A NEW FUEL CELL POWERED AEROSPACE PROPULSION SYSTEM

BY :

THOMAS ARTHUR WARD
OW CHEE SHENG
WAHYU KUNTJORO
AHMAD MALIKI OMAR
NOR'AINI BINTI WAHAB

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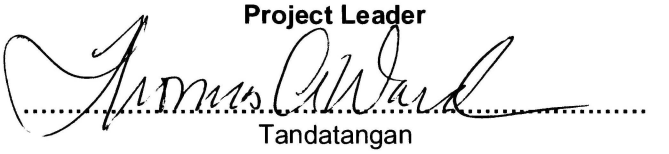
PROJECT TEAM MEMBERS

ASSOCIATE PROF. THOMAS ARTHUR WARD
Project Leader



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Tandatangan

PROF. IR. DR OW CHEE SHENG
Project Member

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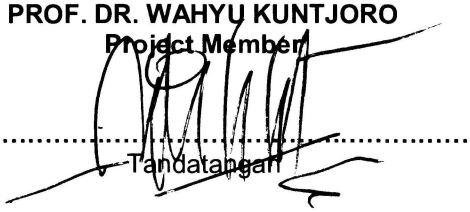
Tandatangan

PROF. DR. WAHYU KUNTJORO
Project Member



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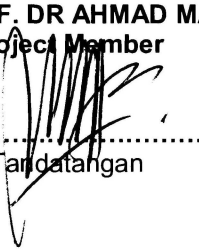
Tandatangan

ASSOCIATE PROF. DR AHMAD MALIKI OMAR
Project Member



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Tandatangan

ASSOCIATE PROF. NOR'AINI BT WAHAB
Project Member

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Tandatangan

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ABSTRACT

A fuel cell powered unmanned air vehicle (UAV) named Kenyalang-1 ("Hornbill") was designed, built, and flight-tested at the Universiti Teknologi MARA (UiTM) in Shah Alam, Malaysia. The project was funding under a grant from the Malaysian Ministry of Science, Technology, and Innovation (MOSTI). The UAV is propeller-driven by a DC brushless motor, powered by a 500 W proton exchange membrane (PEM) hydrogen fuel cell. The objective was to demonstrate the design and technological challenges involved and determine the relative merits or shortcomings that fuel cell electrically-powered propulsion systems have over conventional systems. This final project report describes the UAV design and power plant's performance. The results of this analysis will be used to improve the UAV and power plant system for future research and production models.

1.0 INTRODUCTION

Most aircraft motors rely on combustion of hydrocarbon fuels as a power source. However, the harmful health and environmental effects of combustion motor emissions are of great concern to the global community. There is also growing reluctance by many nations to remain dependent on foreign oil suppliers due to economic and security concerns. Furthermore, the eventual depletion of worldwide oil deposits is a looming threat that is no longer wise to ignore. For these reasons, there is great interest in fuel cells as an alternative energy source.

A fuel cell is unlike a conventional combustion motor, which uses chemical combustion of fuel to release heat. A fuel cell transforms the chemical energy stored in a fuel into direct-current (DC) electricity by breaking molecular bonds. A fuel cell does this in a single step without the need for moving parts (solid state). Fuel cells can be categorized by the type of electrolyte that they use. One of the most promising types for high power applications is a proton exchange membrane (PEM) fuel cell (also called a polymer electrolyte membrane). PEMs use a thin, proton conductive polymer membrane as the electrolyte. This membrane is impermeable to gases but conducts protons. A thin outer layer of platinum is used as a catalyst.[1]

Gaseous hydrogen is commonly used as fuel in PEM fuel cells. Hydrogen is fed on one side of the membrane (the anode electrode). Electrochemical reactions occur at the surface of the catalyst which splits the hydrogen atoms into protons and electrons (oxidation process), as follows:

$$H_2 \rightarrow 2\,H^+ + 2\,e^-$$