ABSTRACT

"Contributions regarding the implementation of renewable energy sources in the electrical power system of commercial ships"

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This paper addresses some of the challenges created by the need to reduce fuel consumption and gas emissions in the field of maritime transport, as well as to increase the electrical resilience of transport vessels by analyzing innovative strategies for the implementation of renewable energy sources on board ships. By analyzing the research directions and the progress made in the implementation

The main direction of this research is to identify solutions for implementing renewable energy sources on board commercial transport ships in operation.

The thesis is structured in seven main chapters, each of which has the role of contributing to the achievement of the general objective and specific objectives:

Chapter 1. Introduction. The general context of the research is presented, the importance of the field of modern naval transport and the integration of solutions to reduce fuel consumption and reduce emissions of harmful gases and greenhouse gases.

Chapter 2. Renewable energy sources usable on board maritime transport vessels. Here, a general presentation of the renewable energy sources that can be exploited in the naval field is made.

Chapter 3. Current status and perspectives of research on the use of renewable energy on board ships. The chapter reviews the research projects carried out or in progress, for the implementation of renewable energy sources on board ships. Here, the approach taken by this work is also highlighted.

Chapter 4. Renewable energy conversion equipment used on board ships. The cyclonic flow wind turbine and wind collector are presented in detail, the sizing calculations for its adaptation for installation on board a 50,000 dwt seagoing vessel are specified, and the additional conditions that must be met by photovoltaic systems for their ship boarding are specified.

Chapter 5. Mathematical modeling of the naval photovoltaic system and the naval wind turbine with cyclonic flow and wind collector. The chapter presents the mathematical models of the naval wind turbine, the synchronous generator and the photovoltaic system.

Chapter 6 Experimental research on board the ship on the potential of wind and

photovoltaic energy conversion systems. Chapter 6 presents the data resulting from the research process on board the ships that were the subject of the study. The results of the research conducted demonstrated the efficiency of implementing such a solution on board the transport vessels of the category analyzed.

Chapter 7 Ecological Naval Power Plants. The chapter presents the concept of ecological naval power plants, a concept introduced by this paper.

Chapter 8. Conclusions. Here are presented the general conclusions, personal contributions and future research directions.

This study has as its main element the transformation of the current naval power systems based exclusively on the energy produced by diesel generators into hybrid naval power systems by installing a new type of naval power plant based exclusively on the conversion of wind energy and solar photovoltaic energy into electricity, defined as an ecological naval power plant. This innovative concept of the ecological naval power plant offers an efficient solution for a simple and flexible integration of renewable energy sources and of solutions for the efficient storage and management of electricity produced from clean sources. At the same time, the installation of this type of plant determines the efficiency of the fuel consumption of diesel generators when they are required to operate.

Determining the theoretical potential for electricity production from renewable sources and analyzing the data on electricity consumption recorded on board the studied ships provide the possibility of understanding the proposed solution and provides an argument regarding its viability.

The analysis of the operating algorithms of the ecological naval power plant provides the possibility of understanding the operating mode of the hybrid naval power system and creates a clear picture of the dynamics of the power system, emphasizing the increased flexibility and safety in operation.

Experimental tests demonstrated the viability of the solution for implementing renewable energy sources on board commercial transport ships, validating the results of theoretical calculations regarding the potential for electricity production from wind and photovoltaic sources.

The special aerodynamic characteristics of the wind turbine used led to the thesis issuing a theory of possible additional benefits brought to the propulsion system. Through experimental tests, the theory of possible additional benefits was validated, which means that the installed wind system, in addition to the basic function of producing electricity, also determines a significant improvement in the aerodynamic coefficient of the ship, reducing its resistance to forward movement.

The results and personal contributions stated in the thesis demonstrate that the transformation of the classic naval electro-energetic system into a hybrid naval electro-energetic system represents a viable solution for reducing fossil fuel

consumption, reducing greenhouse gas emissions and increasing the electrical resilience of ships.

Development prospects offer possibilities for increasing the reliability of naval electro-energetic systems, increasing the autonomy of ships and increasing their energy efficiency.