MILITARY TECHNICAL ACADEMY

„FERDINAND I”

Eng. Ion-Adrian GÎRBĂ

THESIS

CONSIDERATIONS CONCERNING THE OPERATION IN SAFETY CONDITIONS OF THE MARINE GAS TURBINES PROPULSION SYSTEMS

Thesis elaborated in order to obtain the scientific title of "DOCTOR" in the fundamental field "Engineering Sciences", the field "Mechanical Engineering"

Scientific supervisor: Professor PhD. Eng.Anastase PRUIU

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ABSTRACT

In this doctoral thesis, entitled "*Considerations concerning the safe operation of naval propulsion installations with gas turbines* ", structured in six chapters, I investigated aspects of the maintenance of naval gas turbine propulsion installations and the evolution of the functional parameters of the installation, in order to ensure safe operation.

The research I carried out on board of the ship I worked on, equipped with two naval propulsion plants with gas turbines type COmbined Gas Or Gas turbines (COGOG), each having a Tyne RM1C type cruising turbine and an Olympus TM3B turbine for maximum power, both produced by Rolls-Royce.

Starting from the complexity of the installation, I approached the thesis topic through bibliographic research, mathematical calculation research correlated with concepts from physics and thermotechnics, experimental determinations on board the reference vessel, but also study on maintenance and operation to ensure a safe operation.

In the first part of the thesis I studied the diversity of gas turbine propulsion installations and the types of ships they are installed on. Next I studied the regulations of ship classification societies regarding the safe operation of the naval propulsion installations with gas turbines.

I established a calculation algorithm that we implemented in the Mathcad calculation program, through which we calculated the functional parameters of the installation on the reference ship under standard environmental conditions, and then I studied their evolution as a function of temperature and humidity changes of aspirated air. On board the ship we determined the functional parameters that we compared with those obtained by calculation for their validation.

Another aspect pursued in this paper, with direct effects on the safe operation of naval propulsion installations with gas turbines, is the maintenance from the point of view of the organization of it, the training of the personnel,, the diagnosis of defects, tthe effects of the marine environment on the wear and tear of elements of installations and aspects of design and construction in order to facilitate the maintenance operations.

I consider that the importance of this doctoral thesis is that it addresses elements of exploitation that come to the support of the personnel on board of the ships equipped with naval propulsion installations with gas turbines and at the same time the calculation algorithm that I have developed can be used on any type of naval energy installation with gas turbines for the purpose of a correct diagnosis (correlated with the other modalities and diagnostic equipment) in order to avoid the damage or malfunctions in operation of these installations.

In the current context in which all the maritime and military fleets of the world are looking for ways to optimize the functioning of the propulsion plants, I think this thesis opens up new research opportunities regarding the reduction of wears, the recovery of the energy flows transferred to the environment and aspects of the prevention of environmental pollution.

In this thesis I focused my research on the following objectives:

1. Study of the evolution and diversity of naval energy installations with gas turbines;

2. The current state of the regulations and standards of ship classification societies regarding the safe operation of gas turbine propulsion installations;

3. Determination of the functional parameters of a naval propulsion plant with gas turbines by means of a calculation algorithm in which are used the standard reference parameters provided by the manufacturer in the technical book.

4. The study of the evolution of the functional parameters according to the temperature and humidity of the air aspirated from the environment;

5. Study of the methods of monitoring and diagnosing the functional status of the gas turbine propulsion installations;

6. The study of the effects of corrosion in gas turbines and the validation of these effects by endoscopic inspections at different time intervals on the marine gas turbines operated by me on board the ship.

These objectives have been achieved through theoretical and experimental research. The results obtained by calculation I validated on board the reference vessel directly through determinations of some functional parameters, and of others by calculation using the determined parameters. The research related to the wear of some elements of the installation I validated by diagnostic inspections on board the reference vessel directly on a propulsion plant with gas turbines on a 1: 1 scale, executed at various operating time intervals to track and confirm their evolution.