in 2011. The first charging programme to be used on the boat will be a variant of an established IU fast charge regime, modified to optimise the balance between fuel efficiency and battery life.

INSEAN have completed a full CFD modelling code for the Bruntons Autoprop and have started practical testing to validate the code prior to propeller optimisation. Bruntons have manufactured small test propellers in a range of materials to be used in the practical test programme.

INSEAN have built a unique blade torque measurement system to measure the restoring torque on the Autoprop's self pitching blades. This is the subject of a patent application.

Good progress has been made with the system modelling software being produced by Bruntons.

In addition to the practical testing, ESP has delivered the full generator specification used by Homewood to manufacture the test generator and has built a prototype generator control unit (GCU) which was also successfully tested. ESP has written a detailed system specification and user interface for the Energy Management Module (EMM). Development of the functional algorithms for the EMM is ongoing.



Mastervolt have produced and tested a prototype DC to DC voltage scaler (effectively a DC transformer) which will allow the high and low voltage DC busses of the hybrid system to be linked. Mastervolt have completed the build and test of an NMEA 2000 interface and have developed a 144 volt prototype battery monitoring system. All of these items should be ready for practical testing on the test boat by summer 2011.

Bosch Engineering GmbH have withdrawn from the project and plans are in hand to replace them.

Multiple public presentations have taken place including at numerous international boat shows (London, Southampton, Dusseldorf, Amsterdam) and the project has received extensive press coverage.

A new work item has been submitted to, and accepted by, ISO for the development of a standard dealing with the installation of high voltage DC systems in small vessels.

Meetings have taken place to review the NMEA 2000 protocols and to determine if they need to be developed further in order to satisfy the needs of hybrid propulsion systems.