

# ID47- MODELIZATION OF A HYBRID SYSTEM WITH RENEWABLE ENERGY FOR ELECTRIC PROPULSION IN BOATS. APPLICATION TO A ROBOTIC FLOATING PLATFORM

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**Abstract** – A model of a hybrid system with renewable energy for electric propulsion in boats in which energy generated by photovoltaic panels and hydrogenerator is stored in the main battery which exerts its function as central element of a renewable cycle is presented. Additionally, hydrogen plays a role being generated by an electrolyzer for later to be stored in cylinders aboard in order to generate electric power by a fuel cell. Both, batteries and cylinders can be used to feed the different elements of the system, more specially the thruster while the excess of power is stored in another battery which is auxiliary and it is able to feed the first when it is necessary.

**Keywords** – Photovoltaic, Hydrogen, Fuel Cell, Floating Platform, renewable energy

## I. INTRODUCTION

At the dawn of the twenty-first century, we have available a variety of options to meet our energy needs. However, we obtain our most of energy through combustion.

Our fuels are predominantly hydrocarbons, chemical compounds containing hydrogen and carbon. Hydrocarbons are high-energy fuels, but its combustion introduces a variety of pollutants in the atmosphere.

This not only results in smog and respiratory diseases, but also produces large amounts of carbon dioxide. This gas traps heat from the sun in the lower layer of our atmosphere, raising global temperatures. Even without considering the pollution, we must face the fact that most of our fuels are not renewable. The amount of these fuels to be drawn from the earth is limited. When it runs out, we must find new sources of energy [1].

The increase of energetic and environmental problems has favored the development of alternative energy internal combustion engine are being replaced by hybrids systems using two or more power sources. Battery systems are the most widely used power sources due to their high efficiency and relatively low cost. On the other hand, fuel cells are a new emerging technology that could solve environmental problems, contribute the accomplishment of Kyoto Protocol and besides it can help to solve the oil dependence. Generation of hydrogen (also based if possible on renewable resources) using electrolyzers could become the nexus for the implementation of this technology in hybrid systems [2].

It is well known that ROVs are excitingly useful to study the ocean where a number of deep sea animals and plants have been discovered or studied in their natural environment. Furthermore, they are capable of multiple purposes as military for tasks such as mine clearing and inspection, salvage, etc.

Installation of marine renewable energy structures, such as offshore wind turbines and marine hydrokinetic devices, will require a variety of visualization and monitoring equipment to properly survey the sea floor for initial installation, cable lay, and post-installation, monitoring, and maintenance tasks that can be carried out by ROVs [3].

## II. MODELIZATION OF A HYBRID SYSTEM ON BOATS

The following paper shows the feasibility of a conceptual model with an electric hybrid system (fuel cell - battery) in which energy is obtained from renewable sources. The centerpiece of the system is a battery that is charged by renewable energy generated aboard thanks to the solar panels, hydrogenerator or hydrogen stored in bottles which generates electricity through a fuel cell also aboard. When power demand is not possible to get through renewable energy, batteries provide the necessary power.

Thus, depending on the power requirements, the battery as well as the fuel cell and cylinders could be designed depending on average irradiance got by the solar panels.

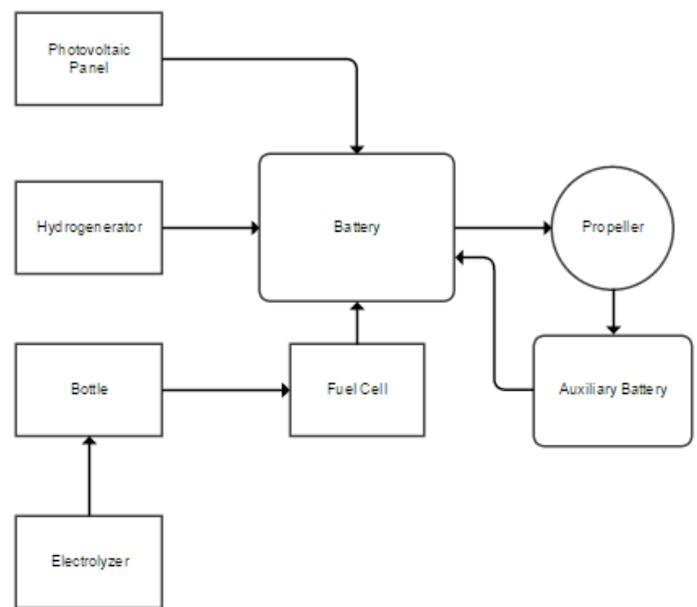
## III. APPLICATION TO A ROBOTIC FLOATING PLATFORM

As consequence of the model, all the points described before can be extrapolated to any boat successfully. The concept of a robotic floating platform can be chosen as demonstrative model.

The floating platform is remotely controlled from port or from another boat. It would have all the elements before listed but the electrolyzer which is placed onshore due to characteristics of the platform that do it non-viable aboard (relatively small dimensions, weight, power demand, etc.). In this manner, it navigates using renewable energy exclusively.

The complete model would consist then of the following elements: solar photovoltaic panel, hydrogenerator, electrolyzer, hydrogen storage bottle, fuel cell, battery and the propeller [Fig.1].

It has been designed in order to support another boats or marine devices for naval inspections -for example, ROVs- while the platform is stopped. It is because the power demanded for propulsion is zero whereas the power generation can be maximized until 3 KW by only photovoltaic energy or even more if it is necessary.



**Fig. 1. Flux diagram of renewable energy cycle**

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